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ORIGINAL ARTICLE

Impact of Priming Okra (*Abelmoschus Esculentus* L.) Seeds on Seedling Performance in Swaziland

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ABSTRACT

Okra (*Abelmoschus esculentus* L.) farmers in Swaziland have a major problem of seeds not promptly germinating after planting. In Swaziland, information is scarce on how to make okra seeds germinate promptly. The objective of the experiment was to determine how long okra seeds should be primed in order to influence seedling growth and development. Five treatments [T_1, non-primed seeds; T_2, seeds primed for 6 hours; T_3, seeds primed for 12 hours; T_4, seeds primed for 24 hours and T_5, seeds primed for 36 hours] were investigated in a randomized complete block design, each treatment being replicated four times. Results showed significant differences in plant height among the treatments at 9-64 DAP, but there were no significant ($p > 0.05$) differences among mean plant height. Plant height was positively and significantly ($p < 0.01$) correlated to some parameters: leaf length ($r = 0.912$; $n = 20$); leaf width ($r = 0.953$; $n = 20$); leaf area ($r = 0.885$; $n = 20$); plant dry mass ($r = 0.960$; $n = 20$); and stem diameter ($r = 0.945$; $n = 20$). Seedlings grown from seeds primed for 24 hours had the greatest mean length (3.9 cm); seedlings from unprimed seeds, 3.3 cm) but there were no significant differences in mean leaf length among the treatments. Mean stem diameter was significantly ($p < 0.01$) greater (3.5 mm) when seeds were soaked for 24 hours, than when seeds were not primed (stem diameter, 2.7 mm). Correlation data showed that stem diameter was positively, but not significantly correlated to soil temperature at 5-cm depth ($r = 0.254$; $n = 20$) and to soil temperature at 10-cm depth ($r = 0.015$; $n = 20$). It was concluded that some plant growth parameters significantly ($p < 0.05$) varied among seedlings from primed and non-primed (control) seeds. It is recommended that okra seeds be primed for 24 hours before planting; further research on okra seed priming in Swaziland is suggested.

Key words: *Abelmoschus esculentus* *Germination studies *Gumbo *Okra * Okro* Priming * Seed germination *Seedling emergence *Seedling performance *Seed physiology

Introduction

Okra (*Abelmoschus esculentus* L.) is a tropical vegetable crop that grows up to 1.0-2.1 metres tall. Okra is also known in many English-speaking countries as lady's fingers, okro, or gumbo. The edible part of okra is the immature pod, which is harvested when tender. Okra is a warm season crop, requiring ample moisture for germination [1]. Young okra leaves are also edible.

Seed priming is the pre-sowing treatment that involves the controlled hydration of seeds, sufficient to allow radicle protrusion through the seed coat. It can also be explained as soaking seeds in water for a period of time and removing them such that germination does not continue once seeds are

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removed from the water [2]. The purpose of priming is increasing germination percentage, decreasing mean of germination time and improving growth and vigor of seedling at very wide range of favored and unfavored environmental conditions [3]. Farmers can prime their seeds if they know the maximum time length for soaking the seeds. In cultivation, the seeds are planted to a depth of 1-2 cm.

Researchers at the Centre for Arid Zone Studies (CAZS) calculated the maximum length of time for which tropical and sub-tropical crop seeds can be soaked, and which if exceeded, could lead to seed or seedling damage. These studies showed that a superior response is often obtained from soaking rice (*Oryza sativa* L.) or corn (*Zea mays* L.) for 18 hours [4]. Primed seeds have been reported to give rise to crops, which matured earlier, and gave higher yields [4].

As reported by FAO [5], studies conducted in Zimbabwe, Pakistan and India reported that primed corn seeds emerged earlier, flowered sooner, required fewer cultivation and less weeding, produced grain faster and matured earlier than the same crops sown at the same time using dry seeds. Farmers reported better drought tolerance and higher yields using primed seeds with yield increase of 10-30%. Less seeds per unit area were needed; for example, 19 kg per hectare of corn was needed instead of 25 kg [5]. Priming corn seed has spread to Thailand, Kenya, Uganda, Ethiopia, India and Tanzania. Corn grown from primed seeds generally emerges earlier and in greater numbers, grows more vigorously, flowers and matures earlier and often yields better than those from non-primed seeds. Farmers in India reported that primed crops emerged 2-3 days earlier than non-primed ones [3]. Hundreds of non-governmental organizations, farmers and researchers are now asking for instructions on how to prime maize seeds [6].

Seed priming describes the different germination-enhancing, pre-sowing treatments, which do not result in radicle emergence. To do so, seeds are partially hydrated to a point where the germination process begins, but radicle emergence does not occur. There are reports that priming permits early DNA replication, increased RNA and protein synthesis, greater ATP availability, faster embryo growth, repair of deteriorated seed parts, and reduced leakage of metabolites compared with control [7]. Another effect of priming is the better performance of seeds under adverse conditions and environmental stress such as salinity [7].

Plants of primed soybean (*Glycine max* L.) seeds were reported to take fewer days to emergence, flowering and maturity as compared with plants of non-primed seed plots; primed plants also produced taller seedlings plants, greater seedling dry mass (DM) and higher grain yield. Furthermore, days to emergence and maturity increased with increase in seed priming duration [8].

Warley [9] observed that a number of important factors, including seed quality could influence seed priming response. Therefore, the response to seed priming treatments might vary among seed lots because of differences in seed vigor. The effectiveness of priming to improve the germination performance of tomato (*Lycopersicon esculentus*) aged seeds depended on the degree of seed deterioration. Primed seed usually emerged from the soil faster, and more uniformly than non-primed seed of the same seed lot. These differences are greatest under adverse environmental conditions in the field, such as cold or hot or saline soils. Muhammad [3] warned that there might be little or no differences between primed and non-primed seed if the field conditions are closer to ideal.

Okra farmers in Swaziland have a major problem of seeds not promptly germinating after planting. In order to address the problem of poor germination, some farmers have resorted to priming (soaking) the seed in water for a day or two before transplanting. In other parts of the world, there is some information on priming corn and other agronomic crops and vegetable seeds, but in Swaziland, no documented information on priming okra seeds is available, hence the need for this investigation. The objective of the investigation was to determine the safe duration of priming okra seeds in order to increase seedling growth and development.

Materials and methods

Site of experiment:

This was both a laboratory and outdoor investigation. Seed soaking was conducted in the laboratory of the Crop Production Department, University of Swaziland, in Luyengo (26.33ºS and 31.11ºE). Luyengo has a mean annual rainfall range of 800-1200 mm, annual mean temperature of 18ºC, and is 732.5 metres above sea level[10]. The outdoor aspect of the experiment was carried out at Malkerns Reserch Station, outside the screenhouse of the Plant Pathology & Quarantine Department. Malkerns is 740 m above sea level; it is located at 26.34ºS, 31.10ºE, with an annual rainfall between 800 mm and 1200 mm, and has a mean annual temperature of 18ºC [10].

Experimental design:

The experimental design was a randomized complete block design of five treatments, each replicated four times. The five treatments (T) were T_1, non-primed seeds; T_2, seeds primed for 6 hours; T_3, seeds primed for 12 hours; T_4, seeds primed for 24 hours and T_5, seeds primed for 36 hours before sowing.

Priming method:

Okra seeds were weighed (60 seeds per treatment) and then soaked between rolled, cotton cloth towels. After the required priming time as described in the respective treatments above, the seeds were re-weighed and planted out in soil. Each experimental unit or plot consisted of soil contained in a 10-litre, black polythene bag.

Planting:

Black polythene bags containing 10 kg of an Oxisol from Malkerns Research Station were used to plant the seeds. Ten seeds per bag per treatment were planted out in four replicates. Of the 60 seeds per treatment from the towels, 50 were actually needed for each treatment. The extra seeds were there just to ensure that there were enough seeds to plant in the plastic bags. The seeds from the towels were not allowed to germinate before being planted out in soil, to avoid damaging the radicle or plumule. There was one bag per plot, which made a total of 20 bags for the experiment. Thinning out to three healthy seedlings per bag was done at two weeks of the first seed emergence.

Data collected:

The following data were collected from three tagged plants per plot: seedling emergence; plant height; leaf length and width; leaf area; seedling dry matter; stem diameter; and soil temperature. Tagging of plants ensured that sequential data collection was made from the same seedlings over time.

Seedling emergence:

The number of seedlings that emerged per treatment was obtained through daily counts of shoots showing above the soil surface at 5-14 days after planting.

Plant height:

Plant height was determined by measuring the height of the three seedlings in each plastic bag. A 30-cm ruler was used to take measurements from the soil surface to the topmost stretched leaf of each plant. Measurements were taken every five days, starting from nine days after planting (DAP).

Leaf Length and Width:

Leaf length and width were measured from the fully opened leaves of each plant. Measurements were taken every five days, using a 30-cm ruler, starting from 14 DAP.

Leaf Area per Seedling:

Leaf area was obtained using the cork-borer method [11], adopted by Edje and Ossom [12], and thereafter, applying the formula below [12]:

$$\text{Leaf area (cm}^2\text{)} = \frac{\text{Area of 10 leaf discs (cm}^2\text{) x leaf dry mass (g) of 3 plants}}{\text{Dry mass of 10 leaf discs (g).}}$$

Seedling DM:

Seedling DM was obtained by drying harvested plants in a hot-air oven regulated at 100ºC for 48 hours [12] and then weighing the dried materials using a laboratory scale.

Stem diameter:

A vernier caliper was used to measure seedling diameter at 5-cm height above the soil. Measurements of stem diameter started when all plants from the different treatments had grown above 5-cm height.

Soil temperature:

Soil temperature readings were taken weekly at 5-cm and 10-cm depths, 5 cm away from plant bases. The Fisherbrand bi-metal dial soil thermometer [13] was used to measure soil temperature on sunny, bright days without rain.

Data analysis:

Data were analyzed using MSTAT-C statistical package, version 1.3[14]; the least significant difference test [15] was used for the separation of means.

Results and discussion

Seedling emergence:

Table I shows the percentage of seedling emergence at 5-14 DAP. Seeds primed for 24 hours showed the best (66.5%) percentage of seedling emergence. There were significant ($p < 0.05$) differences in per cent seedling emergence among the treatments at all intervals of measurements. Table II shows that plant height generally increased with advancing time. There were significant differences in plant height among the treatments at 9-64 DAP, but there were no significant ($p > 0.05$) differences among mean plant height.

Table III shows that per cent seedling emergence was positively and significantly ($p < 0.01$) correlated to: leaf area (r = 0.615; n = 20) and soil temperature at 5 cm depth (r = 0.628; n = 20). It was positively and significantly ($p < 0.05$) correlated to plant DM (r = 0.575; n = 20) and stem diameter (r = 0.546; n = 20). It was positively but not significantly correlated to other parameters: plant height (r = 0.357; n = 20); leaf length (r = 0.327; n = 20); leaf width (r = 0.426; n = 20). It was negatively and not significantly correlated to soil temperature at 10 cm depth (r = - 0.373; n = 20). Plant height was positively and significantly ($p < 0.01$) correlated to some parameters: leaf length (r = 0.912; n = 20); leaf width (r = 0.953; n = 20); leaf area (r = 0.885; n = 20); plant DM (r = 0.960; n = 20); stem diameter (r = 0.945; n = 20). It was positively but not significantly correlated to soil temperature at 5 cm depth (r = 0.311; n = 20). It was negatively and not significantly correlated to soil temperature at 10 cm depth (r = - 0.136; n = 20).

Leaf length:

Table IV shows leaf length at 14-64 DAP; generally, there were increases in leaf length at 19-64 DAP. Seedlings grown from seeds primed for 24 hours had the greatest mean length (3.9 cm); seedlings from unprimed seeds, 3.3 cm) but there were no significant differences in mean leaf length among the treatments. Table III shows that plant leaf length was positively and significantly ($p < 0.01$) correlated to some parameters: leaf width (r = 0.753; n = 20); leaf area (r = 0.677; n = 20); plant DM (r = 0.918; n = 20); stem diameter (r = 0.779; n = 20). It was negatively and significantly ($P < 0.05$) correlated to soil temperature at 10 cm depth (r = - 0.458; n = 20).

Leaf width:

Leaf width increased with advancing growing period as shown in Table V. Though leaf width of seedlings from seeds primed for 24 hours was greatest (5.5 cm), there were no significant differences among mean leaf width. Table III shows that leaf width was positively and significantly ($p < 0.01$) correlated to some parameters: leaf area (r = 0.960; n = 20); plant DM (r = 0.906; n = 20); stem diameter (r = 0.974; n = 20). It was positively but not significantly correlated to: soil temperature at 5 cm depth (r = 0.129; n = 20) and soil temperature at 10 cm depth (r = 0.053; n = 20).

Leaf area:

Table VI shows the mean leaf area among seedlings from differently primed okra seeds. The greatest leaf area (115.2 cm^2) was attained by leaves of seedlings whose seeds were primed for 24 hours. Leaf area was significantly ($p < 0.01$) higher than leaf area (33.8 cm^2) of seedlings whose seeds were not primed. Table III shows that leaf area was positively and significantly ($p < 0.01$) correlated to: plant DM (r = 0.906; n = 20) and stem diameter (r = 0.987; n = 20). It was positively but not significantly correlated to: soil temperature at 5 cm depth (r = 0.201; n = 20) and soil temperature at 10 cm depth (r = 0.078; n = 20)

Plant DM:

Seeds primed for 24 hours resulted in not significantly ($p > 0.05$) greater mean DM (6.8 g) compared with non-primed seeds (DM, 2.9 g). Plant DM was positively and significantly ($p < 0.01$) correlated to stem diameter (r = 0.952; n = 20), as indicated in the correlation matrix in Table 3. Plant dry mass was positively and significantly ($p < 0.05$) correlated to soil temperature at 5 cm depth (r = 0.510; n = 20). It was negatively and not significantly correlated to: soil temperature at 10 cm depth (r = - 0.264; n = 20).

Stem Diameter:

Table VIII shows data on seedling stem diameter at 44-64 DAP. Mean stem diameter was significantly ($p < 0.01$) greater (3.5 mm) when seeds were soaked for 24 hours, than when seeds were not primed (stem diameter, 2.7 mm). As shown in Table III, stem diameter was positively, but not significantly correlated to: soil temperature at 5 cm depth (r = 0.254; n = 20) and soil temperature at 10 cm depth (r = 0.015; n = 20).

Soil Temperature:

As shown in Table IX, mean soil temperature readings indicated no significant ($p > 0.01$) differences among treatments at 5 cm and 10 cm depths. The correlation matrix (Table III) shows that soil temperature at 5 cm depth was negatively and significantly ($p < 0.01$) correlated to soil temperature at 10 cm depth (r = - 0.885; n = 20).

Soaking time:

Table III shows that soaking time was positively and significantly ($p < 0.01$) correlated to some parameters: plant height (r = 0.721; n= 20); leaf length (r = 0.698; n = 20); leaf width (r = 0.653; n = 20); leaf area (r = 0.747; n = 20); plant dry mass (r = 0.807; n = 20); stem diameter (r = 0.791; n = 20). Soaking time was positively but not significantly correlated to soil temperature at 5 cm depth (r = 0.385; n = 20) and 10 cm depth (r = 0.038; n = 20).

Table 1: Per cent seedling emergence of primed okra seeds in Swaziland

Soaking time (hours)	Days after planting okra seeds										Mean
	5	6	7	8	9	10	11	12	13	14	
0	0.0a	0.0b	42.5b	65.0b	75.0c	80.0c	80.0a	82.5d	82.5b	85.0c	59.3c
6	0.0a	10.0a	45.0b	60.0b	72.5b	72.5d	75.0d	75.0b	82.5b	82.5b	57.5d
12	0.0a	15.0a	55.0a	70.0c	77.5bc	77.5c	77.5c	80.0b	82.5b	82.5b	54.0d
24	0.0a	10.0a	42.5b	80.0a	82.5a	85.0b	87.5b	90.0a	92.5a	95.0a	66.5a
36	2.5b	15.0a	52.5a	65.0b	80.0a	80.0a	80.0a	80.0c	85.0c	87.5d	60.5b
Mean	5.0	12.5	47.5	68.0	77.5	79.0	75.5	81.5	85.0	86.5	-

Means followed by the same letters in the same column are not significantly different at p > 0.05, according to the least significant difference test.

Table 2: Plant height (cm) of primed okra seeds at 9-64 days after planting

Soaking time (hours)	Days after planting okra seeds												Mean
	9	14	19	24	29	34	39	44	49	54	59	64	
0	1.6b	4.1a	5.2b	5.9a	6.4b	6.9b	7.4a	7.6a	8.1a	8.4a	9.2b	9.9b	6.7a
6	2.1a	4.4a	5.5b	6.0a	7.0b	7.3c	8.0a	8.3a	9.2a	9.8a	11.3b	11.6ab	7.5a
12	1.9b	4.6a	5.8b	6.3a	7.5b	8.0a	8.4a	8.8a	9.3a	10.1a	11.1ba	12.0ab	7.8a
24	1.7b	4.6a	5.6b	6.4a	7.2b	7.3c	8.1a	8.8a	10.1a	11.1a	13.6a	14.4a	8.2a
36	2.0a	4.4a	5.6b	6.3a	7.0b	7.3c	8.0a	8.5a	9.4a	10.1a	11.6ab	12.8a	7.8a
Mean	1.86	4.42	5.54	6.18	7.02	7.36	7.98	8.4	9.22	9.9	11.36	12.14	7.62

Means followed by the same letters in the same column are not significantly different at p > 0.05, according to the least significant difference test.

Table 3: Correlation matrix for some parameters of okra plants at 64 days after planting

Parameters	Soaking hours	Per cent emer-gence	Plant height	Leaf length	Leaf width	Leaf area	Plant dry mass	Stem diameter	Soil tempera-ture at 5-cm depth
Per cent emergence	0.457*								
Plant height	0.721**	0.357NS							
Leaf length	0.698**	0.327NS	0.912**						
Leaf width	0.653**	0.426NS	0.953**	0.753**					
Leaf area	0.747**	0.615**	0.885**	0.677**	0.960**				
Plant dry mass	0.807**	0.575*	0.960**	0.918**	0.906**	0.906**			
Stem diameter	0.791**	0.546*	0.945**	0.779**	0.974**	0.987**	0.952**		
Soil temperature at 5-cm depth	0.385NS	0.628**	0.311NS	0.600**	0.129NS	0.201NS	0.510*	0.254NS	
Soil temperature at 10-cm depth	0.038NS	- 0.373NS	- 0.136NS	- 0.458*	0.053NS	0.078NS	- 0.264NS	0.015NS	- 0.885**

*Significant at 5.0% level; **, significant at 1.0% level

Table 4: Leaf length (cm) at 14-64 after planting primed okra in Swaziland

Soaking time (hours)	Days after planting											Mean
	14	19	24	29	34	39	44	49	54	59	64	
0	2.7b	2.4a	2.8b	2.9b	3.3b	3.4b	3.5a	3.7b	3.8b	4.0b	4.2b	3.3a
6	2.9b	2.4a	2.7b	3.1b	3.1b	3.3b	3.4a	3.5b	3.9b	4.6a	4.8b	3.4a
12	3.1a	2.8a	3.1a	3.6a	3.7a	3.9a	4.0b	4.3a	4.4a	4.6a	4.8b	3.8a
24	2.9a	2.8a	2.9a	3.2b	3.6a	3.9a	3.9b	4.2a	4.6a	5.3a	5.7a	3.9a
36	2.8a	2.7a	3.0a	3.2b	3.5a	3.6a	3.7b	4.0a	4.3a	4.8a	5.2a	3.7a
Mean	2.9	2.6	2.9	3.2	3.4	3.6	3.7	3.9	4.2	4.7	4.9	3.6

Means followed by the same letters in the same column are not significantly different at p > 0.05, according to the least significant difference test.

Table 5: Okra leaf width (cm) at 44-64 days after planting in Swaziland

Soaking time (hours)	Days after planting					Mean
	44	49	54	59	64	
0	3.2a	3.4b	3.9a	4.1b	4.5b	3.8a
6	3.4a	4.0b	4.7a	6.2a	6.7a	5.0a
12	3.9a	4.5b	4.8a	5.4a	5.6a	4.8a
24	4.1a	4.7b	5.0a	6.6a	7.2a	5.5a
36	3.6a	4.4b	5.0a	6.6a	6.2a	5.0a
Mean	3.64	4.20	4.68	5.78	6.04	4.87

Means followed by the same letters in the same column are not significantly different at p > 0.05, according to the least significant difference test.

Table 6: Mean leaf area (cm^2) for okra seedlings grown from differently primed seeds

Soaking time (hours)	Mean leaf area (cm^2)
0	33.8ab
6	73.3ab
12	44.5b
24	115.2a
36	88.4a
Mean	71.04

Means followed by the same letters in the same column are not significantly different at p > 0.05, according to the least significant difference test.

Table 7: Plant dry mass (g) for the different treatments

Soaking time (hours)	Plant dry mass (g) x 10
0	2.9a
6	4.2a
12	5.0a
24	6.8a
36	5.6a
Mean	4.9

Means followed by the same letters in the same column are not significantly different at p > 0.05, according to the least significant difference test.

Table 8: Stem diameter (mm) of okra at 44-64 days after planting in Swaziland.

Soaking time (hours)	Days after planting					Means
	44	49	54	59	64	
0	2.4ab	2.5b	2.7ab	2.8ab	2.9a	2.7ab
6	2.7a	2.9ab	3.1a	3.5a	3.6a	3.2a
12	2.7a	2.8ab	3.0a	3.3a	3.6a	3.1a
24	3.0a	3.3a	3.5a	3.8a	4.0a	3.5a
36	3.0a	3.2a	3.4ab	3.5a	3.6a	3.3a
Mean	2.8	2.9	3.1	3.4	3.5	3.2

Means followed by the same letters in the same column are not significantly different at p > 0.05, according to the least significant difference test.

Table 9: Soil temperature at 1-3 weeks after planting primed okra seeds in Swaziland

Soaking time (hours)	Soil depth (cm)	Weeks after planting						Mean
		1	2	3	4	5	6	
0	5.0	32.8b	36.8a	36.6a	32.6d	32.9a	26.4d	33.0a
	10.0	32.9d	38.8d	35.1b	37.3e	33.1c	24.4e	33.6b
6	5.0	30.6b	34.8b	37.1a	30.4d	32.9a	27.0d	32.1a
	10.0	36.3b	37.0c	36.0b	36.6e	31.8c	25.5e	33.9b
12	5.0	34.0b	37.3a	37.4a	31.3d	32.1a	25.5d	32.9a
	10.0	37.9c	38.3d	36.5b	35.0e	31.3c	22.5e	33.6b
24	5.0	33.5b	36.1a	37.4a	29.9d	33.4a	26.8d	33.2a
	10.0	34.4c	38.0d	36.9b	36.1e	31.5bc	24.0e	33.5b
36	5.0	37.0a	37.4a	35.3a	31.3d	30.6a	25.6d	32.9a
	10.0	36.4c	39.5c	35.6b	36.5e	29.5b	25.0e	33.8b
Means	5.0	33.6	36.4	36.8	31.1	32.4	26.3	32.8
	10.0	35.5	38.3	36.0	36.3	31.4	24.3	33.6
	10.0	6.54	2.37	6.60	5.97	5.86	6.34	5.61

Means within the same soil depth followed by the same letters in the same column are not significantly different at p > 0.05, according to the least significant difference test.

Discussion:

Per Cent Seedling Emergence:

That seeds primed for 24 hours showed higher per cent seedling emergence than other treatments agreed with the report of Berchie *et al.* [16], which stated that soaking bambara groundnut (*Vigna subterranea*) for 24 hours enhanced seedling emergence. Seedling emergence was delayed under the control, but it was not the lowest, contrary to [16], who reported that it was lowest. Seeds soaked for 36 hours showed lower germination percentage (87.5%) than seeds soaked for 24 hours (95.0%) in agreement with the report of Mohammad[8].

Plant height:

Plant height increased with increase in priming duration, but decreased when priming exceeded 24 hours, consistent with previous findings of Guan *et al.* [17], who reported that seed priming improved plant height much more than plant stand of sweet corn. The results of the present experiment did not corroborate the findings of Farooq *et al.* [18], which reported that seed priming techniques did not affect plant height in *Triticum aestivum*.

Leaf Length and Leaf Width:

That mean leaf length of plants from seeds soaked for 24 hours was greater than mean leaf length from other treatments was in agreement with [8] that seeds soaked for 24 hours gave rise to plants with longer leaves in soybean. That leaf width increased with increase in priming duration in the present experiment, was consistent with [18], who reported that priming rice seeds improved rice leaf growth.

Leaf area and Plant DM:

The observation that leaf area significantly ($p < 0.05$) increased with increasing priming duration, up to 24 hours, and decreased when priming time reached 36 hours, was at variance from the findings of Khalil and Khan [19], which showed no significant differences in leaf area for different primed mungbean (botanical name =) cultivars. Plant DM increasing with prolonged priming time duration, was in support of an earlier assertion [17] that priming treatments increased shoot DM in corn, compared with non-primed seeds.

Stem diameter:

Mean stem diameter from seeds soaked for 24 hours was greatest was in agreement with Faqenabi *et al.* [20], who reported that stem diameter of primed safflower (*Carthamus tinctorius*) increased compared to the control.

Soil temperature:

Lower soil temperature values at 6 WAP might have negatively affected performance of okra seedlings because soil temperature must be warm for best okra performance [21]. Kemble *et al.* [22] reported that okra cannot tolerate low temperatures for a long time. Prasad *et al.* [23] observed germination to be least at low soil temperatures for all peanut (*Arachis hypogaea* L.) cultivars investigated.

Soaking time:

Yamamoto and Turgeon [24] obtained results similar to our observations - that seed priming resulted in improvements in Kentucky bluegrass (*Poa pratensis*) seed performance such as faster and more uniform germination, higher per cent germination and more vigorous seedling development.

Conclusion and Recommendations:

Our conclusion from this investigation was that some plant growth parameters significantly ($p < 0.05$) varied among seedlings from primed and non-primed (control) seeds. Based on our observations, it is recommended that okra seeds should be primed for 24 hours before planting. It would be beneficial to conduct further research on okra seed priming in Swaziland.

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