Studies on Seed Germination of *Gongronema latifolia* Benth

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Abstract

Seed germination of Gongronema latifolia Benth, which has high nutritional and medicinal value, was investigated from harvest to some months of the seeds in storage. The germination of freshly harvested seeds were studied in Petri dishes and in soil medium in repeated experiments over seven months period. Statistical analyses were performed on the seed traits measured and recorded. The seeds exhibited epigeal germination. The seed germination varied from harvest to seven months in storage in both germination techniques. Seed germination in Petri dishes gave a higher mean daily germination, velocity of germination and germination percentage and a lower cumulative dormancy period and days to 50% germination, shed of seed coat and full opening of cotyledons. The technique also had a longer and more reliable germination over the seed germination in soil. The plant exhibits short-lived seed viability (less than one year) and dormancy sets in. Physiological dormancy which may be due to embryonic hormones in the seeds is probably the cause of dormancy in the seeds.

Keywords: Seed germination, Seed storage, Moisture content, Seed dormancy

Introduction

Non-wood forest products (NWFPs) are natural resources mostly sourced from forest. They have been shown to be sustaining the rural poor in many developing countries (Osemeobo and Ujor, 1999; UN, 2002). They are depleted at an alarming rate in Nigeria due to deforestation for agricultural land expansion or timber exploitation and demand. It has been reported that a great percentage of Nigeria's luxurious vegetation has been removed and some species have gone into extinction (UN, 2002).

Gongronema latifolia Benth is a non-wood forest product that is of West African origin (Neilsen, 1965). It is called "*utazi*" in southeastern Nigeria and used as a leafy vegetable and spice in soup making and eaten as a dessert with other preparations. The pant is used in the treatment of loss of appetite, cough, worm and stomach ache (Okafor, 1979). Gamaniel and Akah (1996) pointed out that the use of the plant in treatment of diabetes mellitus is on the increase. They also revealed that the stem extracts contain five bioactive compounds and inferred that those compounds could make the plant have varied pharmacological effects. The endangered position of the forest vegetable has been established. Osemeobo and Ujor, (1999) reported that *G. latifolia*, a major forest vegetable in Nigeria has become scarce.

Seed dormancy and germination are adaptive traits of plants. They are influenced by a large number of genes/hormones and environmental factors (Koorneef *et al.*, 2002). Baskin (2002) showed that physiological dormancy of seed embryo is the most common class of seed dormancy. Dormancy of seeds regulates germination rates and vigor in seedlings which farmers rely on. Williams (2004) inferred that germination rates below 70% are associated with poor seed vigor and should not be relied on by farmers. Singer and Pitman (1988) reported poor germination of freshly harvested legume and pepper accessions. However, Bosland and Votava (2000) claimed to have had an excellent success in germination from pepper seeds planted after harvest.

Information on germination of *G. latifolia* seeds is scanty in literature. Seeds obtained from a clone in a forest in 2003 by the author, produced low emergence rates in green house germination attempts after seven months of seed harvest. Germination studies were conducted to test the germinability and duration of freshly harvested seeds of *G. latifolia*. The objectives of this research were (i) to determine the variation of seed germination from harvest to storage, and (ii) to identify a better technique to germinate the seeds.

Materials and Methods

One source of seed lot harvested from a forest in southeastern Nigeria was used in this germination study. The follicles containing the seeds were harvested in March 2004 before they dehisced. The study commenced on the day the follicles were harvested. The follicles containing the seeds were stored in laboratory bench of Department of Crop Science, University of Nigeria, Nsukka. The average temperature of the laboratory was 30.5°C. Two planting techniques were used, one planted in Petri dishes and the other planted in soil medium. In the Petri dishes, double sheet of litmus paper were moistened inside the Petri dishes and seeds were placed and the Petri dishes covered with the top. In the soil medium, the seeds were broadcast on top of the soil mixture in polybags and not sown. They were broadcast to reduce error due to depth of sowing. The soil was mixed in 3:2:1 top soil, poultry manure and sand conventional mixture and placed under a nursery shade with average temperature of 31.5°C. On the commencement of the study, thirty freshly harvested seeds were placed in each Petri dish or polybag and replicated five times. The same number of seeds was used from the seed lot stored every other month until the study lasted.

The study in each case was laid out in a completely randomized design (CRD). The Petri dishes and polybags were moistened regularly throughout the study to keep them moist. Germination was noted as protrusion of radicle from seed coat. Germinated seeds were counted daily. Normal seedlings are intact seedlings which have a vigorous primary or secondary root system, intact hypocotyls and epicotyls without damage, at least one attached cotyledon, and attached terminal buds (ISTA, 1985). Abnormal seedlings are those which have such defects as: no primary root system with weak secondary roots and more than one cotyledon missing (ISTA, 1985). Dead seeds were further described by (ISTA, 1985) as seeds with decayed tissues at the end of the test and have not produced seedlings while dormant seeds are seeds which have imbibed water, but have not germinated, and remain firm and apparently viable at the end of the test period.

The following traits were calculated from the germination records: complete dormancy period (CDP) i.e. number of days from planting to start of germination cumulative germination percentage (CGP) over 16 days mean daily germination (MDG) coefficient velocity of germination (CVG) which was calculated using the formula set by Kotowski (1978) as $CVG = 1 / N_1T_1 + N_2T_2 + \ldots + N_xT_x \times 100 / 1$; where N is the number of seeds germinating within consecutive interval of time, T is the time between the beginning and end of the particular interval of measurement, days to 50% germination, days to 50% seed coat drop and days to 50% opening of cotyledon.

Plant data collected were subjected to analysis of variance following the procedures outlined for a Completely Randomized Design (CRD). The data were analyzed with GENSTAT 5.0 Release 4.23DE (GENSTAT, 2003). Fisher's least significant difference (LSD) as outlined by Obi, (2002) was used for mean comparisons.

Results

The plant exhibits epigeal germination (Fig. 1). Percentage of normal seedlings was higher in Petri dishes than in soil for fresh seeds (Table 1). Maximum percentage of normal seedlings was reached at the third month of seeds in storage in Petri dishes and soil. The normal percentage of 97 in Petri dishes was significantly higher than any other normal germination at other storage times with the exception of second month. Normal seedlings reduced drastically in seeds germinated in soil medium by the fourth month. However, unreliable percentage of 45 of normal seedlings was recorded at the seventh month in Petri dishes. Abnormal seedlings were minimum at the third month of germination in both systems and increased from the fourth month. Percentage of dormant seeds was relatively high in fresh seeds and reduced to minimum by the third month and increased again with storage time. Percentage of dead seeds increased with increase in length of storage and was very high in seeds germinated in soil medium.

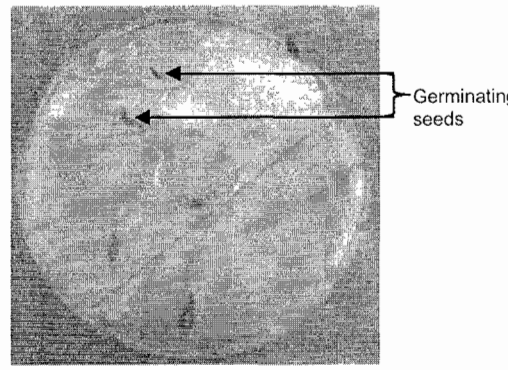

Fig. 1: Germinating seeds of *G. latifolia* showing epigeal germination

Complete dormancy period (CDP) was significantly higher in freshly harvested seeds when compared to early periods of the seeds in storage (Table 2). Days to first germination reduced from beginning up to third month of germination test. By the fourth month, the CDP started increasing in the soil medium. It also increased in the Petri dishes by the fifth month. The CDP was minimum by the third month in both systems. Cumulative germination percentage (CGP) was higher by the third month in the seeds placed in Petri dishes. After the third month of germination test, germination percentage was decreasing with time. It was unreliable at the fourth month in the seeds placed in soil medium and only reduced beyond reliable point by the seventh month in Petri dishes. Significantly (P=0.05) higher mean daily germination of 15 and 9 seedlings were obtained in Petri dishes and soil medium respectively by the third month of germination test. There was an increase in coefficient velocity of germination from fresh seeds and was higher at three months after storage in both systems. The vigor in seed germination reduced significantly from fresh seeds at the seventh month of seeds in storage. The days to germination, shed of seed coat and full opening of cotyledons were least when the velocity of seed germination and number of daily seed germination were highest at three months of seeds in storage. After the period, there was a progressive increase in days for the seeds to attain 50% germination, shed of seed coat and full opening of cotyledons.

Discussion

The type of germination exhibited by *G. latifolia* seeds was epigeal with two green cotyledons which conform to other dicotyledonous plants (Huxley and Housten, 1997). The higher rate of abnormal seedlings in soil medium which affected the percentage of normal seedlings could be attributed to differences in the two environments. In the result of the germination tests in Petri dishes and soil over time, the significant differences in germination potentials showed variation in germinability of *G. latifolia* seeds from harvest to storage. The results suggest that the viability are short-lived and dormancy sets in the seeds. Short-lived seed viability (less than one year) has also been reported

Table 1: Germination at 16 days after sowing of *G. latifolia* seeds harvested fresh and stored over seven months period in Petri dishes and soil over the periods of storage

Storage time (Months)	Treatment	Percentage Germination			
		Normal	Abnormal	Dead	Dormant
0	Petri dishes	76	8	-	16
1		84	6	-	10
2		90	2	-	8
3		97	1	1	1
4		85	5	2	8
5		88	4	6	2
6		80	6	10	4
7		45	15	28	12
F-LSD (p=0.05)		7.2	5.1	8.8	8.0
0	Soil	70	14	-	16
1		78	8	-	14
2		82	6	-	12
3		82	4	2	12
4		54	14	18	14
5		22	12	36	30
6		6	10	52	32
7		3	9	58	30
F-LSD (p=0.05)		8.6	6.0	9.6	9.0

Table 2: Effect of seed storage on seed germination parameters of *G. latifolia* seeds in Petri dishes and soil

Storage time (Months)	Treatment	CDP	CGP	MDG	CVG	Germination	Days to 50% Shed of seed coat	Full Opening of cotyledons
0	Petri dishes	4.6	84	3.2	0.9	7.0	10.4	12.6
1		3.8	90	3.3	1.0	6.6	10.4	12.4
2		3.6	92	6.8	1.8	4.2	10.2	12.0
3		3.0	98	14.9	2.9	3.2	8.8	10.8
4		3.0	90	6.4	2.1	3.2	10.4	13.2
5		4.4	92	5.3	0.9	5.2	10.4	13.2
6		5.2	86	4.9	0.8	5.8	11.0	15.8
7		4.8	60	0.7	0.7	8.0	12.4	18.2
F-LSD (p=0.05)		0.68	9.90	0.73	0.15	0.89	0.92	0.80
0	Soil	7.8	84	3.3	0.9	10.4	10.6	12.8
1		7.6	86	3.3	1.0	10.2	10.4	13.2
2		7.2	88	3.9	1.3	10.0	10.0	13.0
3		6.6	86	8.9	2.5	10.0	11.0	13.6
4		7.4	68	4.0	1.7	11.2	12.0	14.6
5		9.6	34	2.1	0.8	15.2	15.2	17.8
6		11.8	16	0.4	0.7	18.0	18.0	21.2
7		13.6	12	0.2	0.3	18.4	18.4	21.6
F-LSD (p=0.05)		1.08	10.8	0.42	0.16	1.44	1.15	0.99

Where CDP, CGP, MDG, CVG mean: complete dormancy period, cumulative germination percentage, mean daily germination and coefficient velocity of germination, respectively.

in carrot and lettuce seeds (Lu *et al.* 2004). The significant delay in germination of the freshly harvested seeds over one month duration and beyond up to fourth month in both systems may be due to an inherent exhibition of temporal dormancy (Singer and Pitman, 1988). This might have been caused by the moisture level in the seeds after harvest and their inherent character. As the seeds dried further, observed improvement in germination was more rapid and vigorous. Air-drying of seeds has been suggested for improving germination of seeds in other crops (Rasyad *et al.* 1990; Bewley and Black, 1994). In this study, further drying of seeds thereby reducing the moisture content to 13% from second month of storage, improved germination efficiency. However, the germination percentage in the freshly harvested seeds was high even though it occurred in more days which led to low mean daily germination and vigor in germination.

The period of three months after harvest of seeds gave the best germination for the seeds. It suggests the most reliable time to plant *G. latifolia* seed as it gave the highest germination percentage and vigor which agrees with the report of Williams (2004). The best time for germination of *G. latifolia* in the confines of this study, gave the shortest days to shed of seed coat and full opening of cotyledons. This indicates earlier start of independent life by activation of photosynthesizing organs of the plant especially as the food reserves in the cotyledons are small.

The significant differences in seed germination between the two systems might be due to the differences in percentage of dead and dormant seeds in them. Generally, the seeds placed in soil had higher percentage of dead and dormant seeds from fourth month of germination test. This may be due to differences in soil conditions when compared to better conditions in Petri dishes (less microbial influence). This suggests that the environmental conditions available in Petri dishes under the confines of this research were more favourable than the soil condition.

This study has shown that seed germination varies in *G. latifolia* from harvest to some months of seed storage. Dormancy sets in high proportion in about seven months after harvest of seeds. The dormancy obtainable in *G. latifolia* seeds may be physiological as it has thin seed coat (0.52 – 0.04 mm) and no hard seed was identified in the germination test. The physiological dormancy may be due to embryonic hormones (Baskin, 2002 and Koorneef *et al.* 2002) contained in the seeds. This is most probable considering the high and reliable normal germination percentage obtained in both systems from freshly harvested seeds up to the third month when embryonic changes could result and interfere with normal germination. Germination of *G. latifolia* seeds in Petri dishes gave a longer viability period. The high and reliable germination obtained in this study implied that domestication and consequent regular culture cultivation of *G. latifolia* could be achieved through the seeds. This will raise the prospects for exploitation of the nutritional and medicinal uses of the crop plant.

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