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The impact of re-drying of onion primed seeds on seedling emergence

By

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Abstract: The effect of re-drying of onion seeds after soaking in priming media on seeds germination and seedling emergence was observed in a pot experiment at the Teaching and Research farm of the Ekiti State University, Ado Ekiti, Nigeria. Viable red creole onion seeds were soaked in ascorbic acid, moringa leaf extract (MLE), sodium chloride (NaCl) at two concentrations (12.5 and 25 %) and water for 6 and 12 hours. The soaked onion seeds were removed, washed and re-dried for 0, 24 and 48 hours. Re-dried and non-dried onion seeds were down in pots laid out in a completely randomized design in three replicates. Data were collected on the final emergence percentage (FEP), mean emergence time (MET), emergence index (EI) and time to 50 % emergence (E50) and subjected to analysis of variance. The results showed that priming media, concentrations and soaking durations were significantly different from the control (non-primed seeds) ($p < 0.05$) but not significant in MET, EI and E50. Onion seeds soaked in an ascorbic acid solution without re-drying gave the highest FEP (74.25 %). Re-dried seeds resulted in lower FEP except in NaCl but were not significantly different. In hydro priming, the longer the drying period the lower the FEP and EI, and the higher the MET and E50. Primed onion seeds were to be sow immediately as re-drying reduces the germination potentials of seeds.

Keywords: Primed onion seeds, priming methods, seedling emergence.

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INTRODUCTION

Seed priming is a pre-germination technique that had been used to improve the rate of germination, field emergence, uniform seedlings, seedling vigour and overall increase in yield (Harris *et al*., 2001, Nounman, *et al.* 2010) even in stress condition (Basra et al., 2003). This process stimulates the physiological process of seeds to initial germination but not sufficient to permit radical protrusion (Moradi and Younesi, 2009; Nawaz et al., 2013; Paparella et al., 2015). Priming techniques in onion species have been positive (Jagosz, 2015). Primed seeds are usually re-dried after priming to initial seed moisture content to maintain the seed quality caused by seed deterioration (Ratikanta, 2011; Huang, 2012). But Huang (2012) reported that the physiological gain through seed priming was not lost after re-drying.). Caseiro *et al.* (2004) stated that seed moisture content before and after priming is an important factor to be considered to select the best priming procedure in onion seed priming. This is a result of the effect of seed moisture content on onion seed germination. Seed moisture content is one of the major important factor that determine germination and emergence in seeds (Ellis, 1991; Chachalis and Reddy (2000); Alhamdan *et al.* 2011) with seeds quality depending largely on seed moisture content, storage temperature, length of storage, relative humidity and type of seed (Yin *et al.*, 2000; Hung *et al.*, 2001; Amjad *et al.*, 2002). Seeds lost their viability faster at constant temperature with increasing moisture content (Mcdonald, 1999). It was observed in onion (Stumof *et al.* (1997) that as the moisture content and storage period increases, the viability equation becomes less accurate. Onion seeds are short-lived as they usually lose viability and vigour faster than most crops (Ellis, 1996; Yanping, 2000). Therefore, cold storage was implored as the best storage method for onion seeds (Demir *et al*. 2016). Onion is the third most important vegetable in the world after tomato and cabbage (FAOSTAT, 2010) because of its social, economic and health benefits. Re-drying is necessary to allow for seed storage after priming (Di Girolamo and Barbanti, 2012) but rapid re-drying have been reported to cause mechanical damage to seeds (Armstrong and McDonald, 1992; Parera and Cantliffe, 1992). With the use of hydro and osmo-priming, Dorna *et* al. (2013) observed that after re-drying of primed onion seeds, onion seeds can be stored for 6 months regardless of the temperature. But the benefits of priming seeds can be lost in prolonged storage especially on seed vigour which cannot be ensured after drying and storage (Dorna *et* al., 2013). Although Brocklehurst and Dearman. (1983) observed that onion seeds can still retain most of the priming benefits after re-drying, this study is designed to observe the effect of re-drying durations of onion seeds after priming by considering varying priming techniques in varying concentrations and soaking durations.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Teaching and Research Farm of Ekiti State University, Ado Ekiti, Nigeriaj lie between latitude 5˚45ʹ N and longitude 8˚15ʹ E which experiences two seasons of wet (March - October with a mid-break in August) and dry (November – February) per year.

Collection of seeds and soil sample

Viable red creole onion seeds variety of onion was collected from National Horticultural Research Institute (NHRI), Bagauda, Kano, Kano State, Nigeria. Soil samples were collected from the field in the Teaching and Research Farm, air-dried and sieved (2mm sieves) and 2 kg each of the sieved soil was spread evenly on a flat perforated plastic pot (1004.3cm^2). Water was added to each of the pots to moisturize the soil.

Media preparations

Moringa leaf extract (phyto-priming) was prepared with fresh leaves of *Moringa oleifera* blend in distilled water and made into two concentrations of 12.5 and 25 %. Two concentrations (12.5 and 25 %) of ascorbic acid (hormonal priming) and sodium chloride (NaCl) (halo-priming) were also prepared and distilled water was used as a hydo-priming agent.

Experimental Design.

Red creole onion seeds variety were soaked into each of these media concentrations for 6 and 12 hours simultaneously. The seeds were then removed from the media, washed with distilled water and air re-dried at room temperature for zero (sowing immediately after washing), 24- and 48-hour drying time (DT). The seeds were then uniformly spread (sowed) on the prepared flat plastic pots at a depth of 2.00cm and water was added intermittently to keep the soil moist. The experiment was laid out in a completely randomized design (CRD) in three replicates.

Data collection and analysis

The number of seeds germinated was counted from the first day of emergence to the 15 DAS. The final emergence percentage (FEP), mean emergence time (MET) and emergence index (EI) were calculated based on Wu *et* al. (2017) while the time for 50 % seed emergence (E_{50}) was calculated using the formula developed by Farooq *et al.* (2005).

(a) FEP (%) = $(n_{15}/N) \times 100$

Where n_{15} is the cumulative emergence after 15 days of sowing and N is the total seeds sowed.

(b) $\mathrm{MET} = \sum \frac{\mathrm{nt}}{\mathrm{N}}$

Where n is the number of germinated seeds in t days.

(c) $\mathrm{EI} = \sum \left(\frac{Et}{Dt}\right)$

Where Et is the number of emergence seeds in t days; Dt is the number of corresponding germination days.

(d) $E_{50} = tj + \frac{(\frac{N}{2} - ni)(tj - ti)}{nj - ni}$

Where N is the final number of seeds germinated, and ni and nj are the cumulative numbers of seeds germinated at adjacent counts at times ti and tj when ni < N/2 < nj.

The data collected were subjected to generalize linear model of SAS (1995) for ANOVA and treatment means were separated using Duncan's multiple range test at 0.05 level of probability.

RESULTS

The effect of re-drying of onion seeds after soaking is shown in Table 1. Onion seeds soaked for six (6) hours then washed and sow without drying gave the highest FEP (70.43 %) followed by those soaked for 12 hours without drying (70.08 %) but were not significantly different (P≤0.05) from those onion seeds that were re-dried after soaking. All the onion seeds soaked irrespective of the duration of re-drying are significantly different (P≤0.05) to the control (non-primed onion seeds). The MET, EI and E_{50} are not significantly different from the control

Table 1: Effect of drying on soaking durations

Soaking Time (Hours)	**Drying Time (Hours)**	**FEP (%)**	**MET**	**EI**	**E_{50}**
6	0	70.43a	7.00	5.84	8.90
	24	69.14a	6.71	5.47	9.13
	48	69.64a	7.00	5.10	9.47
12	0	70.08a	6.57	5.24	9.13
	24	69.14a	6.86	5.11	9.51
	48	69.29a	7.00	4.96	9.59
Control		60.00b	8.00	5.60	9.50

Final emergence percentage (FEP), Mean emergence time (MET), Emergence index (EI), Time of 50% emergence (E50). Mean with same letter(s) are not significantly different at 5% probability using Duncan's multiple range test.

Table 2 showed the effect of re-drying of onion seeds on the media concentration. The media concentration at 25 % gave 71.08 % (0 hr DT), 70.67 % (24 hrs DT) and 70.25 % (48 hrs DT) FEP which are better than the media concentration at 12.5 % which were not significantly different (P≤0.05) but were significantly different to the control. The media concentration at 25 % in 0-hour DT and 48 hours DT gave the least MET (6.33 days) which is significant to the control (8.00 days) while the media concentration at 12.5 % gave the highest EI (5.76) that are not significantly different to the control (5.60).

Table 2: Effect of drying on media concentrations

Concentration (%)	Drying Time (Hours)	FEP (%)	MET	EI	E_{50}
12.5	0	69.75a	7.17ab	5.76a	8.98
	24	68.42a	6.50ab	5.15ab	9.10
	48	69.67a	7.33ab	5.50a	9.43
25	0	71.08a	6.33b	5.50a	8.88
	24	70.67a	7.00ab	5.63a	9.18
	48	70.25a	6.33b	4.82ab	9.13
Control		60.00b	8.00a	5.60a	9.50

Final emergence percentage (FEP), Mean emergence time (MET), Emergence index (EI), Time of 50% emergence (E50). Mean with same letter(s) are not significantly different at 5% probability using Duncan's multiple range test.

All the media used in this experiment are significantly different (P≤0.05) from the control with ascorbic acid giving the highest FEP in 0 DT (74.25 %). Ascorbic acid shows significant differences to sodium chloride (NaCl) and water but is similar to moringa leaf extract (MLE). Nonredried onion seeds gave the highest FEP in all media used except in NaCl (74.25 % ascorbic acid, 71.25 % MLE, 69.25 % water). Ascorbic acid at 24- hour DT has the least MET (6.00 days) that is similar to other media used but significantly different from the control. Soaked onion seeds in water and re-drying for 48 hours have the least EI (4.25) and highest E50 (11.00) that are similar to the other media including the control in EI but significant in E50.

Table 3: Effect of drying on priming media

Media	Drying Time (Hours)	FEP (%)	MET	EI	E_{50}
Ascorbic acid	0	74.25a	6.25ab	6.10a	8.95b
	24	72.63ab	6.00b	5.24ab	9.03b
	48	71.62abc	6.75ab	5.38ab	9.23b
MLE	0	71.25abc	7.00ab	5.35ab	8.88b
	24	69.25bcde	6.50ab	5.48ab	8.90b
	48	70.00bcd	6.25ab	4.78ab	9.15b
NaCl	0	65.75e	7.00ab	5.45ab	8.98b
	24	66.75de	7.75ab	5.45ab	9.50b
	48	68.25cde	7.75ab	5.33ab	9.48b
Water	0	69.25bcde	7.00ab	5.00ab	9.50b
	24	66.75de	7.00ab	4.70ab	10.40a
	48	66.50de	8.00a	4.25b	11.00a
Control		60.00f	8.00a	5.60ab	9.50b

Moringa leaf extract (MLE), Sodium chloride (NaCl), Final emergence percentage (FEP), Mean emergence time (MET), Emergence index (EI), Time of 50% emergence (E50). Mean with same letter(s) are not significantly different at 5% probability using Duncan's multiple range test.

DISCUSSION

Priming has been observed to increase onion speed of germination and emergence (Caseiro *et al.*, 2004; Arin et al. 2011). Soaking of onion seeds in priming media was effective on emergence irrespective of the re-drying. Hydration and dehydration of seeds through priming affect the physiology and biochemistry of seeds which resulted in an increase in the speed of germination and emergence of seeds (Nawaz *et al*. 2013). The unprimed onion seeds (control) were significantly different from the primed seeds which confirmed the effect of priming on onion seeds (Table 1, 2 and 3). Re-drying of onion seeds was effective to onion seeds sowed directly after soaking though not significantly different in each medium used (Table 3) in FEP. The sowing of onion seeds before re-drying gave higher FEP in all media used except in NaCl indicating that drying reduced germination and emergence rate of seeds. This was as a result of low moisture content of the dry seeds. In hydro priming (water), the lower the moisture content, the lower the FEP and EI, and the higher the MET and E50. Hydropriming has been observed to be effective on onion seeds as it showed a significant increase in germination (Caseiro et al. (2004)). The level of moisture in seeds is one of the major factors that affect germination (Alhamdan *et al.* 2011). Parera and Cantliffe, (1992) reported that rapid re-drying of seeds can cause damage to seeds resulting in the loss of advancement gain during priming. But Huang *et al.* (2002) observed hydrated seeds of watermelon do not loss the physiological advancement after re-drying so also with onion (Dorna *et* al., 2013) which has been confirmed by this study. Osmopriming responded differently from other priming media used based on the salt absorbent characteristic in osmopriming that affect the imbibition of seed. Osmopriming is the most common type of seed priming which involves controlled hydration when exposed to water either alone or in combination with osmotic agents by allowing seeds to imbibe but removing the water and drying seeds to original moisture content prior to radicle emergence (Nyarko et al., 2006; Smith, 2006). Arif et al. (2008) observed that seeds become less accessible to water at high salt concentration, which resulted in a decrease in germination percentage.

CONCLUSION

The level of moisture of onion seeds as affected by re-drying of seeds after soaking in priming media have been showed to affect the rate of emergence of onion seeds. The results indicated that sowing of primed onion seeds immediately after priming gave better performance to the re-dried seeds. The time of re-drying is also very important especially in hydro priming as the longer the drying period the less the FEP. Therefore, it was advisable to sow immediately after priming to avoid delay in seeds emergence as priming initiates germination.

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