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GERMINATION RESPONSE OF SERIALLY HARVESTED 'GBOMA' (*SOLANUM MACROCARPON* L.) SEED TO HYDRO-, OSMO- AND HALO-PRIMING

Adewumi, O. A., *Ibrahim, H., Adediran, O. A. and Oladiran, J. A.

Department of Crop Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Nigeria

**harunamokwa@futminna.edu.ng : 08036970843*

ABSTRACT

Seeds extracted from 'Gboma' fruits harvested at 42 to 66 day after anthesis (DAA) were primed in distilled water, polyethelene glycol (PEG 6000) at -0.1 MPa, -0.2 MPa and -0.3 MPa and NaCl at 50 mM and 100 mM for 24 and 48 hours; unprimed seeds served as the control. PEG and NaCl-primed seeds were subsequently thoroughly washed with water and then air-dried for 24 hours. Samples of seeds of all the treatments were incubated at 30 °C over a period of 16 days to determine germination percentage (GP), germination rate index (GRI) and germination index (GI). Across priming treatments, significantly higher (p=0.05%) GP (18-19%), GRI (ca 1%day^{-1}) and GI (56-75) were recorded in seeds harvested at 58 to 66 DAA than those from earlier harvests. Hydropriming resulted in significantly higher (p=0.05) GP, GRI and GI than in the control and other priming treatments. Response to hydropriming was more pronounced in seeds harvested at 54 to 66 DAA. Response to osmo- and halopriming was poor as only a maximum of about 26% and 28% germination were recorded in the former and the latter respectively compared to 66% and 61% in 24 h and 48 h hydropriming respectively. The poor response of seeds to osmo and halopriming may not be unconnected with inappropriate duration of treatment or and inappropriate concentrations. The significantly poorer germination of unprimed seeds compared to hydroprimed lots at 58 to 66 DAA confirms the presence of dormancy.

Key Word: Germination, Polythelene, Index, Treatment

INTRODUCTION

Gboma' eggplant (*Solanum macrocarpon* L.) also known as 'Igbagba' or 'Igbo' is one of the 1000 species of the genus *Solanum* reported to be grown worldwide and has been recorded in many West African countries with the young leaves and fruits being consumed as a vegetable (Bukenya-Ziraba and Bonsu, 2004). Most farmers normally harvest the leaves of this crop by cutting periodically at some height below the meristematic tip and finally leaving the remnant to fruit for subsequent seed extraction. Ojo *et al.* (2011) recommended that fruits be harvested for seed from a crop that has been subjected to once-in-four weeks shoot cutting to obtain greater profit in an integrated harvesting technique for shoot and seed production. The stage at which seeds are harvested has been reported to affect their quality. The result from a study by Oladiran (1989) showed that "Igbagba" seeds were of greater quality when extracted from brown fruits than from yellowish-green and yellow fruits. Recent study by Mustapha *et al.* (2017) has confirmed this in two different varieties of 'Gboma'. Several studies on other species have shown variations in the quality of serially harvested seeds (Singkaew *et al.*, 2017; Demir and Samit, 2001; Demir *et al.*, 2008; Dias *et al.*, 2006; Ramirez-Rosales *et al.*, 2002; Shamsheer *et al.*, 2008; Chen *et al.*, 2009). One of the problems normally encountered in 'Gboma' is that of seed dormancy. Oyelana (2011) recorded 5% and 75% germination in non-scarified and mechanically scarified seeds respectively. Adediran *et al.* (2015) also reported 1 to 10% seed germination within the first two weeks of storage with significant increases as seed aged. These results affirm the presence of dormancy in 'Gboma'/'Igbagba' seeds. Dormancy normally results in poor seed germination, poor seedling emergence and non-uniformity in plant growth.

One cost-effective and simple technology that has been developed to enhance seed germination in several crops, though with varying degree of successes depending on species, priming agent and its concentration, priming duration, temperature and others, is priming. Common examples are hydropriming, osmopriming and halopriming (Nascimento, 2003; Farooq *et al.*, 2006; Nawaz *et al.*, 2011; Dastanpoor *et. al.*, 2013; Manonmani *et al.*, 2014; Sori, 2014). Hydropriming is described as a very simple, economical and environmental friendly technique (Farooq *et al.*, 2006) in which seeds are soaked in water to accomplish hydration and then dried back before sowing (Soon *et al.*, 2000).

Osmopriming involves the soaking of seeds in osmotic solutions such as polyethylene glycol (Ghassemi-Golezani, *et. al.*, 2008). Information is lacking on the expected variation in the quality of serially harvested seeds of 'Gboma' or eggplant or 'Igbagba' to better guide growers of the crop in ensuring the production of high quality seeds as well as the use of priming for enhanced quality, hence the need for this study.

MATERIALS AND METHOD

Seeds were extracted from fruit harvested at 42, 46, 50, 54, 58, 62 and 66 days after anthesis (DAA), washed with clean water, air-dried for 7 days, packaged in plastic bottles and kept at ambient condition. Priming was done using distilled water (hydropriming), -0.1 MPa, -0.2 MPa and -0.3 MPa PEG 6000 (osmopriming) and 50 mM and 100 mM NaCl (halopriming) for 24 and 48 hours. PEG and NaCl-treated seeds were subsequently thoroughly washed with water and then air-dried for 24 hours before they were tested for germination alongside an unprimed sample (control). Germination was tested by placing four replicates of 50 seeds each on distilled water-moistened filter paper in Petri dishes at 30 °C for 16 days and counts were taken every-other-day. The number of normal seedlings was expressed as a percentage of the total number of seeds sownto determine germination percentage. Germination rate index (GRI), an estimation of the percentage of seed germination per day and germination index (GI) were also determined using the expressions under:

GRI (% day^{-1}) = $\sum$ (Ni/i); (Esechie, 1994)

Where N is the number of seeds germinated on day i.

The higher the GRI value, the higher and faster the germination (Kader, 2005).

GI was calculated using a modification of the formula developed by (Bench Arnold, 1991):

GI = (16 x n1) + (14 x n2) + ……+ (2 x n16)

Where n1, n2……., n16 are the number of seeds that germinated on the first, second and subsequent days until the 16th day, respectively; 16, 14,……., and 2 are the weight given to the number of seeds that germinated on the first, second and subsequent days respectively.

GI is assessed by Kader (2005) to be a comprehensive measuring parameter since it combines both germination percentage and speed (spread, duration and high and low events).

RESULTS

Table 1 reveals that seed germination percentage was generally low across priming methods, but was however significantly higher ($p<0.05$) in those harvested at 58 to 66 DAA (which germinated equally: 18-19%) than those from younger fruits (<1%-15%). GRI values were also highest at 58 to 66 DAA (1.30, 1.40 and 1.02% day^{-1} respectively) but not significantly different from that of 54 DAA (0.84 day^{-1}). GI was significantly higher ($p=0.05$) at 66 DAA (75.36% day^{-1}) compared to other ages except the 69% day^{-1} recorded at 58 DAA. Furthermore, hydropriming for 24 and 48 h resulted in general significant enhancement of GP, GRI and GI. Table 2 shows that germination percentage of unprimed seeds increased significantly from 0% at 42 and 46 DAA to about 18% at 58 DAA followed by an insignificant increase to 23% at 66 DAA. GP did not differ significantly ($p>0.05$) among the different priming treatments within both 42 and 46 DAA. At 50 DAA the GP of 20% day^{-1} recorded for 48 h hydropriming was similar to the 17% for hydropriming at 24 h, 5.5% for PEG at 48 h and 4.5% for NaCl at 48 h but significantly higher than those of other treatments. At 54 to 66 DAA GP values were significantly higher in both 24 and 48 h hydropriming regimes than in the other priming treatments. Generally both osmo and halopriming were not superior to the unprimed treatment at these fruit ages. There were generally no significant ($p>0.05$) differences in the GRI values (0-3.12% day^{-1}) of seeds from fruits at 42 to 54 DAA without or with osmo and halopriming (Table 3). Contrary to this trend, hydropriming of seeds from fruits harvested at 58, 62 and 66 DAA resulted in significantly higher ($p<0.05$) GRI (*ca* 3.8-6.0% day^{-1}) than in those from younger fruits. Table 4 reveals that priming did not significantly ($p>0.05$) affect the GI values of seed harvested at 42 and 46 DAA but did so at 50 to 66 DAA. The highest value of 107 obtained for 48 h hydropriming was not significantly different from the 13.0, 23.0, 22.0, 22.0 and 69.5 recorded for PEG -0.1MPa, 24h; PEG -0.2MPa, 24h; PEG -0.3MPa, 24h; NaCl 50 mM, 48 h and 24h hydropriming respectively. At 54 to 66 DAA the GI values

recorded for hydropriming at both 24 and 48h were significantly higher ($p<0.05$) than those of the other priming treatments except for the similarity between that of 24 h hydropriming and NaCl at 50 mM. Both PEG and NaCl did not result in enhanced GI when compared with the unprimed treatment.

Table 1: Effects of fruit age and priming methods on germination percentage(GP), germination rate(GR), germination rate index(GRI) and germination index(GI) of *Solanummacrocarpon*seeds.

Treatments	Parameters			
DAF(d)	GP(%)	GR(days)	GRI(%/days)	GI
42	0.54e	0.48d	0.28bc	0.62f
46	4.45d	3.70c	0.17c	10.58ef
50	8.79c	5.70bc	0.29bc	22.88de
54	14.91d	6.82ab	0.84ab	40.92cd
58	19.40a	6.82ab	1.30a	69.00ab
62	18.07ab	6.94ab	1.40a	55.81bc
66	18.39ab	7.95a	1.02a	75.36a
SE±	0.85	0.52	0.14	4.39
Priming methods (P)				
UP	11.84bc	4.53b-d	0.645b	38.07b
PEG 0.1 24	10.18b-d	7.45ab	0.78b	18.57bc
PEG0.1 48	5.71de	5.15a-d	0.12b	7.71c
PEG 0.2 24	8.88b-d	3.45de	0.46b	23.50bc
PEG 0.2 48	5.96de	5.72a-d	0.16b	9.00c
PEG 0.3 24	11.83bc	6.28a-d	0.51b	25.86bc
PEG 0.3 48	5.84de	4.04c-e	0.30b	9.14c
NaCl 50 24	14.28b	6.84a-c	0.65b	40.14b
NaCl 50 48	7.75cd	5.02a-d	0.27b	13.95bc
Nacl 100 24	8.24cd	6.38a-d	0.28b	18.14bc
NaCl 100 48	1.67e	1.18e	0.04b	2.14bc
Hydro 24	31.55a	7.23a-c	2.63a	147.14a
Hydro 48	33.28a	8.06a	2.47a	157.64a
SE±	1.17	0.7	0.19	5.98
Interaction				
D x P	S	S	S	S

S = Significant difference at $p<0.05$ Turkey test.

Means having the same letter for a factor within a column are not significantly different at $p>0.05$.

Table 2: Interaction of fruit age and priming methods on germination percentage of *Solanum macrocarpon* seeds.

Priming methods	Days after anthesis						
	42	46	50	54	58	62	66
Control	0.00l	0.00l	1.00j-l	1.00j-l	17.50d-g	15.1d-j	23.00b-e
PEG 0.1 24	0.50kl	2.50g-l	2.50f-l	3.00f-l	9.00d-l	8.00d-l	5.00d-l
PEG0.1 48	0.50kl	0.00l	0.50kl	1.50i-l	4.00d-l	2.50f-l	3.50e-l
PEG 0.2 24	0.00l	0.00l	3.50g-l	10.00d-l	25.50b-d	1.00j-l	2.00g-l
PEG 0.2 48	0.00l	1.50j-l	1.50i-l	4.50d-l	1.00j-l	2.00g-l	2.50f-l
PEG 0.3 24	1.00jkl	1.00j-l	5.50e-l	14.50d-k	5.50d-l	9.00d-l	7.00d-l
PEG 0.3 48	0.00l	0.00l	1.50j-l	2.00h-l	6.00d-l	6.00e-l	2.00g-l

NaCl 50 24	0.00l	1.00j-l	2.00g-l	14.00d-k	10.50d-l	27.50b-e	17.00d-i
NaCl 50 48	0.00l	1.00i-l	4.50e-l	9.00d-l	2.00g-l	1.00j-l	8.00d-l
Nacl 100 24	0.00l	1.50j-l	1.50j-l	5.50d-l	7.00d-l	2.00g-l	8.00d-l
NaCl 100 48	0.00l	0.00l	1.50j-l	2.00j-l	0.00l	1.00j-l	0.00l
Hydro 24	0.00l	7.00d-l	17.00d-h	24.50b-e	58.00a	65.50a	57.50a
Hydro 48	0.00l	10.00d-l	20.00c-f	47.00a-c	56.50a	61.00a	54.50ab
SE±				3.09			

Means having the same letter in a column are not significantly different at p>0.05 according to Tukey test.

Table 3: Interaction of fruit age and priming methods on germination rate index of *Solanum macrocarpon* seeds.

Priming methods	Days after flowering						
	42	46	50	54	58	62	66
Control	0.00f	0.00f	0.08f	0.05f	1.85b-f	0.79d-f	1.74b-f
PEG 0.1 24hr	3.50a-d	0.16f	0.12f	0.20ef	0.65d-f	0.47ef	0.37ef
PEG0.1 48hr	0.06f	0.00f	0.02f	0.07f	0.31ef	0.16f	0.22ef
PEG 0.2 24hr	0.00f	0.00f	0.16f	0.83d-f	2.01b-f	0.09f	0.17ef
PEG 0.2 48hr	0.00f	0.05f	0.09f	0.71d-f	0.06f	0.10f	0.13f
PEG 0.3 24hr	0.07f	0.59d-f	0.42ef	1.02c-f	0.47ef	0.54ef	0.49ef
PEG 0.3 48hr	0.00f	0.00f	0.17ef	0.70c-f	0.42ef	0.68d-f	0.12f
NaCl 50 24hr	0.00f	0.05f	0.10f	1.16c-f	0.78d-f	1.62b-f	0.86c-f
NaCl 50 48hr	0.00f	0.09f	0.31ef	0.70d-f	0.15f	0.11f	0.56d-f
Nacl 100 24h	0.00f	0.08f	0.15f	0.59d-f	0.63d-f	0.12f	0.42ef
NaCl 100 48h	0.00f	0.00f	0.08f	0.17ef	0.00f	0.07f	0.00f
Hydro 24hr	0.00f	0.47ef	1.19f	1.66b-f	5.26a	5.55a	4.33ab
Hydro 48hr	0.00f	0.65d-f	0.87c-f	3.12a-e	4.33ab	4.55ab	3.79a-c
SE±				0.49			

Means having the same letter in a column are not significantly different at p>0.05 according to Tukey test.

Table 4: Interaction of fruit age and priming methods on germination index of *Solanum macrocarpon* seeds.

Priming methods	Days after flowering						
	42	46	50	54	58	62	66
Contro	0.00j	0.00j	5.00j	5.00j	75.00e-j	52.50e-j	129.00de
PEG 0.1 24hr	3.50j	11.50h-j	13.00g-j	12.50g-j	36.50e-j	35.00e-j	18.00f-j
PEG0.1 48hr	1.00j	0.00j	3.50j	8.50ij	18.00f-j	12.00gh-j	11.00h-j
PEG 0.2 24hr	0.00j	0.00j	23.00f-j	31.00f-j	101.50d-i	3.00j	6.00j
PEG 0.2 48hr	0.00j	3.50j	8.50ij	26.50f-j	5.50j	9.00ij	10.00ij
PEG 0.3 24hr	3.50j	5.00j	22.00f-j	51.50e-j	20.50f-j	49.00e-j	29.50f-j
PEG 0.3 48hr	0.00j	0.00j	4.50j	6.00j	22.50f-j	21.50f-j	9.50ij
NaCl 50 24hr	0.00j	5.50j	11.00h-j	27.50f-j	38.50e-j	109.50d-f	89.00e-j
NaCl 50 48hr	0.00j	7.00ij	22.00f-j	29.00f-j	7.00ij	2.50j	30.15f-j

Nacl 100 24h	0.00j	8.50ij	3.50j	31.50f-j	29.50f-j	10.00ij	44.00e-j
NaCl 100 48h	0.00j	0.00j	5.00j	6.00j	0.00j	4.00j	0.00j
Hydro 24hr	0.00j	42e-j	69.5e-j	106.00d-h	288.00ab	186.00cd	338.50a
Hydro 48hr	0.00j	54.5e-j	107d-g	191.00cd	254.50a-c	231.50bc	265.00a-c
SE±				15.8			

Means having the same letter in a column are not significantly different at $p>0.05$ according to Tukey test.

DISCUSSION

The poor seed germination percentage (GP) up to only a maximum of 23% at 66 DAA in unprimed treatment compared to the range of about 55-58% in hydroprimed of same DAA is an indication of dormancy. Oyelana (2011) also recorded a germination of 5% in non-scarified seed of this crop compared to 75% in the scarified. The increases in GP, germination rate index (GRI) and germination index (GI) with increase in maturity (though only more glaring under hydropriming), is tied to greater deposit of assimilate as seed matured (Chen *et al.*, 2009). Demir and Balkaya (2005) enumerated changes in various morphological (seed size and colour), physiological (dry weight, moisture content and germination), chemical (oil, protein and carbohydrate) and functional (vigour and viability) aspects in developing kale seed and recommended 65 days after harvest as being best for assurance of greatest vigour. The significant enhancement of seed quality by hydropriming in the current study is in agreement with what has been reported for sage (Dastapoor *et al.*, 2013), rice (Farooq *et al.*, 2006), wheat (Basra *et al.*, 2002) and maize (Afzal *et al.*, 2002). As may have been the case in this study Farooq *et al.* (2006) opined that higher germination in hydroprimed seeds might be the consequence of breakdown of dormancy because of the fresh seeds used. Soon *et al.* (2000) attributed sychronised germination in hydroprimed gourd seeds to increased metabolic activities. The ineffectiveness of PEG and NaCl in seed vigour enhancement in this study has been reported in other studies. Nascimento (2003) also reported reduced germination percentage of muskmelon seeds primed in salt solution at high osmotic potential. Nawaz *et al.* (2011) recorded the failure of 25 and 50 mM to improve vigour of tomato seeds and posited that this might be due to Na^+ and or Cl^- toxicity. That PEG might be toxic to seed has been reported by Grzesik and Nowek (1998) and may also be due to decreased oxygen solubility during priming as has reported to be the case in cotton seeds (Toselli and Casenave, 2003). It is concluded from this study that 'Gboma' or 'Igbagba' seed attained maximum quality at 58 DAA. Though 100% germination was not recorded in this study, the dormancy exhibited by seeds harvested at this stage was significantly alleviated by 24 and 48h hydropriming. The use of PEG 6000 at -0.1 to -0.3 MPa and NaCl at 50 and 100 mM did not increase seed germination, germination rate index and germination index.

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