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Full Length Research Paper

Variation in germination and seed longevity of kenaf (*Hibiscus canabinus*) as affected by different maturity and harvesting stages

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Laboratory experiments were carried out during November 2010 to October 2011 at the seed testing Laboratory of the Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan, to determine the effects of harvesting stages on seed viability and longevity of kenaf. Kenaf seeds of four genotypes were harvested at four stages of seed maturity namely; (1) four weeks after flowering (4 WAF), (2) five weeks after flowering (5 WAF), (3) six weeks after flowering (6 WAF) and (4) at full maturity (FM). All the seeds were packed inside envelop and wrapped with polyethylene bags and kept at 10°C and 60% RH for a period of 12 months. The highest germination percentage average seed moisture content, average dry seed weight and the lower ion leakage concentration were recorded in all the kenaf genotypes when harvested at 5 WAF. Upon storage, after harvesting, the germination percent declined, while the highest viability was recorded by genotype A-60-282b at 4 months after storage, followed by genotype Ex shika at 8 and 12 months storage periods, respectively. The seed deterioration during storage could be minimized by proper harvest timing. Seeds harvested 5 WAF and stored at 10°C showed the highest seed viability. Therefore, mature seeds are recommended for harvested 5 WAF for enhanced storability.

Key words: Kenaf seed, harvesting stage, seed longevity, viability.

INTRODUCTION

Seed development is the period between fertilization and maximum fresh weight accumulation. Seed maturation begins at the end of seed development and continues till harvested (Mehta et al., 1993). The decision on when to harvest a seed crop is influenced amongst other things by the state of fruit at maturity. The stage of seed maturity determines the storage potential of the seeds if all other factors are kept constant (Fontes and Ohlrogge, 1972). Maturity and storability of seeds are important but the exact relationship between these variables is not elucidated. Harvesting stage influences the quality of seed in relation to germination, vigor, viability and also storability. Seeds harvested at right stage (physiological maturity) will be well developed, matured and possess maximum viability and vigor. Nkang and Umoh (1997) reported that germinability of cultivars harvested at different maturity periods differed significantly after six months of dry storage.

On the contrary, early harvesting prior to physiological maturity drastically lowers seed yield and quality on account of under developed and immature seeds. It is well documented that seeds harvested at an early stage of development are germinable but generally have poor vigor, indicating that germinability does not mean complete physiological development (Coolbear et al., 1997). Storability of seeds is mainly a genetic character and is influenced by pre-storage history of seed, seed maturation and environmental factors during pre-and

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Table 1. Mean value of moisture content (%) of kenaf at different harvesting stages.

Genotype	4 WAF	5 WAF	6 WAF	FM
A-60-282b	44.93	15.99	15.30	11.26
Ex- Shika	44.41	20.35	14.88	11.94
Ifeken-100	47.67	19.86	17.94	11.91
S-72-78-10	49.61	19.02	21.23	18.07
Mean	46.66	18.81	17.34	13.30
CV (%)	4.20	12.31	9.60	21.18
S.E.	0.49	0.73	0.69	0.74

WAF: Weeks after flowering; FM: full maturity.

post-harvest stages (Mahesha et al., 2001b). Early harvested seeds will be immature and poorly developed and as such, are poor storers compared to seed harvest at physiological maturity (Singh and Lachanna, 1995; Deshpande et al., 1991).

A high vigor seed lot has good storage potential and retains germination potential during storage, whereas low vigor seed lot show poor storage potential and may show a rapid decline in germination (Delouche and Baskin, 1973; Hampton, 1992). Research on kenaf seed storage indicated that when stored at 8% RH, kenaf seeds remained fully viable for 5.5 years when stored at either -10 or 10°C, and fully viable for 5.5 years when stored at -10,or 0°C and 12% RH (Toole et al., 1960). Meints and Smith (2003) reported that seed germination remained acceptable and was unaffected by storage for up to 4 years, when kenaf (Everglades 41) seeds were stored at 10°C and ambient relative humidity. We are willing to decipher whether kenaf seeds harvested at different developmental stages (physiologically immature, mature, and over matured) store well to give a reasonable high percent viability following sowing. In light of this, there was need to determine at what developmental stage kenaf should be harvested, so as to store well and promote better seed viability.

MATERIALS AND METHODS

The experiment was carried out in 2010 at the Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeria. Four kenaf lines were evaluated in the experiment. All lines were planted in a randomized complete block design with 3 replications. Four seeds per hill were planted at a spacing of 50 by 20 cm in a plot of 2.5 by 5 m with 6 rows per plot. The pre-emergence herbicide, Pendimethalin (500 EC) was applied at the rate of 1.7 kg ai/ha, using a knapsack sprayer. Two weeks after sowing, the plants were thinned to 2 plants per hill. NPK fertilizer was applied 2 days after weeding at the rate of 80:30:30. The insecticide lambda-cyhalothrin (2.5% EC) was applied at the concentration of 0.68 L/ha. At about 50% flowering, 200 flowers were tagged within the experimental rows. Seeds for the experiment were harvested at four different stages of development, namely; 4 weeks after flowering (WAF), 5 WAF (when the pods had turned brown), 6 WAF and lastly, at full seed maturity (FM).

Harvested pods were carefully shelled and the seeds extracted and bulked to make average samples for determination of moisture content, seed mass and germination percentage. Calculation of seed mass and moisture content were based on weight determined before and after oven drying seed samples at 105°C for 24 h. The harvested seeds were later packed inside envelopes and wrapped with polyethylene bag and kept at 10°C and 60% RH for a period of 12 months. The following tests were conducted on the stored seeds at 4 month interval for a period of 12 months.

Standard germination test

The test was performed according to International Seed Testing Association (ISTA, 2001). Fifty seeds of each genotype were germinated and replicated three times in 11 cm diameter Petri dishes inside a moistened filter paper with 5 ml of distilled water. The Petri dishes were arranged inside an incubator at 30°C in a completely randomized design (CRD). After seven days of germination, the proportion of germinated seed that produced normal seedlings was expressed as germination percentage.

Electrical conductivity

Fifty intact seeds from the three replicates were counted, weighed, and placed in a glass flask containing 100 ml of distilled water. The flasks were covered with aluminum foil to prevent contamination by flying insects and the flasks were gently shaken intermittently. Conductivity measurements were taken after 24 h at 25°C reference temperature using Mettler Toledo MC126 conductivity meter. All measurements were expressed as $\mu Scm^{-1}g^{-1}$ and the results were interpreted as suggested by Hampton and Tekrony (1995). Data were taken on seed viability and conductivity. The collected data were subjected to statistical analysis using SAS (2003) version 9.1 Software for test of significance and accurate inferences.

RESULTS AND DISCUSSION

Effect of maturity stages on dry seed weight and moisture content

The obtained results (Table 1) indicated that marked reduction in seed moisture content occurred in all the kenaf genotypes tested between 4 and 5 WAF. The average moisture content for the two harvesting stages are 46.66 and 18.81%, respectively, where 60% of the seed moisture content was lost during this period. The average lowest moisture (13.3%) was observed with the seeds that were collected at harvesting maturity. Mehta et al. (1993) reported that seeds of chickpea harvested at 29 days after anthesis (DAA) showed the highest moisture percentage, while seeds harvested at 45 DAA showed the lowest moisture percentage. Moisture WAF (Mahesha et al., 2001a). In all the genotypes, the content was the highest at 4 WAF and was lowest at 7 dry seed weight increased from 25.67 mg/seed at 4 WAF and reached the maximum of 26.49 mg/seed at about 5 WAF (Table 2). There was little change in dry weights of the seed harvested at later dates. The mass maturity or the end of grain filling period was attained at 5 WAF. At

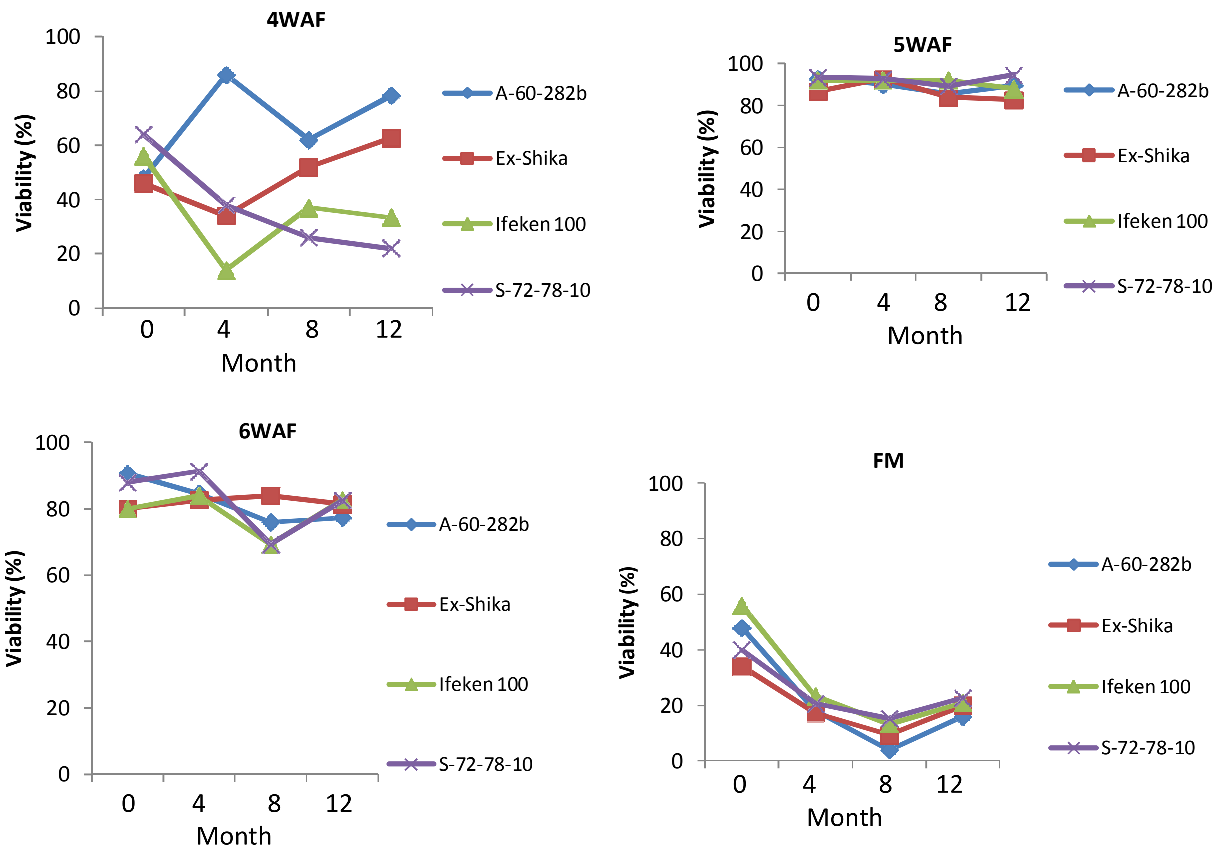

Figure 1. Percentage viability of kenaf seeds after dry storage.

Table 2. Mean value of seed mass (mg) of kenaf at different harvesting stages.

Genotype	4 WAF	5 WAF	6 WAF	FM
A-60-282b	25.87	27.32	25.06	24.20
Ex- Shika	25.26	25.52	25.26	24.06
Ifeken-100	25.92	27.00	26.52	25.60
S-72-78-10	25.66	26.12	25.72	24.20
Mean	25.67	26.49	25.64	24.52
CV (%)	6.65	5.72	4.43	4.27
S.E.	0.014	0.013	0.014	0.011

WAF: Weeks after flowering; FM: full maturity.

full maturity, the seed moisture content ranged between 15.99 and 20.35% among the fours kenaf genotypes with a mean of18.81%.

Effects of maturity stages on seed germination after storage

Different longevity of seed storage as well as storage condition exert significant influence on seed viability (Nkang and Umoh, 1997). The results clearly pointed out declining trends in seed germination during storage at different harvesting stages. Overall seed germination was influenced by seed maturity stages. Germination performance was smaller for seeds collected at harvesting maturity (Figure 1). The reduction in germination performance of seeds harvested at harvesting maturity (HM) from the initial stage could be as the result of a decline of inherent germination due to unnecessary delay after physiological maturity before harvesting. Seed germination performance among different categories of seed maturity was higher in seeds harvested at 5 WAF (> 95%) followed by those harvested at 6 WAF and lowest in seeds harvested at usual harvesting maturity. Initial viability at 4 WAF (< 60%) was the same in all the tested kenaf genotypes. After some months in storage, the germination percent declined in 3 out of the 4 kenaf genotypes. Highest viability was recorded by genotype A-60-282b at 4 months after storage followed by genotype, Ex shika at 8 and 12 months storage periods, respectively. This agreed with the works of Nkang and Umoh (1997) that reported that the germinability of cultivars harvested at different maturity periods differed significantly after six months of storage for soybean. At 5 WAF, the result showed that the viability of all the kenaf genotypes throughout storage period were almost the same. This stage of harvest coincides with achievement

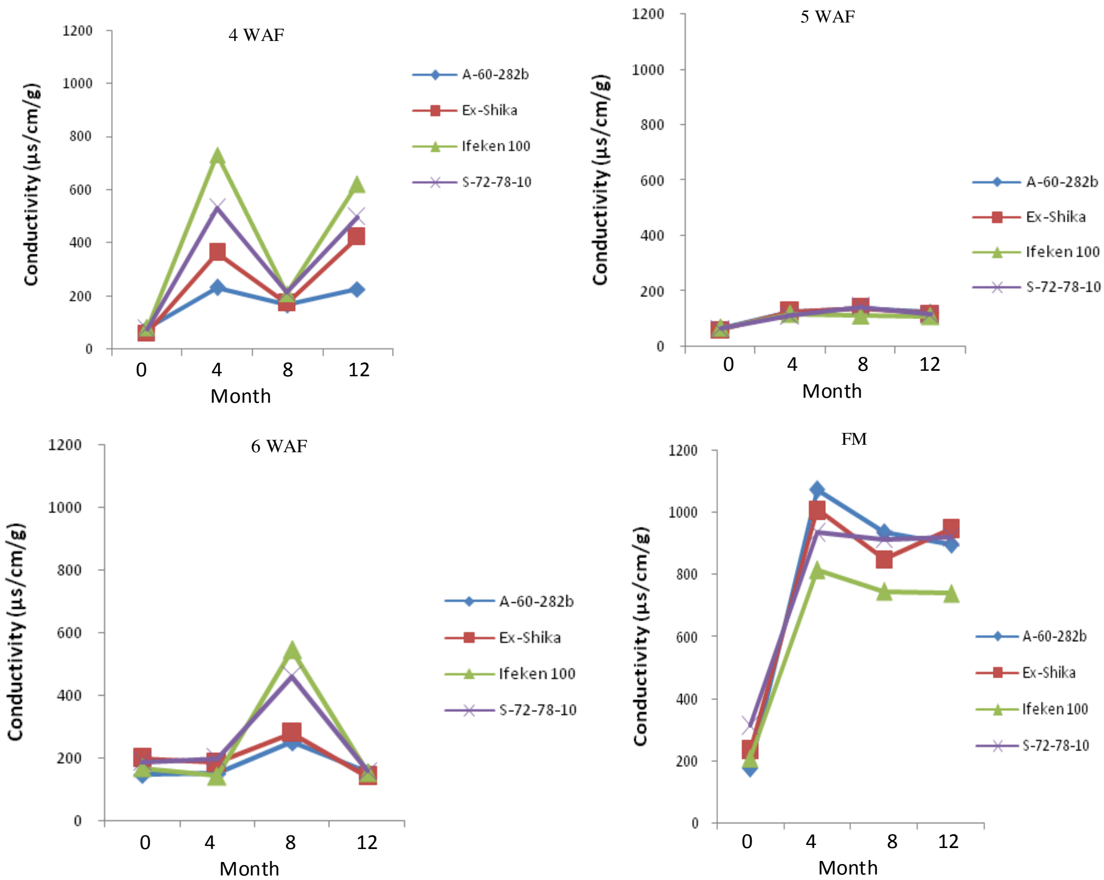

Figure 2. Conductivity (µs/cm/g) of kenaf seeds after dry storage.

of maximum dry weight of the seeds. Kumar et al. (2002) reported that seed yield and quality largely depends on the stage of maturity. As such, harvesting of seeds at the right stage of maturity is most important since harvesting either at early or late stage results in poor quality seeds. The viability was at the highest throughout the storage period because the seed had acquired maximum quality at harvest. At 6 WAF, Ex-shika maintained its viability percentage from the time of harvest to 12 months after storage suggesting that regardless of other factors, some genotypes store better than others. Our findings agreed with the earlier work of Meints and Smith (2003). Other genotypes had their viability potentials reduced 4 months after storage. At full maturity (FM), the initial viability had gone down even before storage. During storage, the viability decreased significantly. This could be as a result of unfavorable weather conditions the seeds were exposed to or experienced due to delayed harvesting after physiological maturity on the field.

Effects of maturity stages and storage on ion leachate

The mean conductivity of seeds harvested at 5 WAF and stored at 10°C for 12 months tended to be lower than that of seed harvested at harvesting maturity (Figure 2). The conductivity of seeds harvested at 4 WAF was high in 3 of the kenaf genotypes with the exception of A-60-282b that showed moderate value. At 6 WAF, 2 of the genotypes showed increasing of ion leakage concentration 8 months after storage. The bulk conductivity of seeds harvested at FM showed huge increase in ion leakage concentration after 4 months of storage. The bulk conductivity test demonstrated the degree of the loss of solutes from the seeds, which reflects the extent of membrane deterioration resulting from seed aging (Roberts, 1986). Higher seed vigor was found at 5 WAF, which was also the stage at which lower ion leakage concentration was recorded. This means that the seeds at this stage of harvest had maintained their membrane integrity. The lower bulk conductivity values in seeds harvested at 5 WAF coincided with the higher values of standard germination (Figure 1).

Conclusion

The viability of kenaf seed in terms of standard germination and bulk conductivity was affected by the stage of seed maturity at harvest. The seed deterioration process could be minimized with proper harvest timing. Seed viability of seeds harvested at 5 WAF and stored at 10℃, stored better. Therefore, mature seeds of kenaf should be harvested at the right time, that is, 5 WAF are recommended for seed storage, to enhance viability and promote storability in the seeds

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