Journal of Agriculture and Environment
Vol. 20 No. 1, 2024: 239-251

Effect of seed priming using potassium dihydrogen phosphate on seedlings emergence, growth and yield of Bambara groundnut (*Vigna subterranea* (L) Verdc.)

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ABSTRACT

Bambara groundnut takes a very long period to emerge from the soil, this negatively affect plant establishment and final yield; meanwhile, priming has helped reduced time to seedling emergence in several crops. Thus, a field experiment was conducted at the Teaching and Research Farm, University of Ilorin, Nigeria, during the 2019 cropping season to evaluate the effect of priming using potassium dihydrogen phosphate (KH_2PO_4) on emergence, growth, and yield of Bambara groundnut. There were two factors; concentration (0, 100 and 200 ppm of KH_2PO_4) and duration (0, 6, and 12 hours) laid out in a 3 x 3 factorial arrangement fitted into a randomized complete block design (RCBD) replicated three times. Data were collected on days to 50% seedling emergence, growth parameters (petiole length, number of leaves, dry matter, leaf area, and leaf area index), and yield. Results showed that treatments improved emergence, growth, and yield of Bambara groundnut, with significant interaction effects. Using 200 ppm of KH_2PO_4 and soaking for 12 hours significantly fastened seedling emergence and growth parameters. Increasing the concentration of KH_2PO_4 showed no significant effect on yield, but increasing soaking duration significantly affected yield. Farmers are therefore encouraged to adopt priming of Bambara groundnut seeds for 12 hours using 200 ppm of KH_2PO_4 to hasten seedling emergence.

Keywords: Bambara groundnut; emergence; KH_2PO_4; priming; yield

INTRODUCTION

Bambara groundnut (*Vigna subterranea* (L) Verdc.) is a grain legume native to Africa. It is widely cultivated in sub-Saharan Africa (Baudoin and Mergeai, 2001). The grain yield of Bambara groundnut in Africa ranges from 650-850kg/ha, with huge differences between agroecologies and landraces (Linnemann, 1994). It is an essential source of rich and cheap protein in the diets of many African rural households.

Bambara grain contains about 33 and 66% of essential and non-essential amino acids, respectively (Amarteifio *et al.*, 2006). The haulms are palatable to ruminants, and the leaves are rich in nitrogen and phosphorus. Thus, it is an excellent source of animal feed. Brink and

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https://dx.doi.org/10.4314/jagrenv.v20i1.23

Belay (2006) reported that an infusion from the leaves can treat abscesses, while the roots are said to have aphrodisiac properties.

A crop like Bambara groundnut takes a very long period to emerge from the soil because of its hard seed coat. Berchie *et al.*, (2010) reported that Bambara groundnut landraces differ markedly in their germination ability. Within the same landraces, for example, seedling emergence varies from 7 to 21 days after sowing (Sesay and Yarmah, 1996; Berchie *et al.*, 2010). This negatively affects plant establishment and reduces final yield. Poor seed germination of Bambara groundnut is primarily due to its hard seed coat. Linnemann and Azam-Ali (1993) reported that the low grain yield of Bambara groundnut is associated with poor seed viability, crop establishment, and plant density. Subsequently, after harvesting, a seed gradually loses its viability and becomes dormant or inactive if it is not properly preserved. After sowing, it takes time for the seed to break dormancy and establish itself, thus delaying the emergence of the seedling from the soil, negatively affecting germination and yield.

The priming technique is one successful method that has helped reduce seedling emergence in several crops. Seed priming is an effective technology that enhances rapid and uniform emergence and achieves high vigour, leading to better plant stand, establishment, and yield. This technique is easy-to-use and low-cost. It speeds up pre-germination metabolic activities without germination. Then, the seeds are dried again until almost at their initial dry weight. Thus, priming helps break seed dormancy or inactivity and increases seed viability before planting. Seed priming can improve seedling emergence, plant stands and establishment, seedling vigour, and final yield (Harris *et al.*, 1999; Rashid *et al.*, 2002). However, priming has not been done on Bambara groundnut. This study was undertaken to determine an optimum concentration-duration combination that best enhances Bambara groundnut's emergence, growth, and final yield.

MATERIALS AND METHODS

Experimental Site

A field experiment was conducted at the University of Ilorin Teaching and Research Farm, Nigeria (8°041N 4°051E, 307 m above sea level) during the 2019 cropping season. The study area is located in southern Guinea savannah zone of Nigeria on an Alfisol belonging to the Bolodunro Series (Ogunwale *et al.*, 2002). The area's soil depths range from shallow to profound, and its surface soils are coarsely grained and deficient in organic matter; in certain places, the soils are severely degraded, and topsoil erosion is expected, which results in low soil fertility. Rainfall in this area follows a bimodal trend from late March to July, with a first peak in late July and a break in August. The second part of the rainy season usually starts in late August, peaking in late September and ending in late October. The annual rainfall for the location was 991 mm in 2018 and 1432.92 mm in 2019. The mean annual temperature of the study area is 29^{o}C, while the average annual relative humidity is about 85%.

Seed Treatment

One hundred (100) ppm of KH_2PO_4 solution was prepared by dissolving 100 mg of KH_2PO_4 in 1 litre of distilled water, while 200 ppm was prepared by dissolving 200 mg of

KH_2PO_4 in 1 litre of distilled water. Note that priming with 100 and 200 ppm KH_2PO_4 for 0 hours was carried out by soaking seeds for a few seconds in each solution of KH_2PO_4, after which the seeds were immediately removed from the solutions. After the designated priming durations, the soaked seeds were drained and washed three times with distilled water. These seeds were then air-dried to average moisture content on clean filter paper.

Treatments and Experimental Design

The treatments were set up in a randomised complete block design (RCBD) in a 3 x 3 factorial experiment. The factors were priming concentration (0, 100, and 200 ppm of KH_2PO_4) and priming durations (0, 6, and 12 hours). Each treatment was replicated three times.

Crop Husbandry

Fields were ploughed, harrowed and divided into three blocks with 9 plots per block, giving a total of 27 plots with 1 m alleyway between blocks and 0.5 m space between plots. Planting was done on 25th of May 2019. The size of each plot measured 2 x 2 m. Two seeds were sown per hole along the rows of each plot. The inter-row and intra-row spacing were 45 x 20 cm, respectively. Each plot consisted of four rows with 10 stands per row to give a total of 40 stands per plot (80 plants per plot). Seeds were sown at approximately 5cm depth using a measured stick to minimize errors resulting from the effect of sowing depth on the emergence and establishment of the seedlings.

Data Collection

Days to 50% seedling emergence

This was done by counting the number of days it took half the number of seeds sown on each plot to emerge. Seedlings were considered to have emerged when the first true leaves were broken from the soil and visible.

Petiole length

Petiole length was measured by measuring the petiole length of five randomly sampled plants on each plot with a measuring tape, and the average calculated.

Number of leaves

The trifoliate leaves were counted as one leaf. The number of leaves of five randomly sampled plants was counted per plot, and the mean was determined.

Leaf area

Leaf area was determined by measuring and estimating the average leaf length and width of five sampled plants from each plot, and the area was calculated using the model below:

Leaf Area $= 0.71\,\mathrm{L} \times \mathrm{W} + 0.23$ (Nguy-Ntamag, 1995). Where "L" and "W" are the average length and width of leaves.

Leaf area index

Leaf area index (LAI) per plant was calculated using the formula below:

$$Leaf\ Area\ Index\ = \frac{Leaf\ area}{Land\ area}$$

Land area = 45 cm x 20 cm = 900 cm^2

Dry matter accumulation

Dry matter accumulation was determined by uprooting a representative plant from each of the 27 plots. The samples were then taken to the laboratory to determine the initial weight. Each sample was oven-dried until it reached a constant weight. The final weight was determined, and all values were recorded.

Yield per hectare

The seed weight obtained per plot was extrapolated on a hectare basis using the equation below:

$$yield = \frac{seed\ weight\ \times 10{,}000}{area\ harvested}$$

Data Analysis

The data collected were subjected to analysis of variance (ANOVA) using GENSTAT statistical software, 17th edition. Fisher's Least Significant Difference (LSD) was used to separate means at 5% level of significance.

RESULTS

Days to 50% Seedling Emergence

The effect of priming concentration and duration on days to 50% seedling emergence of Bambara groundnut is presented in Table 1. Days to emergence reduced in seeds that underwent priming as priming concentration and duration increased. Priming with 200 ppm, KH_2PO_4 significantly reduced the number of days for Bambara seeds to emerge from the soil by 42.9% than seeds without soaking. Likewise, priming Bambara seeds for 12 hours significantly reduced days to seedling emergence by 54% than seeds primed for 0 hour. The interaction effect between priming concentration and duration significantly affected days to 50% seedling emergence of Bambara; seed priming with 200 ppm KH_2PO_4 for 12 hours was the best treatments combination.

Table 1: Effect of priming concentration and duration on days to 50% seedling emergence of Bambara groundnut

Concentration (ppm) (C)	Value		
0	12.91[a]		
100	10.39[ab]		
200	7.37[b]		
LSD $_{(p \leq 0.05)}$	4.810		
Duration (hrs) (D)			
0	13.12[a]		
6	11.56[a]		
12	5.99[b]		
LSD $_{(p \leq 0.05)}$	4.262		
	Interaction (C × D)		
		Duration (hrs)	
Concentration (ppm)	0	6	12
0	5.97[c]	7.03[bc]	9.10[bc]
100	6.00[c]	11.67[abc]	13.50[ab]
200	6.00[c]	15.97[a]	16.77[a]
LSD $_{(p \leq 0.05)}$		6.265*	

Means having a letter in common are not significantly different at 5% significance level

Growth Parameters

The effect of priming concentration and duration on petiole length of Bambara groundnut at 4, 6, 8 and 10 WAS is presented in Table 2.

Table 2: Effect of priming concentration and duration on petiole length (cm) of Bambara groundnut

Concentration (ppm) (C)	Weeks After Sowing (WAS)			
	4	6	8	10
0	9.10[b]	11.42[a]	13.73[a]	15.88[a]
100	9.25[ab]	11.77[a]	13.92[a]	16.03[a]
200	9.82[a]	12.09[a]	14.78[a]	17.20[a]
LSD $_{(p \leq 0.05)}$	0.656	Ns	ns	Ns
Duration (hrs) (D)				
0	8.85[b]	11.49[a]	13.57[a]	15.62[a]
6	9.56[a]	11.82[a]	14.14[a]	16.17[a]
12	9.77[a]	11.97[a]	14.71[a]	17.31[a]
LSD $_{(p \leq 0.05)}$	0.600	Ns	ns	ns
	Interaction (C × D) at 10 WAS			
		Duration (hrs)		
Concentration (ppm)	0	6	12	
0	17.17[b]	14.29[g]	16.62[c]	
100	14.54[fg]	22.14[a]	14.91[ef]	
200	15.16[de]	15.51[d]	16.98[bc]	
LSD $_{(p \leq 0.05)}$		0.397**		

Means having a letter in common are not significantly different at 5% significance level

Priming concentration and duration using KH_2PO_4 increased the petiole length of Bambara across all sampling periods. Petiole length increased as priming concentration and duration increased at 4 WAS only. Priming with 200 ppm KH_2PO_4 increased petiole length at a significant rate by 7.9% than 0 ppm, while 6 hours and 12 hours soaking durations significantly increased petiole length by 8% and 10.4%, respectively. The interaction between the concentration of the priming agent (KH_2PO_4) and the duration of priming had a highly significant effect ($P \leq 0.01$) on the petiole length of Bambara across all sampling periods; seed priming with 100 ppm KH_2PO_4 for 6 hours was the best treatments combination at 6, 8 and 10 WAS.

Number of Leaves

The effect of priming concentration and duration on the number of leaves of Bambara groundnut at 4, 6, 8 and 10 WAS is presented in Table 3. The number of leaves increased as the priming concentration increased. However, increments were not significant except at 6 WAS, where priming with 200 ppm KH_2PO_4 increased the number of leaves by 42.2% than 0 ppm. Soaking durations increased the number of leaves at significant rates, except at 6 WAS, where increments were not significant. At 4 and 6 WAS, the number of leaves increased as priming duration increased, with an increment of 17% when Bambara seeds were soaked for 12 hours at 4 WAS.

Table 3: Effect of priming concentration and duration on the number of leaves of Bambara groundnut

Concentration(ppm) (C)	Weeks After Sowing (WAS)			
	4	6	8	10
0	15.69^{a}	40.61^{b}	68.09^{a}	99.13^{a}
100	15.78^{a}	45.87^{ab}	72.62^{a}	101.18^{a}
200	16.66^{a}	57.74^{a}	73.89^{a}	102.78^{a}
LSD $_{(0.05)}$	Ns	12.47	ns	Ns
Duration (hrs)				
0	14.80^{b}	44.60^{a}	63.65^{b}	88.43^{b}
6	16.03^{ab}	47.23^{a}	76.61^{a}	109.15^{a}
12	17.29^{a}	52.40^{a}	74.34^{a}	105.50^{a}
LSD $_{(0.05)}$	1.995	ns	7.07	10.19

Interaction (C × D) at 8 WAS			
	Duration (hrs)		
Concentration (ppm)	0	6	12
0	65.44^{g}	73.40^{d}	82.84^{b}
100	68.04^{f}	85.84^{a}	63.97^{g}
200	57.47^{h}	70.60^{e}	76.20^{c}
LSD $_{(p \leq 0.05)}$	2.192*		

Means having a letter in common are not significantly different at 5% significance level

Soaking Bambara seeds for 6 hours produced plants with more leaves than 12 hours priming duration at 8 and 10 WAS. At 8 WAS, soaking seeds for 6 hours and 12 hours before planting increased the number of leaves by 20.4% and 17%, respectively, whereas soaking Bambara seeds for 6 hours and 12 hours increased the number of leaves by 23.4% and 19.3%, respectively, at 10 WAS. The interaction between the concentration of the priming agent

(KH_2PO_4) and the priming duration significantly affected the number of Bambara leaves across all sampling periods; seed priming with 100 ppm KH_2PO_4 for 6 hours was the best treatments combination at 8 and 10 WAS.

Leaf Area and Leaf Area Index

The effect of priming concentration and duration on leaf area of Bambara groundnut at 4, 6, 8 and 10 WAS is presented in Table 4. Priming concentrations and durations had no significant effects on the leaf area of Bambara. The interaction between the concentration of the priming agent (KH2PO4) and the duration of soaking only showed significant effects on the leaf area of Bambara at 4 and 8 WAS.

Table 4: Effect of priming concentration and duration on leaf area (cm^2) of Bambara groundnut

Concentrations (ppm) (C)	Weeks After Sowing (WAS)			
	4	6	8	10
0	65.36[a]	254.0[a]	606.9[a]	1150[a]
100	77.82[a]	266.4[a]	622.7[a]	1184[a]
200	78.09[a]	284.1[a]	652.2[a]	1235[a]
LSD $(p \leq 0.05)$	ns	Ns	ns	Ns
Duration (hrs) (D)				
0 hour	67.51[a]	248.0[a]	543.5[a]	1015[a]
6 hours	68.45[a]	277.0[a]	668.8[a]	1249[a]
12 hours	85.31[a]	279.5[a]	669.5[a]	1305[a]
LSD $(p \leq 0.05)$	ns	ns	ns	Ns
Interaction				
C*D	35.302*	ns	284.973*	Ns

Means on the same column having a letter in common are not significantly different at 5% level of significance

Effect of priming concentration and duration on leaf area index of Bambara groundnut at 4, 6, 8 and 10 WAS is presented in Table 5. Priming concentrations and durations had no significant effects on the leaf area index of Bambara.

Table 5: Effect of priming concentration and duration on leaf area index of Bambara groundnut

Concentrations (ppm) (C)	Weeks After Sowing (WAS)			
	4	6	8	10
0	0.0726[a]	0.2822[a]	0.6744[a]	1.278[a]
100	0.0865[a]	0.2960[a]	0.6918[a]	1.315[a]
200	0.0868[a]	0.3157[a]	0.7246[a]	1.372[a]
LSD $(p \leq 0.05)$	ns	ns	ns	Ns
Duration (hrs) (D)				
0	0.0750[a]	0.2756[a]	0.6039[a]	1.128[a]
6	0.0761[a]	0.3078[a]	0.7431[a]	1.387[a]
12	0.0948[a]	0.3105[a]	0.7439[a]	1.450[a]
LSD $(p \leq 0.05)$	ns	ns	ns	Ns
Interaction				
C*D	0.0392*	ns	0.3166*	Ns

Means on the same column having a letter in common are not significantly different at 5% level of significance

The interaction between the concentration of the priming agent (KH_2PO_4) and the soaking duration only had significant effects on the leaf area index of Bambara at 4 and 8 WAS.

Dry Matter Accumulation

Effect of priming concentration and duration on dry matter accumulation of Bambara groundnut at 4, 6, 8 and 10 WAS is presented in Table 6. Dry matter increased as the concentration of priming agent (KH_2PO_4) increased. However, 100 ppm KH_2PO_4 is not significantly different from the control. On the other hand, using 200 ppm of KH2PO4 significantly increased dry matter by 23.12, 49.55, 85.65, and 94.4% at 4, 6, 8 and 10 WAS. Dry matter increased equally as the duration of soaking increased. Differences in dry matter accumulation were insignificant as priming duration increased, except at 6 WAS, where dry matter increased significantly by 29.64% when Bambara seeds were soaked for 12 hours. The interaction effects between the concentration of the priming agent (KH_2PO_4) and the duration of soaking were highly significant ($P \leq 0.01$) on dry matter accumulation of Bambara across all sampling periods; seed priming with 0 ppm KH_2PO_4 for 6 hours was the best treatments combination at 8 and 10 WAS.

Table 6: Effect of priming concentration and duration on dry matter (g/m^2) of Bambara groundnut

Concentrations (ppm) (C)	Weeks After Sowing (WAS)			
	4	6	8	10
0	3.72^{b}	6.68^{b}	10.31^{b}	13.98^{b}
100	4.26^{ab}	7.64^{b}	11.62^{b}	15.68^{b}
200	4.58^{a}	9.99^{a}	19.14^{a}	27.18^{a}
LSD $_{(p \leq 0.05)}$	0.711	1.725	1.813	3.023
Duration (hrs) (D)				
0	4.06^{a}	7.32^{b}	13.59^{a}	17.85^{a}
6	4.25^{a}	7.50^{ab}	13.69^{a}	19.32^{a}
12	4.25^{a}	9.49^{a}	13.78^{a}	19.67^{a}
LSD $_{(p \leq 0.05)}$	ns	2.028	ns	ns

Interaction (C × D) at 10 WAS

Concentration (ppm)	Duration (hrs)		
	0	6	12
0	24.34^{c}	32.4^{a}	24.81^{b}
100	14.37^{g}	11.80^{i}	15.77^{e}
200	19.24^{d}	14.81^{f}	12.99^{h}
LSD $_{(p \leq 0.05)}$		0.431**	

Means having a letter in common are not significantly different at 5% significance level

Yield

Effect of priming concentration and duration on yield of Bambara groundnut is presented in Table 7. Priming concentrations had no significant effects on the yield of Bambara. On the other hand, yield increased significantly as priming duration increased, with 6 hours and 12 hours soaking durations producing yield higher than control (0-hour soaking duration) by 39.5 and 105.75%, respectively. Similarly, the interaction effect between

priming concentration and duration had a highly significant effect on the yield of Bambara groundnut; seed priming with 200 ppm KH_2PO_4 for 12 hours was the best treatments combination at 4 and 8 WAS.

Table 7: Effect of priming concentration and duration on yield (kg/ha) of Bambara groundnut

Concentration (ppm) (C)	Value		
0	592.6[a]		
100	616.8[a]		
200	686.3[a]		
LSD $_{(p \leq 0.05)}$	ns		
Duration (hrs) (D)			
0	425.8[c]		
6	593.9[b]		
12	876.1[a]		
LSD $_{(p \leq 0.05)}$	83.5		
	Interaction (C × D)		
		Duration (hrs)	
Concentration (ppm)	0	6	12
0	420.3[d]	451.3[d]	404.3[d]
100	626.3[c]	491.0[d]	662.7[c]
200	802.7[b]	834.0[b]	990.3[a]
LSD $_{(p \leq 0.05)}$		94.2**	

Means having a letter in common are not significantly different at 5% significance level

DISCUSSION

Days to 50% seedling emergence reduced as priming concentration and duration increased. Primed seeds may have emerged faster probably due to reduced dormancy through the initiation of physiological activities that prepare the seeds for germination. This observation corroborated Rajpar and Wright (2000), who also found that early seedling emergence after priming is possible, attributing it to advanced metabolic activities. This also agreed with the findings of Berchie *et al*. (2010), who reported that soaking Bambara groundnut in water for 24 hours before sowing significantly improved seedling emergence and establishment. According to Rha and Jamil (2007), seed priming can increase the germination rate of Bambara groundnut. Sivritepe and Dourado (1995) proposed osmo-conditioning as an easy physiological seed priming technique to enhance and synchronize the germination rate in Bambara groundnut. Assefa and Hunje (2011) reported that the germination speed in soybeans increased as the priming duration increased from 0 to 14 hours.

Priming treatments (concentration of KH_2PO_4 and soaking duration) had enhanced growth parameters as evidenced with longer petiole length, higher number of leaves, greater dry matter, larger leaf area, and leaf area index when compared to plant arising from unprimed seeds. This is likely due to the fact that priming enhanced the seed germination and emergence rate, leading to early crop growth and establishment, ultimately impacting overall plant growth. Additionally, phosphorus is essential for growth and vigour during early plant development. Hence, high seed-phosphorous content has been regarded as essential for seed germination, seedling establishment, and subsequent plant growth. Thus, phosphorus present

in the priming agent (KH_2PO_4) may have been absorbed by the seeds to increase the phosphorus content of the seed, this is in agreement with Atar *et al.* (2020), who reported that priming techniques could be used to fortify seedlings' nutrient contents to induce better performance in the proceeding growth stages. This is similar to the findings of Imran *et al.* (2013) who reported that seed priming with Fe, Zn, and Mn showed a significant increase in their seed contents of maize during the early growth stage.

Priming concentration and duration elongated petiole in this study. This observation has earlier been reported by Dhingra *et al.* (2022), that leaf petiole length was increased when seeds of Indian mustard were primed with carbon nanotubes and silicon dioxide nanoparticles. This also agreed with Aghdaei *et al.* (2019), who reported that the leaf petiole length of pepino was influenced by priming treatments and duration.

This study has showed that number of leaves per plant increased with priming concentration at certain stage of the study. Priming duration was also found to increase the number of leaves per plant. Number of leaves increased with increase in priming duration at certain growth stages. The interaction effect between priming concentration and duration was significant across all sampling periods. This is in line with the report of Shah *et al.* (2011) that priming sources (distilled water, 1% phosphorus solution of each of DAP, SSP, SSP + Na2CO3) along with soaking duration affected number of leaves per plant. Vazirimehra *et al.* (2014) also reported seed priming with KNO_3 solution in five levels (0, 0.05, 1, 1.5, and 2%) significantly affected the number of leaves.

This study has demonstrated that priming concentration and duration influenced leaf area and leaf area index at certain stage stages of growth. This is consistent with Yari *et al.* (2011) that seed priming treatment significantly affected the leaf area of wheat cultivars. Previous researches by Jamal *et al.* (2011) and Ahmadvand *et al.* (2012) corroborated this finding.

Similarly, seed priming improved leaf area index, an essential parameter for assessing crop growth and development. Hussain *et al.* (2013) reported that seed priming enhanced leaf area index in wheat plants, indicating better leaf development and potentially increased photosynthetic capacity. In a study by Dastborhan and Ghassemi-Golezani (2015), seed priming had positive impact on the leaf area index under well watering, indicating that the earlier advantage in rapid seedling emergence due to seed priming was more pronounced under favourable conditions.

Dry matter increased with priming concentration and duration. The interaction effect between priming concentration and duration was significant across all sampling periods. Similarly, Singh *et al.* (2014) has stated that osmo-priming with KNO_3 for different durations was superior to unprimed treatment regarding dry matter accumulation in cowpea. Turuko and Mohammed (2014) has reported that increasing phosphorus concentration produced substantially higher dry matter.

In this study, it was observed that priming seeds with KH_2PO_4 and duration increased yield. This could probably be due to resulting from its effect on growth especially as they enhanced leaf area. A larger leaf area can capture more solar radiation for photosynthetic activities leading to greater production of assimilates, thereby increasing productivity. Thus, yield improvement resulted from faster germination and seedling emergence, improved seedling establishment, and enhanced crop growth. Previous research work by Linnemann and Azam-Ali (1993) showed that good seed germination and the emergence of primed seeds resulted in a higher grain yield of Bambara groundnut. Also, Harris *et al.* (1999) and Rashid *et al.* (2002) reported that soaking Bambara groundnut seed overnight in water and

drying before sowing markedly improved the final yield. Rehman *et al*. (2011) reported that seed priming is a cost-effective technology that can enhance early crop growth, leading to an earlier and more uniform stand with yield-associated benefits in many field crops, including oil seeds.

CONCLUSION

Priming treatments and duration hastened seedling emergence, enhanced growth, and improved the yield of Bambara groundnut, in which 200 ppm of KH_2PO_4 and 12 hours of soaking significantly fastened seedling emergence; growth parameters (petiole length, dry matter, leaf area, and leaf area index) increased across all sampling periods as KH_2PO_4 concentration and soaking duration increased.

On the other hand, only soaking duration had effect on the yield. Farmers are therefore encouraged to adopt priming of Bambara groundnut seeds for 12 hours using 200 ppm of KH_2PO_4 before sowing to hasten seedling emergence and yield improvement.

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