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ASSESSMENT OF HYDRO PRIMING OF SEEDS ON PERFORMANCE OF MORPHOLOGICAL INDICES OF BAMBARA GROUNDNUT (*VIGNA SUBTERRENEA* LINN.) LANDRACE

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Abstract

Field experiment was conducted in 2012 at Teaching and Research Farm of faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri to assess the effect of hydro priming duration on performance of morphological indices of Bambara groundnut (*Vigna subterranean* (L.) Verdc). The experiment was based in a Randomized Complete Block Design (RCBD) with five treatment levels and four replications. The treatments are 12hours, 24hours, 36hours, 48hours and 0hours which served as control (untreated seeds). Result indicated that all studied traits such as percentage emergence, plant heights, leaf area, leafareaindex, were significantly affected at 5% probability level. The 24 hours duration gave the highest percentage emergence (61.8%), leaf area (130.910cm^2), plant height (25.675cm), number of leaves (81.76). Control gave the highest leaf area index (0.126) while the 12hours produced the highest net assimilation rate (0.0088mgcm^2). In conclusion, 24hours hydro priming duration improved the performance of growth indices measured whereas the 36 hours was the least effective. Therefore, the results suggest that hydro priming is a useful method of improving seedling emergence, stand establishment and yield of bambara groundnut in the field hence should be recommended for poor farmers who are in engaged in production of bambaragroundnut.

Keyword: *Assessment, hydropriming, bambara groundnut, morphological*.

Introduction

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). Seed priming has been successfully demonstrated to the growth parameters in seeds of many crops particularly seeds of vegetables and small seeded grasses (Arif *et al.*, 2008). Seed priming improves plant height root dry weight, shoot dry weight, root length, shoot length and chlorophyll of plants compared to plants raised from the untreated seeds. Plant height of maize was increased by priming (without drying) (Al-soqueer, 2004). In contrast, many scientists have reported that the beneficial effect of hydropriming persisted only till early vegetative growth of maize and failed to improve the plant height (Basu *et al.*, 2005), shoot dry weight and leaf area of maize plants that had emerged on the same day (Harris *et al.*, 2002).

However, the resultant effect of priming depends on duration of seed soaking (Ashraf, *et al.*, 2005; Ghassemi-Golezani *et al.*, 2008). According to Aziza *et al.* 2004; Farooq *et al.*, 2010), a significant decrease in emergence time and increase in final emergence count may be because of the fact that seed priming induces a range of biochemical changes such as hydrolysis, activation of enzymes and dormancy breaking in the seed which are required to start the germination process and it resulted in improvements in field emergence heading to better canopy development and Crop Growth Rate (CGR). Brocklehurst *et al.* (1987), reported that faster emergence of primed seed may be due to the completion of pregerminative metabolic activities making the seed ready for radical protrusion and the primed seed germinated soon after planting compared with untreated dry seed. 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. Also, Rajpar *et al*. (2006), reported that compared to the control, seeds took significantly fewer days to emerge and reach maturity.

Bambara groundnut (*Vigna subterranean* L. Verdc) 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 a snack or mature as pulse. The seed germination is slow and sporadic and on the field, seedling emergence could take up to 21 days after sowing (Sesay and Yarmah, 1996). 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.

Therefore, this study is aimed at identifying the duration of the priming suitable for optimum germination and seedling growth of bambara groundnut.

Materials and Methods

This experiment was conducted at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri. Owerri lies between the latitudes 5^{o}10'N and 6^{o}0'N and longitude 6^{o}35'E and 7^{o}0'E within the south east rainforest agricultural zone of Nigeria having an average temperature, rainfall and relative humidity of 27^{o}C, 2500mm and 75% respectively (NIMET, 2008). The altitude is 57m.

The experimental field was cleared using cutlass, rake and the existing vegetation was removed. The experimental field was marked with pegs and ropes to determine the accurate plot size. The soil was tilled, pulverized the soil lumps into workable form. Beds of 2m x 2m were made at 1m apart using spade with soil depth of 50cm and the plot size was 14m by 11m. Soil samples were collected from various spots on the experimental plot at 0.15cm depth and bulked for analysis to ascertain the physico-chemical parameters of the soil.

Seeds of Bambara groundnut (landrace variety) obtained from the Imo State Agricultural Development Programme (Imo ADP) Office Owerri were used for planting.

The Bambara groundnut seeds were divided into five groups and each group was assigned to a degree of priming period. The various priming periods used were:

Control (without water)
Soaking seeds in water for 12hours at 23^0c
Soaking seeds in water for 24hours at 23^0c
Soaking seeds in water for 36hours at 23^0c
Soaking seeds in water for 48hours at 23^0c

After soaking, the seeds were spread on a filtered paper and allowed to sundry for 3hours and were sown immediately after sun drying in the farm The experiment was laid out in a Randomized Complete Block Design with five treatments and four replications.

Data were collected every two weeks on the following parameters: Percentage emergence, Number of leaves, Plant height, leafarea, leafarea index,Crop growth rate and Net assimilation rate.

Percentage emergence: This was the percentage number of bambara groundnut seeds that emerged and was calculated using the formular

$$\frac{Sg}{St} \times \frac{100}{1}$$ where Sg = germinated seed, ST = Total seed planted

As applied by Bormann *et al*. (2002)

Number of leaves per plant: This was the visual count of leaves on the plants per stand.

Plant Height (cm): This was the distance between the base of the plant at ground level to the tip of the highest leaves and it was measured using ruler.

Leaf Area (cm^2): This was calculated by measuring the maximum width (w) of central leaflet of the bambara groundnut using the formular

$L.A. = 2.137 \times (L^{1.9642}) - 2.7013$

where; L.A. = area
L = Maximum width of central let of each

as applied by Madukwe *et al.* (2011).

Leaf Area Index: This was the ratio of the area of a plant to the area of ground covered by the plant. It was calculated as;

$$\frac{\text{Leaf area of crop } (cm^2)}{\text{Land area covered by individual crop } (cm^2)}$$

As applied by Akonye and Nwauzoma (2003)

Net Assimilation Rate (gm^{-2} (leaf) day^{-1}): This was the value that relates plant productivity to plant size. It was calculated as;

$$NAR = \frac{2.303 \log (L_2-L_1) \times W_2 - W_1}{(t_2-t_1)(L_2-L_1)}$$

Where: L = leaf area
W_1 = crop dry weight at first harvest
W_2 = crop dry weight at second harvest
t_1 = days to first harvest
t_2 = days to second harvest

As applied by Williams 1946; Akonye and Nwauzoma, (2003).

Results

Effect of Hydropriming on the Percentage Emergence

Bambara Groundnut

The effect of hydropriming on percentage emergence of Bambaragroundnut seeds were significant (Table 1). The highest percentage emergence (61.8%) was obtained from 24 hours which was significantly different ($P<0.05$) compared to percentage emergence values (37.5%, and 30.9%) recorded from 12 hours and (control) respectively. However, the lowest percentage emergence was recorded from36 hours which was significantly different ($P<0.05$) from the values recorded from control. 12hours, 24hours and 36hours. It was observed that 48hours didn't record any seedling emergence.

Effect of Hydropriming on the Plant Height of Bambara Groundnut

The result of the effect of hydropriming durations on plant heights (table2), showed that 24hours at 2,4.6,8, and 10WAP recorded maximum plant heights (18.425cm, 23.075cm, 23.975cm, 25.675 and 25.675cm respectively) which was significantly difference ($p<0.05$) compared to the minimum plant heights (5.95cm, 7.750cm, 9.900cm, 12.475cm and 2.175cm respectively) recorded from 36hours priming time.12hours priming time was found to increased plant heights which was not statistically different from observed plant heights recorded in control as shown in table 2.

Effect of Hydropriming on the Number of Leaves per Plant of Bambara Groundnut

Table 3, shows the number of leaves as influenced by hydropriming duration. At early stage, it was observed that control recorded maximum number of leaves (40) which was significantly difference ($p<0.05$) compared to the minimum (14.63) recorded in 36hours priming time. Whereas at 6, 8 and 10 (maturity stage), 24hours priming times significantly recorded the maximum number of leaves (60.39, 78.82 and 81.76 respectively) compared to minimum numbers of leaves (21.50, 27.00 and 28 respectively) observed from 36hours duration.

Effect of Hydropriming on the Leaf Area of Bambara Groundnut

The mean leaf area of bambara groundnut was significantly influenced by priming periods.Table4,showed that at 2,4,6,8 and 10 WAP,24hours hydropriming time recorded maximum leaf areas (15.750cm^2, 64.208cm^2, 73.45cm^2, 126010cm^2 and 130.910cm^2 respectively) which was significantly different ($p<0.05$) compared to the minimum (2.225cm^2, 14.862cm^2, 17.980cm^2, 54.410cm^2 and 58.890cm^2 respectively) recorded from 36 hours priming duration. 12 hours only increase leaf area at early stage of growth while at 8 and 10WAP (maturity stage) control (unprimed seeds) gave a better performance (119.710cm2 and 99.340cm^2 respectively) compared to the leaf areas (104.970cm^2 and 81.780cm^2) recorded from 12hours hydropriming time.

Effect of Hydropriming on the Leaf Area Index (LAI) of Bambara Groundnut

Leaf area index was not significantly affected by hydropriming periods shown in table 5.36hours priming duration have the least leaf area index when compared to the 12 hours , 24 hours and control. At 4,6,8 and 10WAP control have higher leaf area index (0.136,0.177,0.117 and 0.126 respectively) compared to the lowest (0.058, 0.034, 0.056 and 0.058 respectively) recorded from 36 hours priming duration. At maturity stage (10WAP), control recorded the maximum leaf area index (0.126) which was statistically not different from leaf area index (0.118, 0.095 and 0.058 respectively) recorded from 12hours, 24hours and 36hours respectively.

Effect of Hydropriming on the Net Assimilation Rate(NAR) of Bambara Groundnut

Net assimilation rate significantly responded to the hydropriming duration periods (table 6). Statistically higher NAR values (0.0088$mgcm^2$ and 0.0047$mgcm^2$) were recorded from 12hours and control at 10 WAP compared to lowest (0.0026$mgcm^2$ and 0.0019$mgcm^2$ respectively) recorded from 24hours and 36hours respectively. It was observed that seed treatment duration as shown in table 7 had little or no effect on Net assimilation rate.

Table 1: Effect of hydropriming percentage emergence of Bambara Groundnut

Treatment	Emergence (%)
T_1 (Control)	30.9a
T_2 (12 hours)	37.5c
T_3 (24 hours)	61.8a
T_4 (36 hours)	5.9d
T_5 (48 hours)	0

Means in the same column, having the same letter(s), superscript are not significantly different at $P<0.05$ according to LSD.

Table 2: Effect of hydropriming on the plant height of Bambara groundnut

TREATMENT LEVELS	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Control	17.575^a	20.125^a	21.475^a	22.675^{ab}	22.850^{ab}
12 hours	17.700^a	21.150^a	23.325^a	25.000^a	23.750^a
24 hours	18.425^a	23.075^a	23.975^a	25.675^a	25.675^a
36 hours	5.950^b	7.750^b	9.900^b	12.475^b	12.175^b
48 hours	0.000^b	0.000^c	0.000^c	0.000^c	0.000^c

Means in the same column, having the same letter(s), superscript are not significantly different at $P<0.05$

Table 3: Effect hydropriming on the number of leaves per plant of Bambara groundnut

TREATMENT LEVELS	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Control	40.00[a]	32.52[ab]	47.70[b]	52.90[c]	53.40[c]
12 hours	32.97[b]	33.97[a]	43.64[c]	60.13[b]	60.84[b]
24 hours	31.18[bc]	32.25[ab]	60.39[a]	78.82[a]	81.76[a]
36 hours	14.63[c]	18.75[b]	21.50[d]	27.00[d]	28.13[d]
48 hours	0.00[d]	0.00[c]	0.00[e]	0.00[e]	0.00[e]

Means in the same column, having the same letter(s) superscript are not significantly different at P<0.05

Table 4: Effect of hydro-priming on the leaf area of Bambara Groundnut

TREATMENT LEVELS	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Control	7.650[b]	45.577[a]	64.780[a]	119.710[a]	99.340[ab]
12 hours	8.150[b]	58.538[a]	72.720[a]	104.970[a]	81.780[ab]
24 hours	15.750[a]	64.208[a]	73.450[a]	126.010[a]	130.910[a]
36 hours	2.225[c]	14.862[b]	17.980[b]	54.410[b]	58.890[b]
48 hours	0.000[c]	0.000[b]	0.000[b]	0.000[c]	0.000[c]

Means in the same column, having the same letter(s) superscript are not significantly different at P<0.05

Table 5: Effect of hydropriming on the leaf area index of Bambara Groundnut

TREATMENT LEVELS	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Control	0.017[bc]	0.136[a]	0.177[a]	0.117[a]	0.126[a]
12 hours	0.036[b]	0.148[a]	0.105[a]	0.137[a]	0.118[a]
24 hours	0.065[a]	0.141[a]	0.109[a]	0.117[a]	0.095[a]
36 hours	0.017[bc]	0.058[b]	0.034[b]	0.056[b]	0.058[ab]
48 hours	0.000[c]	0.000[b]	0.000[b]	0.000[b]	0.000[b]

Means in the same column, having the same letter(s) superscript are not significantly different at P<0.05.

Table 6: Effect of hydropriming on the net assimilation rate of Bambara Groundnut

TREATMENT LEVELS	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Control	0.0035[a]	0.0037[a]	0.0025[a]	0.0028[ab]	0.0047[a]
12 hours	0.0038[a]	0.0024[a]	0.0030[a]	0.0034[a]	0.0088[a]
24 hours	0.0032[a]	0.0023[a]	0.0031[a]	0.0038[a]	0.0026[a]
36 hours	0.0001[b]	0.0007[b]	0.0004[b]	0.0015[ab]	0.0019[a]
48 hours	0.0000[b]	0.0000[b]	0.0000[b]	0.0000[b]	0.0000[a]

Means in the same column, having the same letter(s) superscript are not significantly different at P<0.05.

Discussion

Results revealed that the effect of hydropriming on percentage emergence of bambara groundnut was significant. The short periods of priming resulted in early seedling emergence compared to the control seeds. This was found in 12 hours and 24 hours primed seeds, although 24 hours was the highest. 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. Also, Rajpar *et al*. (2006) reported that compared to the control, seeds took significantly fewer days to emerge and reach maturity.

There was poor germination in 36 hours primed seeds but 48 hours primed seeds inhibited germination. This inhibition could be as a result of longer period of priming that led to excess water in the seeds. The inhibition could be caused by greater reduction in the O_2 availability to the embryo since the diffusion of O_2 in to water becomes more difficult as temperature is increased. This was reported by Perry and Harrison (1974) for cultivars of *Beta vulgaris* that excess water was inhibitory to seed germination. The reduction in O_2 availability could lead to an inhibition of ethylene synthesis (Beyer *et al.,* 1985), and consequently seed germination. Also, Chiu *et al.* (1995), reported that in many coated seeds, germination and subsequent seedling growth can be inhibited by mechanical restriction exerted by the seed coat. The present study is in contrast to Mabika (1991) who reported seedling emergence in 48 hours primed seeds but 24 hours primed seeds is in conformity with Mabika (1991), who also reported that the primed duration affected days to seedling emergence and final percentage seedling establishment. However, the early emergence of the primed seeds may be as a result of advancement in seed metabolic activities. This was reported by Raipar and Wright (2000) that the early emergence of seed priming treatment may be as a result of advancement in seed metabolic activities. This primed duration is advantageous over farmers practice (unprimed seeds) compared to other primed durations.

However, hydro priming had a positive effect on the plant height. As the growth advanced from 2WAP - 6WAP, plant height gradually increased in 12 hours and 24 hours primed seeds compared to the control even though they were

statistically at par but 36 hours primed seeds had the lowest plant height and maintained significant different till maturity. This in conformity with findings of Al-soquer (2004) that Plant height of maize was increased by priming.

This vegetative growth declined progressively in 12hours priming duration but became constant in growth in the 24 hours primed seeds compared to the control at later stage. This showed that the effect of hydro priming is only beneficial at germination and early vegetative stage of the crop. This is in agreement with Basu *et al.* (2005) who reported that effects of hydro priming persisted only till early vegetative growth of maize.

Similarly, the effect of hydro priming on the number of leaves per plant was significant. The number of leaves increased gradually at the early stage. As the crop near to maturity more leaves were produced although 24 hours primed seeds had the highest compared to the control. This is in line with Chivasa *et al.* (2000), who reported that hydroprimed seeds of sorghum had significantly more plants and produced more number of leaves.

On the other hand, hydro priming was highly effective on the leaf area at vegetative growth and decreased in 12 hours primed seeds as the crop reached to maturity stage. This poor performance at maturity could signify the onset of senescence. Also Harris *et al.* (2002) reported that hydro priming persisted only till early vegetative growth of maize and failed to improve the leaf area. During maturity, the growth rate decreased, however, the 24 hours primed seeds had the highest leaf area which will result in high photosynthetic activities leading to high yield. Ahmad and Shad, (2010) suggested that priming of seed prior to sowing has key role in improving crop growth during seedling emergence and consequently affects crop leaf area.

The leaf area index increased across the primed seeds at early seedling growth of the crops but declined in 12hours and 24 hours primed seeds at maturity compared to the control even though they were statistically at par from 4 WAP – 10WAP. This increased slowly in 36hours primed seeds which was significant from the primed seed in control. The growth pattern could also be the onset of senescence. According to Salisbury and Ross, (1985), they reported that leaf area index of Bambara groundnut declined at maturity stage as a result of the onset of senescence.

The effect of hydro priming on the net assimilation rate of Bambara groundnut was not significant among 12hours and 24hours primed seeds compared to the control seeds except 36 hours primed seeds from 2WAP – 6WAP. At 4WAP, 12hours and 24hours primed seeds declined in values. As the crops near to maturity, the primed seeds increased but later declined in 24hours primed seeds compared to the control although they were not significant. This could be that hydro priming was not highly effective on Net assimilation rate.

In conclusion, seed priming with water (hydro priming) at 24hours duration period increased the percentage emergence ,plant height, number of leaves and leaf area leading to ability of Bambara groundnut to grow successfully in the field. Therefore, hydro-priming is a simple, low cost and environmentally friendly technique for improving Bambara groundnut seedling growth.

References

Ahmad .k and Shad, K.K (2010). Effect of leaf area on dry matter production in aerated mungbean seed. *Int. j. plant physio. and biochem*.vol2(4).pp 52-61.

Al-Soqueer, A.A. (2004). The potential of seed soaking in sorghum (*Sorghum bicolor* (L) Monech) production Ph.D Thesis, University of Nottingham, U.K. unpublished.

Arif, M., M.T. Jan, K.B. Marwat and M.A Khan (2008). Seed priming improves emergence and yield of soybean. *Pak J. Botany 40 (3):* 1169-1177.

Ashraf, M., and M.R. Foolad (2005). Pre-sowing seed treatment a shotgun approach to improve germination plant growth, and crop yield under saline and non-saline conditions. *Adv. Agron. 88:223*-271.

Ashraf, M., and M.R. Foolad (2005). Pre-sowing seed treatment a shotgun approach to improve germination plant growth, and crop yield under saline and non-saline conditions. *Adv. Agron. 88:223*-271.

Aziza, A., A. Haben, and M. Becker, (2004). Seed Priming enhances germination and seedling growth of barley under condition of P and Zn deficiency. *J. Plant Nutri. Soil Sci. 167, 630-636.*

Basu, S., Sharma, S.P. and Daldani, M., (2005). Effect of hydropriming on field mergence, crop performance and seed yield of maize parental lines during winter and spring – summer season. *Seeds Res*., 33(1): 24-27.

Beyer Jr., E.M., Morgan, P.W. and Yang, S.F. (1985). Ethylene. In: Wilkins, M.ed. *Advanced Plant Physiology*. London, Pitman, P. 111-126.

Brocklehurst, P.A., Dearman, R.A.K., Drew (1987). Recent Developments in Osmotio treatment of vegetable seeds. *Acta Hort. 215:* 193-201.

Chiu, K.Y., C.S. Wang, J.M. Sung, (1995). Lipid peroxidation and peroxide – scavenging enzymes associated with accelerated aging and hydration of water melon seeds differing in ploidy. *Physiol. Plant.*, 94:441-446.

Chivasa, W., Harris, D., Chiduza, C., Mashingaidze, A.B. and Nyamudeza, P., (2000). Determination of Optimum on-farm seed priming time for maize *(Zea mays L.)* and sorghum (*Sorghum bicolor (L.) Moench)* for use to improve stand reestablishment in semi arid agriculture. *Tanzanian J. Agric. Sci.*, 3(2): 103-112.

Ghassemi-Golezani, K., P. Sheikhzacleh –Mosaddegh, and M. Valizadeh (2008). Effects of hydropriming duration and limited irrigation on field performance of chickpea. *Research Journal of Seed Science, 1 (1):*34-40.

Harris, D., Joshi, A.J., Khan, P.A. Gothkar, P. and Sodhi, P.S., (1999). On-farm seed priming in semi-arid agriculture: Development and evaluation in maize, rice and chickpea in India using participatory methods. *Exp. Agric.*, 35: 15-29.

Harris, P.A., Hollington, Rashid, A., D. and R.A. Khattak, (2002). On-farm seed priming: A key technology for improving the livelihoods of resource poor farmers on saline lands. In: Prospects *for saline Agriculture*, Ahmad, R. and K.A. Malik (Eds). Kluwer Acad Pub. The Netherlands, Pp. 423-431.

Mabika, V.C. (1991). Germination and emergence of Bambara groundnut (*Vigna subterranea* (L.) Verdc) in relation to temperature and sowing depths. M.Sc Thesis, University of Nottingham, UK. Unpublished.

Madukwe, D.K., Onuh, M.O. and Christo, I.E.C. (2011). Agronomic and physiological performance of Bambara groudnut (*Vigna subterranea* (L.) Verdc) in southeastern Nigeria. *World Journal of Agricultural Sciences* 7(2): 166-171.

Rajpar, I. and D. Wright, (2000). Effects of sowing methods on survival, ion update and yield of wheat *(Triticum aestuvum L.)* in-sodic soils. *J. Agric. Sci. Cambridge*, 134:269-278.

Rajpar, I., Y.M. Kanif and A.A Memon (2006). Effect of seed priming on growth and yield of wheat *(Triticum aestivum L.)* under non-saline conditions. *Int. J. Agric. Res., 1:* 259-264.

Salisbury, F. and Ross C.W. (1985). *Plant Physiology*. Wadsworth Publishing Co. California pg. 554.

Sesay, A. and A. Yarmah, (1996). Field studies of bambaragroundnut in Sierra Leone Proceedings of the *International Bambara groundnut Symposium*, July 23-25, University of Nottingham, U.K., Pp. 45-60.