EFFECT OF SEED PRIMING ON THE GERMINATION AND EARLY SEEDLING GROWTH OF BUTTER SQUASH (*CUCURBITA MOSCHATA* L.) IN KEFFI, NASARAWA STATE, NIGERIA

***Ubazi C. C[1]., Yusuf H. O[2]., Asala W. S[1]., Abdulkarim B. M[3]., Umar Y. I[3]. and Abolaji M. O.[3]**

[1]Department of Crop Protection, Faculty of Agriculture, University of Abuja, Nigeria.
[2] National Biotechnology Development Agency, Umaru Musa Yar'adua Express Way, Lugbe FCT, Abuja.
[3]Department of Plant Science and Biotechnology Nasarawa State University Keffi, Nasarawa State.
***Corresponding author: E-mail*: Christchuks06@gmail.com**

ABSTRACT

The effects of seed priming on Butter squash (Cucurbita moschata) seed germination and early seedling performance was investigated via a laboratory emergence test. The experiment was conducted at the department of Plant Science and Biotechnology Laboratory, Nasarawa State University, Keffi. Thirty six (36) Butter squash seeds were primed in 500ml of two priming agents (3% KNO_3 and Distilled Water) for two different priming durations (12hours and 24hours) and another set of thirty six (36) unprimed seeds were used as control treatment, making a total of five (5) experimental units. The treatments were replicated three (3) times. The data collected were percentage germination, shoot length and root length. Results from the experiment indicated that there was significant difference between treatments and the control and within the treatments at $p \leq 0.05$. Priming with distilled water (DH_2O) at both 12 and 24 hours was most effective for germination. Priming with 3%KNO_3 at 12 and 24 hours were the most effective for shoot and root length. The increase in germination percentage observed in seeds primed with water can confer a huge advantage on butter squash seedlings over competing weed-pest species in the field during early crop development. Hydro-priming of seeds of this crop can also serve as an important biological and crop management approach to check over reliance on synthetic herbicides for the control weeds. In addition, seed priming, when adopted can considerably minimize the need for early fertilizer application thereby reducing the huge financial costs of fertilizer applications for Butter squash farmers.

Keywords: Butter squash, priming-agent, priming-duration, percentage germination.

INTRODUCTION

Seed priming basically means the soaking of seeds in water or any choice solution for certain duration. Scientists have employed this technique either with water (hydro-priming) or salt solutions (halo-priming) to increase and sustain better early crop establishment. Seed priming is nowadays being extensively used to improve seed germination and seedling emergence in a wide range of crop species (Hosseini and Koocheki, 2007). Basically, it is a physiological process in which the seeds are presoaked before planting, allowing partial imbibitions to improve the germination (Nascimento and Aragao, 2004).

During priming, several processes including storage, material handling, activation and synthesis of a number of enzymes occur. Nucleic acids repair, ATP synthesis, cytoplasmic membrane repair also takes place in treated seeds (Hosseini and Koocheki, 2007). Seed priming generally induces fast and uniform germination especially when physical conditions for crop growth is adverse

or harsh (Nascimento, 2003). Sivritepe *et al*. (2003) indicated that watermelon seeds priming with 1% NaCl for 3 days at 20 °C reduced salinity effects on germination of watermelon and increased watermelon tolerance to salinity in the early stages of growth. Jian *et al*. (2007) investigated the effects of different osmotic which can be used in seed priming on watermelon germination and reported that priming with solutions of copper sulfate 1% for 4 h and zinc sulfate 0.2% for 24 h will enhance germination by respectively 17.1% and 73.3% compared with untreated seeds. Manigopa *et al*. (2007) reported that priming in chickpea (Cicer arietinum L.) led to better crop establishment and growth and greater yield. Seed priming increased the number of plants at harvest, yield, germination, number of pods per plant, number of lateral branches per plant, and number of seeds per plant by 12.8%, 9.6%, 9.4%, 6.4%, and 6.5%, respectively, over the non-priming treatment. Some researchers have considered hydro-priming a key technology that is simple and cost-effective, the impact of which is very high in terms of enhanced yield (Ashraf and Foolad, 2005; Farooq *et al*., 2008). Hydro-priming has been effectively used to enhance seed germination, radical, and plumule emergence in different crop species (Harris *et al*., 1999).

Butter squash is an important horticultural crop cultivated mostly in the arid and semi-arid regions of the world where salinity, high temperature, rapid soil drying, and crust formation are barriers to good butter squash crop establishment. However, no study has been previously reported in the context of Nigeria on the effects of Halo and Hydo-priming on butter squash seed germination and early seedling growth. Consequently, this study is to evaluate the effects of seed priming on seed emergence and early seedling growth of butter squash using 3% KNO3 and distilled water as priming media.

MATERIALS AND METHODS

Study Area

A laboratory study was carried out in the Department of Plant Science and Biotechnology laboratory, Nasarawa State University Keffi, Nigeria, which lies between latitude 8º51ºN and longitude 7º53ºE (Ileoje, 2007). Keffi has a mean annual rainfall of 1500mm and situated on an altitude of 850m above sea level (Bimbol, 2007). Keffi has a land area of 140.47Km2, a population density of 654 persons per km2, and a population of 92,664 people according to the 2006 census (BLSL, 2005).

SAMPLE COLLECTION AND PREPARATION OF PRIMING AGENT

Seeds of Butter squash were obtained from ECHO SEEDS USA. Five (5) sets of 36 healthy-looking seeds were handpicked and weighed to obtain the original weight of the seeds.

3%KNO3 was prepared by dissolving 101g of potassium nitrate in 800ml distilled water and made up to a one-liter solution. 3ml of the stock was added into 100ml of distilled water to obtain 3% of the solution (ChemLab, Nasarawa State University, Keffi).

PRIMING

Thirty-six (36) Butter squash seeds were primed in 500ml of each priming agent (3% KNO3 and DH2O) contained in 500ml conical

flasks for two different priming durations (12hours and 24hours) respectively. Another set of thirty-six (36) seeds were left unprimed as the control treatment, making a total of four (5) experimental units. The treatments were replicated three (3) times. Primed seeds were rinsed in distilled water and air-dried and labeled according to the treatments (Control, DH_2O-12hours, DH_2O-24hours, 3%KNO3-12hours, and 3%KNO3-24hours) for germination test (Basra *et al*., 2005).

BIOASSAY STUDIES

Bioassay studies were carried out following a modified method of Rejila and Vijayakumar, (2011). Six seeds of the crop were placed on Whatman No1 filter paper in Petri plates (9cm × 2cm). Petri plates were moistened with a 2ml of distilled water and incubated under laboratory conditions. Percentage germination and shoot length were measured after 15 days. Five (5) seedlings were randomly harvested from each Petri plate to determine average shoot length and root length.

DATA ANALYSIS

All the data collected from the study were subjected to analysis of variance (ANOVA) using SPSS 2.1.0 software. The least significant difference (LSD) test was used to compare means.

RESULT

The result (Table 1) shows that all treatments except $KNO_3$12hours had a high percentage of germination compared to the control with 86.11%. Treatments DH_2O-12hours and H_2O-24hours both recorded 91.67% while, $KNO_3$12hours and $KNO_3$24hours were observed to have percentage germination of 77.78% and 88.89% respectively, and were not considerably different from the control.

Also, all the treatments were significantly different ($P \leq 0.05$) in their average shoot length compared with the control (15.04mm). Seeds primed with KNO_3 for 12hours (15.73mm) and seeds primed with KNO_3 for 24hours (15.53mm) were observed to have a better shoot establishment compared to seeds primed with H_2O for 12hours and 24hours which recorded 12.23mm and 12.16mm respectively (Table 2).

Table 1: Effect of seed priming on germination percentage of Butter squash (*Cucurbita moschata*).

Treatments	(%G)
Control	86.11
DH_2O12	91.67
DH_2O24	91.67
$KNO_3 12$	77.78
$KNO_3 24$	88.89

%G= Percentage Germination, DH_2O12= Distilled water (12 hours), DH_2O24= Distilled water (24 hours), $KNO_3 12$= 3% salt (12 hours), KNO_3= 3% salt (24 hours).

Table 2: Effect of seed priming on shoot length and root length of Butter squash (*Cucurbita moschata*).

Treatments	ASL (mm)	ARL (mm)
Control	15.04^{c}	7.66^{c}
DH_2O12	12.23^{d}	6.65^{d}
DH_2O24	12.16^{d}	6.55^{d}
$KNO_3 12$	15.73^{a}	8.73^{b}
$KNO_3 24$	15.53^{b}	9.18^{a}

Note: Means within the same column having like-alphabets are not significantly different at $P \leq 0.05$. ASL= Average shoot length, ARL= Average root length, DH_2O12= Distilled water (12 hours), DH_2O24= Distilled water (24 hours), $KNO_3 12$= 3% salt (12 hours), KNO_3= 3% salt (24 hours).

DISCUSSION

In this study, seed priming with water has been demonstrated as a successful and effective method for improving the germination of Cucurbita moschata seeds. Seed priming with water sufficiently increased seed germination over the control. Comparisons between the percentage germination of control (86.11%) and hydro priming treatment for 12h and 24h (91.67%) showed that germination was increased by 5.56%, a significantly higher germination

percentage in hydro-primed seeds as compared to non-primed and halo-primed seeds which indicates a positive effect in improving seed germination. This result father proves that Water as a basic requirement for germination and it is essential for enzyme activation, breakdown, translocation and utilization of reserve stored material in seeds (Shaban, 2013).

Twelve and twenty-four hours of soaking duration in water were found to be optimum time because maximum germination (91.67%) were recorded as compared to other treatments, 3%KNO_3 (77.78%) and 3%KNO_3 (88.89%) at the same durations and this agrees with the findings of Ashraf and Foolad, (2005) and Farooq *et al*. (2008) which reported hydro-priming to be effective at short priming durations. This report is also furthermore supported by the findings of Harris *et al*. (1999) which reported that hydro-priming has been effectively used to enhance seed germination, radical and plumule emergence in different crop species. Therefore, these positive effects are suggested to be probably due to the stimulatory effects of water on seed physiological processes leading to germination.

Furthermore, seeds primed with 3%KNO_3 for 12h and 24h duration both recorded 15.73mm and 15.53mm for the average shoot length respectively, which were significantly different when compared with control which recorded 15.04mm. Seeds primed with DH_2O for 12h and 24h duration recorded the least shoot length of 12.23mm and 12.16mm respectively compared to control and seeds primed with 3%KNO_3 at the same duration. This suggest that priming seeds with 3%KNO_3 at 12 and 24hr duration is the most favorable for shoot length of Butter squash when compared with hydro-primed and non-primed seeds. This result is in line with Ashraf *et al*. (2001) and Basra *et al*. (2005) which stated that halo-priming was effective at short priming durations. However, the reduction in shoot and root length observed in this work is in divergence with the result of Harris *et al*. (1999) which stated that hydro-priming has been effectively used to enhance seed germination, radical and plumule emergence in different crop species requires further investigation. This observed difference remains an important area for research focus in order to underscore those intrinsic factors in play during germination processes that may affect both plumule and radical development in seeds of Butter squash under different priming conditions.

Similarly, when compared to the control, seeds primed with 3%KNO_3 for 12h and 24h duration recorded the highest root length of 8.73mm and 9.18mm respectively, compared to the control which recorded 7.66mm. Seeds primed with H_2O for 12h and 24 h durations both recorded 6.65mm and 6.55mm each, the least in terms of root length. This result agrees with the result of a similar experiment carried out by Afzal *et al*. (2006) which reported that seeds primed with salt exhibited better growth and performance over seeds primed with other priming agents including water, though under saline condition. Therefore, the variations observed in the average shoot and root length of seedlings in this experiment is suggested to be due to varying degree of response of the test crop to the two priming agents and as well as the effect of water and KNO_3 on the physiological and biochemical conditions of

seeds during germination process. Furthermore, the observed performance in germination and growth of treated seeds is of great economic value as; early emergence, increased vigor, and rapid growth rate have been associated with an increased yield of crops by various authors (Ashraf *et al*., 2001; Basra *et al*., 2005; Harris *et al*., 2007). Increased number of the root, increased root and shoot length were also described by Farooq *et al*. (2008) and El-Mohammedy *et al*. (2006) as critical crop yield indicators. Hydro-priming was effective in improving germination in Butter squash. Halo-priming was effective in improving the early seedling growth as observed in the increased shoot and root length of seeds. These observable differences in the response of seeds of Butter squash to various priming treatments and durations is suggested to be due to physiological and biochemical changes induced in seeds of this crop under saline and non-saline conditions.

CONCLUSION

Seed priming though under different conditions and duration has been proven to be an effective technique for enhancing the early seedling performance of Butter squash. The agro-economic importance of this study cannot be over-emphasized. The observed performance in germination and growth of primed seeds is of great economic value as early germination will increase vigor and rapid growth rate as observed in this study and can lead to better yield performance of *Cucurbita moschata* L.). Increased shoot and root length have been described as some critical crop performance and yield indicators. Furthermore, the increase in germination percentage observed in seeds primed with water can confer a huge advantage on butter squash seedlings over competing weed-pest species in the field during early crop development. Hydro-priming of seeds of this crop can also serve as an important biological and crop management approach to check over reliance on synthetic herbicides for the weed control. In addition, seed priming, when adopted can considerably minimize the need for early fertilizer application thereby reducing the huge financial costs of fertilizer applications for butter squash farmers.

REFERENCES

Afzal, I., Basra, S. M. A., Farooq, M. and Nawaz, A. (2006). Alleviation of salinity Stress in Spring. *Pakistan journal of Crop Science*. 4:332-338.

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

Ashraf, M. and Rauf, H. (2001). Inducing salt tolerance in maize (*Zea mays* L.) through seedpriming with chloride salts: growth and ion transport at early growth stages. *ActaPhysiological Plantarum*. 23: 407-414.

Basra, S. M. A., Zia, M. N., Mehmood, L., Afzal, I. and Khaliq, A. (2005). Comparison of different invigoration techniques in wheat(*Triticum aestivum* L.) seeds. *Pakistan journal of Arid Agriculture*. 5:325-329.

Bimbol, N. L. (2007). Climate on geographical perspective in Nasarawa State. A publication of the Department of Geography, Nasarawa State University, Nasarawa State, Nigeria.Pp31-37.

Bureau of Land and Survey, Lafia. (2005). *The geography of Nasarawa State*.

El-Mohammedy, R. S. R., Abd-Alla, M. A. and Badiaa, R. I. (2006). Soil amendment and seed bio-priming treatments as alternative fungicides for controlling root rot diseases oncowpea plants in Nobiara province. *Research Journal of Agriculture and Biological Sciences.* 2: 391-398.

Farooq, M., Basra, S. M. A., Rheman, H. and Saleem. B. A. (2008). Seed priming enhances the performance of late sown wheat (*Triticum aestivum* L.) by improving chilling tolerance.*Journal of Agronomy and Crop Science*. 194: 55-60.

Harris, D., Joshi, A., Khan, P. A., Gerhard, 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. *Experime ntal Agriculture*. 35: 15-29.

Hosseini, A. and A. Koocheki, 2007.The effect of different priming treatments on germination percent and mean germination time of four varieties of sugar beet. *Journal of Agronomic Research*. 5(1): 69-76.

Ileoje, N. P. (2007). *Geography of West Africa*. Longman Group. 35-37.

Jian, J. F., Jie, C.K., Yoen, K.J., Yong, X., Yang, Z.X. and Qiang, L. J. (2007). Effect of seed priming on seedling growth and disinfection to *Acidovoraxavenae*Subsp. Citrulli in triploid watermelon seeds. *Acta Phyto pathologica Sinica*, 37(5): 528-534

Manigopa, C., Ghosh, J., Virk, D. S. and Prasad, S. C. (2007). Effect of seed priming on germination, growth and yield of horse gram cultivars. *Journal of Arid Legumes.* 4(1): 56 58.

Nascimento, W. M. (2003). Muskmelon seed germination and seedling development in response to seed priming. *Scientia Agricola*. 60(1): 71-75.

Nascimento, W. M. and Aragão, F.A.S. (2004). Muskmelon seed priming in relation to seed vigor. *Scientia Agricola*. 61(1): 114-117.

Rejila, S. and Vijayakumar, N. (2011). Allelopathic effect of *Jatropha curcas* on selected intercropping plants (Green Chili and Sesame). *J. Phytology. Humnabad*. 3(5): 01-03.

Shaban, M. (2013). Effect of water and temperature on seed germination and emergence as aseed hydrothermal time model. *Int. J Adv Biol Biom Res*, 1 (12): 1686 – 1691.

Sivritepe, N., Sivritepe, H.O. and Eris, A. (2003). The effects of NaCl priming on salt tolerance in melon seedlings grown under saline conditions. *Scientia Horticulturae*, 97: 229-237.