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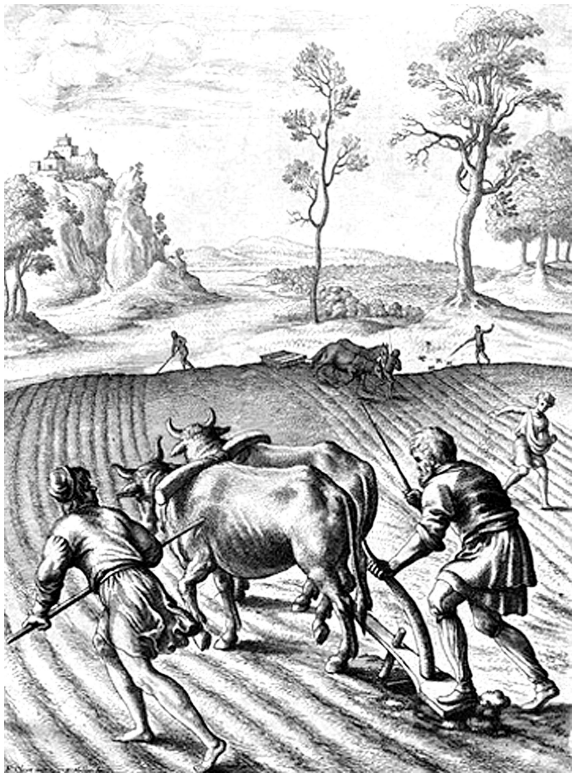

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Effect of Seed Priming on Seedling Emergence and Establishment of Four Bambara Groundnut (*Vigna subterranea* L. Verdc.) Landraces

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Abstract: Bambara groundnut is an indigenous African legume which is cultivated for human consumption. Mature seeds have hard coat which prolongs seedling emergence especially under drought. An experiment was conducted to determine the effect of seed priming on seedling emergence and establishment of four bambara groundnut landraces. Two hundred seedlot of bambara groundnut landraces; Burkina, NAV 4, NAV Red and Black eye were soaked separately in tap water for 24 and 48 h. The control was not soaked in water. Seeds were sown on the field at a spacing of 20×10 cm at approximately 5 cm depth using a measured dipper. Treatments were arranged in a Randomised Complete Block Design (RCBD) with three replicates of each treatment. Days to 50% emergence were significantly different among the three treatments. No significant difference was however, observed among the landraces with respect to 50% emergence. Final seedling establishment was significantly different among the landraces ($p = 0.02$). Soaking bambara groundnut seeds in water for 24 h significantly enhanced final seedling establishment ($p = 0.001$). Seedling emergence was delayed under the control treatment. Percentage seedling establishment was also significantly lowest under the control treatment. Seed priming also significantly affected the final percentage seedling establishment. Results from this study provide farmers a cheap and easy technology which can improve on the final plant stand and yield of bambara groundnut.

Key words: Bambara groundnut, seed, priming, emergence, establishment, water

INTRODUCTION

Bambara groundnut is an indigenous African legume. The crop is adapted to dry areas and grows as intercrop with dry area crops like sorghum and millet. The crop is grown for human consumption with pods formed on or beneath the soil containing seeds that can be eaten fresh as snack or mature as pulse. Seedling emergence in Bambara groundnut was observed in all field studies conducted by the authors between 2006 and 2009 not to be uniform. Within the same landrace seedling emergence was observed to begin from 7 days to as long as 15 days or more and in some cases seedlings emerge at 21 days after sowing (DAS). The issue of seedling emergence in Bambara groundnut is of paramount importance considering the hard seed coat which makes moisture permeability relatively difficult as well as the dry areas where the crop is mostly grown which makes moisture availability also more difficult. This has a practical implication for days to flowering, podding and days to maturity. Delayed seedling emergence and establishment also have implication on early and efficient capture and use of resources such as light through timing of canopy development, nutrient uptake, weed control and hence final pod yield at harvest. Germination of Bambara groundnut is hypogeal as the cotyledon remain on the ground.

Bambara groundnut seed germination is slow and sporadic and on the field, seedling emergence could take up to 21 Days after Sowing (DAS) (Sesay and Yarmah, 1996). Sesay *et al.* (2004) reported of delayed and prolonged seedling emergence in bambara groundnut trial in Luve and Malkernes both in Swaziland in 2001 and 2002 respectively, due to drought. Zulu (1989) observed that seed germination in bambara groundnut seems to be more sensitive to moisture stress than groundnut. He attributed this to the restrictive uptake of water by bambara groundnut due to the hard seed coat. Rha and Jamil (2007) observed that seed priming in sugar beet increased germination percentage under salt stress. They observed 150 and 200 mg L^{-1} of Giberrelic Acid (GA) was the most effective in increasing germination under salt stress among the treatments used with water uptake increasing significantly with increasing GA compared to the control. Sivritepe and Dourado (1995) also reported that seed priming (osmoconditioning) was observed to be one of

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the easy techniques which is a physiological method for improving seed germination as well as enhancing faster and more synchronised germination. Controlled hydration maintained during osmoconditioning may permit repair processes of various deteriorative processes which occur during seed storage (Burgass and Powell, 1984).

This study was conducted to determine whether seed priming by soaking bambara groundnut seeds in water for 24 or 48 h before sowing can have an effect on the rate and uniformity of seedling emergence as well as final seedling establishment relative to the control which is sowing without soaking seeds in water.

MATERIALS AND METHODS

Two hundred seed lot each of Burkina, NAV 4, NAV Red and Black eyes were soaked separately in tap water for 24 and 48 h in a well lighted barn with environmental temperature of 28±3°C. A control treatment was not soaked in water. Seeds were sown at 20×10 cm at one seed per hill on the field in a Randomized Complete Block Design with three replicates. Seeds were sown at approximately 5 cm depth using a measured dipper to minimise error due to the effect of sowing depth on seedling emergence. Data was taken on 40 predetermined hills per plot. Sowing was done on 18th September, 2009 at the CSIR-Crops Research Institute, Fumesua-Kumasi. Plot length was 100 cm (1 m).

Data taken: Days to 50% seedling emergence was determined as the number of days 50% seedlings on a plot emerged. Seedlings were considered to have emerged when the first true leaf had broken from the soil and was visible. Final plant establishment was determined as seedlings that have established at 20 days after sowing (DAS).

Data analysis: Data was analysed using GENSTAT statistical package. Data in percentage were transformed using ARCSINE transformation. Mean separation was done using the Duncans's Multiple Range Test (DMRT).

RESULTS

Days to 50% emergence: Significant difference was observed with respect to seed priming treatment on number of days to 50% emergence. No significant difference was however, observed in days to 50% emergence with respect to landrace for the three treatments (Table 2). Seeds soaked in water for 24 and 48 h emerged earlier when sown (6.9 days) whereas the control took a mean of 9.3 days to attain 50% emergence (Table 1).

Table 1: Effect of seed priming on mean number of days to 50% emergence

Seed priming treatment	Mean number of days to 50% emergence
Soaking seeds in water for 24 h	6.9b
Soaking seeds in water for 48 h	6.9b
Control (No soaking in water)	9.3a

Values in a column bearing the same letters are not significantly different (p = 0.05) by Duncan's Multiple Range Test (DMRT)

Table 2: Days to 50% emergence as affected by landrace and seed treatment (Hours of soaking in water)

	DAS		
Landrace	Control 0 h	24 h	48 h
Black eye	9.3	6.7	7.0
Burkina	9.0	7.0	6.7
NAV 4	9.3	7.0	7.0
NAV Red	9.7	7.0	7.0
	NS	NS	NS

NS: Not significant

Table 3: Effect of seed priming on mean final percentage establishment

Seed priming treatment	Mean final percentage establishment
Soaking seeds in water for 24 h	85.6a
Soaking seeds in water for 48 h	79.6a
Control (No soaking in water)	53.4b

Values in a column bearing the same letters are not significantly different (p = 0.05) by Duncan's Multiple Range Test (DMRT)

Table 4: Final percentage seedling establishment (20 DAS) as affected by landraces and seed treatment (Hours of soaking seeds in water)

	Percentage establishment		
Landraces	Control	24 h	48 h
Black eye	34.2c	86.7	71.7b
Burkina	49.2b	82.5	77.5ab
NAV 4	64.2a	82.5	84.2a
NAV Red	66.7a	90.8	85.0a
		NA	

Values in a column bearing the same letters are not significantly different (p = 0.05) by Duncan's Multiple Range Test (DMRT). NS: Not significant

Percentage seedling establishment: Significant difference was observed among landraces with respect to final percentage seedling establishment (p = 0.02) at 20 DAS. Significant difference was also observed on seed priming treatment on the final seedling establishment (p<0.001). No significant difference was observed in the seed priming by landrace interaction. Final percentage establishment was also highest under 24 h soaking in water (85.6%) and least under the control (53.5%) (Table 3). No significant difference was however, observed between the 24 h treatment and the 48 h treatment with respect to the final percentage seedling establishment (Table 3). NAV Red at the different seed priming treatment showed a high percentage seedling establishment than the other landraces even though this was not significantly different from NAV 4 (Table 4).

DISCUSSION

Seedling emergence were highest under 24 and 48 h soaking in water relative to the control (Table 1). Final

seedling establishment was highest under 24 h soaking even though this was not significantly different from the 48 h treatment (Table 3). Zulu (1989) observed that seedling emergence in bambara groundnut seems to be more sensitive to moisture stress than groundnut. He attributed this to the restrictive uptake of water by bambara groundnut due to the hard seed coat. This was also observed in a two-year field studies conducted by the authors when under drought, seeds could remain in the soil for almost 20 days before germination occurred with the availability of moisture. Mabika (1991) however, reported that scarification by scratching three openings did not hasten germination. Mabika (1991) also observed that seed priming by pre-soaking the seeds in distilled water at 21°C for 24 h did not affect the germination of the crop. The findings of this study however, did not agree with Mabika (1991) since bambara groundnut seeds soaked in water for 24 and 48 h both affected days to seedling emergence and final percentage seedling establishment. The temperature, at which seeds were soaked in this study was 28±3°C. This temperature was higher than that of Mabika (1991) and this could have facilitated the imbibition of water by the seeds and hence enhanced their germination. This temperature also pertains in most bambara groundnut growing areas in Ghana. Massawe (1997) however, observed that soaking bambara groundnut seeds in water for 24 to 72 h promoted initial germination by two to three days depending on the landrace and also reduced the spread of germination. This result was observed in the in the present study where seed priming did not only facilitate the rate of seedling emergence but also reduced the spread of seedling emergence. Rajpar and Wright (2000) observed that the early emergence and its effect on early maturity of seed priming treatment may be as a result of advancement in seed metabolic activities. Seed priming by soaking seeds in water overnight, drying them before sowing markedly improves plant stand, establishment, vigour and the final yield (Harris *et al*., 1999; Rashid *et al*., 2002). Again this finding is in agreement with results of the present study where seedling emergence was observed to be fastest and final percentatge establishment greatest under seed priming treatment relative to the control.

Rajpar *et al*. (2006) also reported that compared to the control, seeds took significantly fewer days to emerge and reach maturity. Rajpar *et al*. (2006) again observed that the effect of seed priming was greatest when seeds were primed with fresh water than with 0.2 and 0.4% gypsum. Mayer and Poljakoff-Mayber (1989) observed that osmoconditioning improves vigour in seed lots with low vigour and enables formation of uniform stands in the field. The germination phase of planted seeds is critical because it directly determines the density of a crop stand especially under arid conditions where dry soil may impair imbibition of water and high temperature may affect seed viability and eventual density of a crop stand (Hadas and Russo, 1974). Hadas and Russo (1974) further observed that a good stand can be ensured by a complete and fast germination and if germinating seed is slow in taking up water, emergence is impaired and consequently the final stand is reduced. Rajpar *et al*. (2006) did not observe any significant seed priming treatment by cultivar interaction for most of the parameters measured. This was observed in the present studies where no significant interaction was observed for the landrace by seed priming treatment for the parameters measured.

Seeds soaked in water for 48 h in this study became soft and the cotyledons easily split into two when not handled well. It is possible the low seedling emergence and poor stand in the control treatment could be due to the relatively longer time the seeds took to imbibe water. The practical significance of this findings is that with a simple soaking of bambara seeds in water for 24 h the farmer does not only benefit from the early emergence of seedlings but also improved crop stand which has a positive implication on the more efficient utilization of resources of light, nutrient and water, efficiently control weeds and improve crop yield. Soaking bambara seeds in water for 24 h has the possibility of improved crop stand and bambara groundnut yield which is beneficial for bambara groundnut growers in terms of food security and poverty alleviation through income generation. Results from this study can improve the income and livelihood of bambara groundnut growers most of whom are women. Berchie *et al*. (2010) observed that more females (63%) are involved in bambara groundnut production than men (37%) in the Transition and Upper East Regions of Ghana. The technology does not only provide a cheap way of increasing the productivity of bambara groundnut but also an easy technology which can easily be adopted by bambara groundnut growers.

CONCLUSION

A study was conducted to determine whether seed priming by bambara groundnut seeds in water for 24 and 48 h will affect the days to seedling emergence and the final seedling establishment compared to the control where seeds were not soaked in water. Seedlings were observed to emerge earliest under 24 and 48 h soaking in water (6.9 days) compared to the control (9.3 days). No significant difference was observed between the 24 h treatment and 48 h treatment. Seedling establishment under 24 h soaking in water was 59% higher than the

control. Seeds soaked in water for 48 h became soft and the cotyledons split into two when not well handled. Soaking bambara groundnut seeds in water for 24 h before sowing has the possibility of improving plant stand and final yield.

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