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EFFECT OF SEED HYDROPRIMING ON DRY MATTER PRODUCTION AND YIELD OF BAMBARA GROUNDNUT (*VIgna subterranean* (L.) Verdc.) LANDRACE

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Abstract

Field experiment was conducted to study the effect of seed hydro- priming with different durations on dry matter production and yield of Bambara groundnut landrace during 2012 season. The experiment was design based on Randomized Complete Design with five treatment levels (12hours, 24hours, 36hours, 48 hours and control) replicated four times. Data were collected on Root dry weight, Shoot dry weight, Number of pods, Fresh seed weight, Seed dry weight and Yield. There was significant difference ($p<0.05$) in root dry weights and shoot dry weights of primed seeds over unprimed seeds (control). The highest root dry weights and shoot dry weights were recorded from 24hours duration period compared to the control, 12hours, 36hours and 48hours respectively. However, maximum number of pods (10.33), seed fresh weight (124.1g), seed dry weight (118.16g) were observed in 24hours duration treatment compared to other duration periods. Seed yields was equally highest (828.3kg/ha) in 24hours compared to minimums recorded in control (6.90g) and 36hours (4.19g) respectively. Therefore hydro priming of seed should be encouraged for peasant farmers to help alleviate the low yield encountered due to poor crop stand. However, 24hour duration could be recommended to the acceptable presoaking time for maximum production of Bambara groundnut in Imo state, south east rainforest zone of Nigeria

Keywords: Dry matter, Bambara groundnut, hydro priming and yield.

Introduction

Priming which is a pre-soaking hydration treatment with the objectives to allow water uptake and germination metabolism to proceed to a point just short of radical extension (Bradford,1986), has been used to enhance seed germination response and subsequently dry matter production (Ahmad and Shad, 2010). Priming, a technology that enhances early emergence and stand establishment would enable the crop capture more soil moisture, nutrients and solar radiation and thus increase dry matter production (Ahmad and Shad, 2010).

Priming of seed prior to sowing has a key role in improving the crop growth during seedling emergence and consequently affects crop leaf area , dry matter production and yield. Establishment of primed seed is more successful if rain fell, or if the soil dried out slowly after sowing. Consequently, both stand count and dry matter are directly proportional to the rate at which seedling emerge (Harris.1996).

Several investigations confirmed that seed priming has many benefits including early and rapid emergence, stand establishment, higher water use efficiency, deeper roots, increasing in root growth, uniformity in emergence, germination in wide range of temperature, break of seed dormancy, initiation of reproductive organs, better competition with weed, early flowering an maturity. Resistance to environmental stresses (such as drought and salinity and diseases (*Sclerotium rolfsii* L.); higher grain yield in wheat (*Triticum aestivum* L.) (Ghana and Schilinger, 2003), corn (*Zea mays* L.) (Subedi and Ma, 2005), canola (Brassica napus L.) (Farhoudi and Sharifzadeh, 2006), is reported from field and laboratory studies.

However, there are several reports indicating the beneficial effect of hydropriming on root dry weight of maize and sorghum (Srivastava *et al.*, 2006). The number of root axes per plant was not increased relative to the non-primed treatment until seeds had been primed for at least 14hours - 20hours.

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.

The objectives were to study the optimum hydro priming duration that will increase dry matter production and seed yield in Bambara groundnut landrace.

Materials and Methods

The study was carried out at the Teaching and Research Farm of Imo state university Owerri, Imo State, Nigeria (latitude 5^0 10'N and 6^o 0N, longitude 6^o 35'E and 7^o0'E) within the rainforest agricultural zone of Nigeria (temperature, 27^oC, relative humidity 75%, rainfall 2500mm and altitude, 57m) in 2102. The soil has sandy loam texture with low Nitrogen and some physical and chemical properties as shown in the table 1.

Table 1: Soil physical and chemical properties of experimental site

Soil Properties	
pH (H_2O)	4.84
Kcl	4.38
Sand (%)	80.80
Silt (%)	2.00
Clay (%)	17.20
Textural class	L.S.
Organic carbon (%)	1.11
Organic matter (%)	1.93
T.E.A. (meq/100gsoil)	0.60
Al^{3+} (meq/100gsoil)	0.40
H^+ (meq/100gsoil)	0.20
Total Nitrogen (%)	0.09
Ca^{2+} (meq/100gsoil)	1.80
Mg^{2+} (meq/100gsoil)	1.00
K^+ (meq/100gsoil)	0.09
Na^+ (meq/100gsoil)	0.14
CEC (meq/100gsoil)	3.63
Base Saturation (%)	83.4
Available Phosphorus (ppm)	5.04

The experimental design was on basis of Randomized Complete Block Design (RBCD) with five treatments and four replications. The seed of Bambara groundnut was primed using hydropriming time rate of 12hours, 24hours, 36hours, 48hours and untreated seed which served as control.

Growth Experiment

The experimental field was marked with pegs and ropes to determine the accurate plot size. The soil was ploughed and seed bed of 2mx2m were made at 1m apart using spade with soil depth of 50cm and plot size was 14m by 11m. Seeds were planted 3 seeds per hole on the plots with planting spacing of 45cm at planting depth of 3cm depth using a measuring dipper to minimize error due to the effect of sowing depth on seedling Emergence. Weeds were also hand weeded during the season. Data collected included root dry weight and shoot dry weight determined after drying at 80^oC for at least 8hours in an oven. The following measurement were carried out, 100-seed weight, number of seeds per pod and seed yield measured in kg/ha.

Statistical analysis

The data were statistically analysis using analysis (ANOVA) Procedure, means were separated using Duncan test at 0.05 level of probability.

Results

Root dry weight: priming duration significantly increased the root dry weight (table2). At 2, 4, 6, 8 and 10WAP, 24hours gave maximum root dry weights (0.138g, 0.349g, 0.321g, 0.556g and 0.720g respectively) which was significantly different ($p<0.05$) compared to the minimum root dry weights (0.028g, 0.036g, 0.035g, 0.085g and 0.106g respectively) recorded in 36hours priming duration. However at 4, 8 and 10 WAP control showed marginal increase in root dry weight which was significant only at 10WAP compared to 12 hours 48hours was found to have no germination therefore no growth was recorded.

Shoot dry weight: shoot dry weight was markedly affected by various priming duration (table 3). Higher amount of shoot dry weight (0.505g, 3.036g, 9.864g, 20.540g and 31.204g respectively) which was significantly different ($p<0.05$) compared to the 36hours treatment which recorded 0.111g, 0.494g, 0.894g, 3.471g and 4.339g respectively. However, the increase in shoot dry weight observed in 24hours was not significantly different ($p<0.05$) compared to the shoot dry weights recorded in control and 12hours treatment as shown in table 3.

Mean number of pods: the effect of hydropriming durations on number of pods was significant (table 4). The maximum number of pods per plant (10.33) was recorded in 24hours which was significantly difference ($p<0.05$) compared to the minimum (4.19) recorded in 36hours duration. 12hours was found to produce higher number of pods (8.72) than the control (6.90) although it was statistically not different.

Seed fresh weight: the seed fresh weight was significantly affected by priming duration (table 4). 24hours priming duration recorded maximum seed fresh weight (124.14g) which was significantly difference ($p<0.05$) compared to the

minimum (12.76g) recorded in 36hours. However, 12hours was found to give higher seed fresh weight than that recorded from control.

Seed dry weight: the seed dry weight was significantly affected by priming duration. The highest seed dry weight(118.16g) was recorded in 24hours priming duration which was statistically different from lowest (9.33g) recorded in 36hours duration.12hours gave seed dry weight of 95.19g which was not statistically different from 77.25g recorded from control.

Yield: seed yield is main target of crop production. The seed yield was significantly affected by hydro priming durations. The seed yield varied according to duration time.Maximium seed yield was produced by 24hours priming duration (828.3kg/ha) while minimum was produced by control (534.4kg/ha).the observed difference in various duration time was statistically not difference as shown in table 4.

Table 2: Effect of hydropriming on the root dry weight of Bambaragroundnut

TREATMENT LEVELS	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Control	0.126^{a}	0.237^{b}	0.282^{a}	0.547^{a}	0.627^{a}
12 hours	0.097^{a}	0.233^{b}	0.287^{a}	0.416^{a}	0.347^{b}
24 hours	0.138^{a}	0.349^{a}	0.321^{a}	0.556^{a}	0.720^{a}
36 hours	0.028^{b}	0.036^{c}	0.035^{b}	0.085^{b}	0.106^{c}
48 hours	0.000^{b}	0.000^{c}	0.000^{b}	0.000^{b}	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 of hydropriming on the shoot dry weight of Bambara groundnut

TREATMENT LEVELS	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Control	0.416^{a}	2.769^{a}	7.267^{b}	15.848^{a}	26.939^{ab}
12 hours	0.450^{a}	2.327^{a}	8.291^{ab}	17.247^{a}	16.838^{cb}
24 hours	0.505^{a}	3.036^{a}	9.864^{a}	20.540^{a}	31.204^{a}
36 hours	0.111^{b}	0.494^{b}	0.894^{c}	3.471^{b}	4.339^{cd}
48 hours	0.000^{b}	0.000^{b}	0.000^{c}	0.000^{b}	0.000^{d}

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

Table 4: Effect of hydropriming on the yield and yield components of Bambara groundnut

TREATMENT LEVELS	Number of pods/plant	Seed fresh weight	Seed dry weight	Yield (kg/ha)
Control	6.90^{bc}	82.29^{a}	77.25^{a}	534.4^{ab}
12 hours	8.72^{ab}	99.94^{a}	95.19^{a}	649.0^{ab}
24 hours	10.33^{a}	124.14^{a}	118.16^{a}	828.3^{a}
36 hours	4.19^{b}	12.76^{b}	9.33^{b}	806.1^{a}
48 hours	0.00^{c}	0.00^{b}	0.00^{b}	000.0^{b}

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

Discussion

The root dry weight of bambara groundnut was significantly influenced by hydro priming durations from vegetative to maturity stage and 24 hours primed seeds produced the highest root dry weights. This is in conformity with several reports indicating the beneficial effect of priming on root dry weight of maize and sorghum (Srivastava *et al.*, 1999, Sundarababu *et al.*, 2001, Aher 2003, Gupta *et al.*, 2006). However, root dry weight decreased in 12 hours primed seeds at maturity stage. This could be that the crop ceased growth at maturity due to completion of the life cycle. This is in line with Ezedinma (1995) who reported that plants or Bambara groundnut bambara groundnut mature and cease growth because of completion of life cycle. Similarly, hydro priming increased the shoot dry weight in 12 hours and 24 hours primed seeds, while at initial stage 36 hours primed seeds had the lowest compared to the control seeds. This increased progressively as the growth stage advanced but declined in 12 hours primed seeds at maturity relative to the control. However, 24 hours primed seeds performed better in all the studied traits measured. This showed that hydro priming was more effective on the 24 hours primed seeds both at vegetative and maturity stages. Al-soqueer (2004), reported that the shoot dry weight of maize were increased by priming (without drying). This is in contrary to Harris *et al.* (2002) who reported that the beneficial effect of hydropriming persisted only till early vegetative growth of maize and failed to improve the shoot dry weight.

The effect of hydropriming on the number of pods per plant was more beneficial on 24 hours primed seeds (10.33) compared to the control seeds (6.90), also seed fresh weight (124.14g) and seed dry weight (118.6) even though was not statistically difference ($p<0.05$) with the control seeds. While the minimum performance was found in 36 hours primed seeds with number of pods (4.19), seed fresh weight (12.76g), seed dry weight (9.33g) relative to the control but significantly different from it. The performance of the 24hours primed seeds is similar to the observation made by Bastia *et al.* (1999) who reported that the use of hydropriming treatment in safflower increased the number of heads per plant, the number of seeds per head, and seed weight.

Additionally, 24 hours primed seeds had the highest yield (828.3kg/ha). Due to the best performance of the primed duration in pod number, seed dry weight and also plant height, it affected the yield. This is in line with Seyed *et al.* (2012) who reported that pod number, plant height and grain dry weight of soybean are among the factors which could affect yield. Also, Ghassemi-Golezani *et al.* (2008) reported a higher chick pea seed yield in 16 hour hydro priming, also Hussain *et al.* (2006) reported higher seed yield in hydroprimed seeds of sunflower and wheat.

The higher dry matter during the letter stage from primed seed in 24hours indicate that most of the energy intake was used to develop seeds. The increase in dry matter accumulation of after the reproductive stage was the result of increase in dry matter of roots, shoots and pods. This in conformity with Surya et al.,(2004) who reported that the faster dry matter accumulation after reproductive stage was result of the increase in dry matter of stem and pods, whose continuous gain occurred as a result of plant height, number of tillers and internodes.

Conclusion

The performance of Bambara groundnut plant was significantly influenced by hydropriming using tap water which can be an alternative way for the farmers to improve seed germination, seedling emergence and vigour, growth and yield of the crop. However, according to the result in this research, 24hours primed seeds showed greater influenced on dry matter production, yield and yield components of the crop than other primed durations and control. Therefore, it is recommended that 24 hours seed hydropriming should be adopted by farmers to improve seed germination so as to generate high income from the crop.

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