BREAKING DORMANCY AND IMPROVING GERMINATION IN SEEDS OF *Solanumaethiopicum* L. (SCARLET GARDEN EGG)

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ABSTRACT

Introduction: *Solanumaethiopicum* (Scarlet eggplant) is an important vegetable in Africa due to the crop's medicinal and economic purposes, but it faces seed dormancy challenges which affect its germination. This study wasaimed at breaking seed dormancy and improvingseed germination in seeds of *S.aethiopicum*.

Methods: The seeds of *S.aethiopicum* used in this study were locally sourced from a market in Alimosho Local Government Area, Lagos, Nigeria. The seeds of *S. aethiopicum* were subjected to different dormancy breaking methods including chemical scarification, mechanical scarification, pre-chilling and hot water treatments.

Results: The seed germination of *S.aethiopicum*was highest in seeds withpre-chilling treatment for 48 hours the germination percentage being at 36%.KNO_3 and H_2SO_4 had a significant effect in breaking seed dormancy at 0.75% and 5% concentrations respectively while HCl at 10% and 20% concentration significantly broke seed dormancy. H_2O_2 and hot water treatment improved germination of the seeds. Also, the seeds were destroyed at higher chemical concentrations. Mechanical scarification and control recorded no germination after 14 days

Conclusion: The study showed that the seeds of *S.aethiopicum* are naturally dormant but pre-chilling the seeds and use of chemical treatments can help in overcoming its seed dormancy and improve germination.

Keywords: Seed dormancy, mechanical scarification, chemical scarification, pre-chilling treatment, *Solanumaethiopicum*.

INTRODUCTION

Some seeds fail to germinate even when all conditions necessary for germination are put in place. Poor seed germination rate limitsthe proliferation of plants for commercialization. Unfavorable environmental conditions, impermeable seed coats, immature embryos from lack of seed development and maturation, and innate chemical inhibitors are some factors that can make viable seeds not germinate (Finch-Savage and Leubner-Metzger, 2006). A seed can be said to have germinated when the radicle emergesfrom the cotyledon.Different methods have been used to break dormancy, including mechanicalscarification, chemical scarification, soaking of seeds in water, and cold shocking. Excessive or insufficient treatment protocols could result in failure to break seed dormancy (McDonald and Copeland, 1997; Vivrette, 2001).

Some seeds can naturally break their dormancy and will germinate if kept for a certain period of time usually for several months in dry storage, this is called after-ripening (Mayer and Poljakoff, 1989). *Solanumaethiopicum*(scarlet garden egg) is a vegetable plant mainly grown for its leaves and scarlet fruits mostly in West Africa (Lester and Seck, 2004). Fruits of *S.aethiopicum*turn red at maturity due to suspected high carotene levels (Seek 1997; Macha, 2005).

Solanumaethiopicum is a very common vegetable in both rural and metropolitansocieties in Africa. In Nigeria, *S.aethiopicum* is an economic plant important for both rural and urban communities. It is cultivated for medical purposes used to treat an array of diseases and food production, eaten raw or cooked by the locals. They are used for various purposes all over the world, including traditionally to receive visitors in the southeasternpart of Nigeria (Lester and Seck, 2004).Members of the Solanaceaefamily produceplants with unpredictable germination of seeds due to dormancyoccurring (Carter and Vavrina, 2001). Thus, this study was aimed at

breaking seed dormancy and improving seed germination in the seeds of *S.aethiopicum*.

MATERIALS AND METHOD

Study area

The research was carried out in the laboratory of the Department of Botany, Lagos State University, Ojo, Lagos State, Nigeria with a Latitude of 6.4670Nand Longitudeof 3.1830E under sterile conditions. Mature fruits of *Solanumaethiopicum* were bought from a local market in Alimosho local government area of Lagos state.The pulps were pulverized and seeds were extracted and dried.

Preliminary experiment

The preliminary experiment adopts the Oluwole*etal*., 2020 method with somemodifications. A test for the viability of the seeds was carried out and unviable seeds were disposed of. Petri dishes were lined with filter paper and cotton wool of the same size. Hence, a preliminary experiment was initially conducted to estimatethe germination time of the seeds of *Solanumaethiopicum*without subjecting them to any treatment. Thus, this served as a template for the ensuing experimental work.

Dormancy breaking experiments

The major dormancy methods used in this experiment were adopted with slight modification from the experiments of Oluwole*etal*., 2020; Jasmina*etal*., 2013; Yogeesha*etal*., 2006 and Imani *etal*., 2011. Four replicates of 25 viable undamaged seeds of *S.aethiopicum*were used respectively for this experiment.

Treatments

Pre-chilling treatment of the *S.aethiopicum*seeds was conducted at 4°C for 96 hours (4 days), 72 hours (3 days), 48 (2 days) and 24 hours continuously. Chemical treatments were of

the*S.aethiopicum*seeds with Potassium nitrate (KNO_3) in concentrations of 0.25%, 0.5%, 0.75%, and 1% solutions for 24 hours (Jasmina*etal*., 2013 with slight modification). Hydrogen chloride (HCl) in concentrations of 40%, 50%, 60%, 70% for 30 minutes and 10%, 20%, 30%, 40% for 15 minutes. Sulfuric acid(H_2SO_4) in concentrations of 10%, 20%, 30%, 50% for 30 minutes and 5%, 10%, 15% for 15 minutes (experiment adopts Oluwole*etal*., 2020 with slight modification). Hydrogen peroxide (H_2O_2) in concentrations of 3.0%, and 6.0% for 24 hours (experiment adopts Imani *etal*., 2011 with slight modifications). Hot water treatment at 50 for about 30 minutes and drying at 37 for 24 hours (Yogeesha*etal*., 2006). Seeds were soaked in the solutions for various periods and then later subjected to germination.The acids were decanted from the petri dishes after each treatment and the seeds of *S. aethiopicum* were cleaned with distilled water and then placed in petri disheswhich contained filter paper and cotton wool which served as a growth surface. Mechanical scarification of the seeds was also carried out by pouring sand into a zip lock and placing the *S. aethiopicum* seeds into it.The zip lock was shaken for a particular period of time and the sand was sieved. The seeds were placed in petri dishes which contained filter paper and cotton wool which served as a growth surface. The untreated *S. aethiopicum*seeds served as the control.

Germination

Germination test recorded in percentage was conducted using the standard ISTA method (1985) by sowing 25 seeds in petri dishesin 4 replicates for all the treatments and controls. The emergence of radicles from the seeds was an indicator that germination had occurred. Seeds that were fresh but didn’t germinate were termed and recorded as fresh ungerminated seeds.

Statistical analysis

The data obtained from the study of this experiment wererecorded in germination percentage.

Total GP = SNG / SNO X 100%.

Where; GP is germination percentage, SNG serves as the total number of germinated seeds and SNO is the number of viable undamaged experimental seeds (Close and Wilson, 2002; Danthu*et al*., 2003).

Results

Influence of Pre-chilling treatments on the seeds of *Solanumaethiopicum*:

Results presented in Table 1, show the germination percentages of *S.aethiopicum*seeds subjected to pre-chilling treatment. Seeds chilled for 24 hours had a germination percentage of 12%, and seeds chilled at 48 hours, had a germination percentage of 36%. Seeds chilled for 72 hours had a germination percentage of 20% and seeds chilled for 96 hours had a germination percentage of 12%. The result shows that chilling seeds of *S.aethiopicum* for 48 hours is the best method to break dormancy using the pre-chilling treatments.

Influence of Chemical scarifications on the seeds of *Solanumaethiopicum*:

Seeds of *S.aethiopicum* in KNO_3 concentrations of 0.25%, 0.5%, 0.75%, and 1.0% for 24 hours turned bright yellow, and in higher concentrations of KNO_3 the seeds attained a bright yellow colorfaster becoming almost transparent. KNO_3 at concentrations of 0.25%, 0.50%, 0.75%, and 1.0% broke seed dormancy of the seeds with the germination percentages recorded as 16%, 12%, 20%, and 8% respectively.

The seeds of *S.aethiopicum* failed to germinate at concentrations of 20%, 30%, and 50% H_2SO_4 for 30 minutes and turned black. Another experiment was done but with a reduction in concentration and duration of H_2SO_4which the seeds were subjected to. Using H_2SO_4 at concentrations of 5%, 10%, and 15% for 15 minutes showed a positive effect. For 5%, 10%, and

15% concentrations ofH_2SO_4 for 30 minutes broke the seeds' dormancy with the evidence of radicle emergence, although the radicle length was short. The germination percentage of H_2SO_4 for the concentrations of 5%, 10%, and 15% were 8%, 4%, and 4% respectively.

Seeds of*S.aethiopicum*treated with higher concentrations of HCl(40%, 50%, 60%, and 70%) failed to break dormancy. The seeds turned black and no emergence of radicle was noted. Further experiments took place to identify whetherHCl could break the dormancy of *S. aethiopicum*by reducing time and concentration.HCl concentrations of 10%, 20%, 30%, and 40% broke seed dormancy of the seeds with germination percentages of 8%, 8%, 4%, and 4% respectively.

Solanumaethiopicum seeds soaked with H_2O_2 at a concentration of 6% for 24 hours broke seed dormancy with a germination percentage of 4%.

Concentration H_2O_2 at 3% failed to break *S. aethiopicum*seeds dormancy since no radicle emergence was accounted for at this stage.

Influence of hot water on the seeds of *Solanumaethiopicum*:

Hot water treatment broke the seed dormancy with the emergence of radicle which is valid proof that germination has occurred with a germination percentage of 8%.

Influence of mechanical scarification on the seeds of *Solanumaethiopicum*:

The results showed that mechanical scarification and control treatments methodshad no germination recorded in the two treatments.

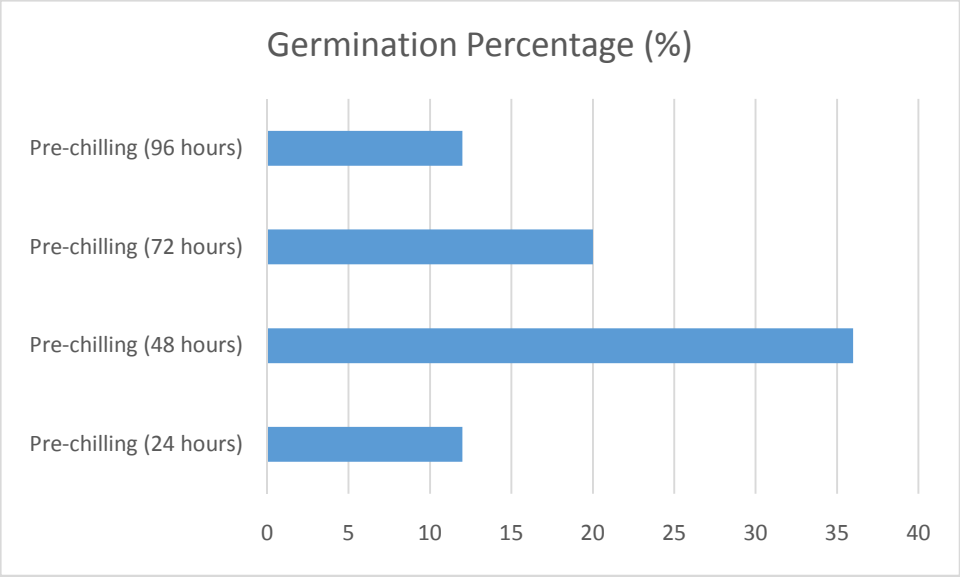

Figure 1: Influence of Pre-chilling treatments on germination of *S. aethiopicum*

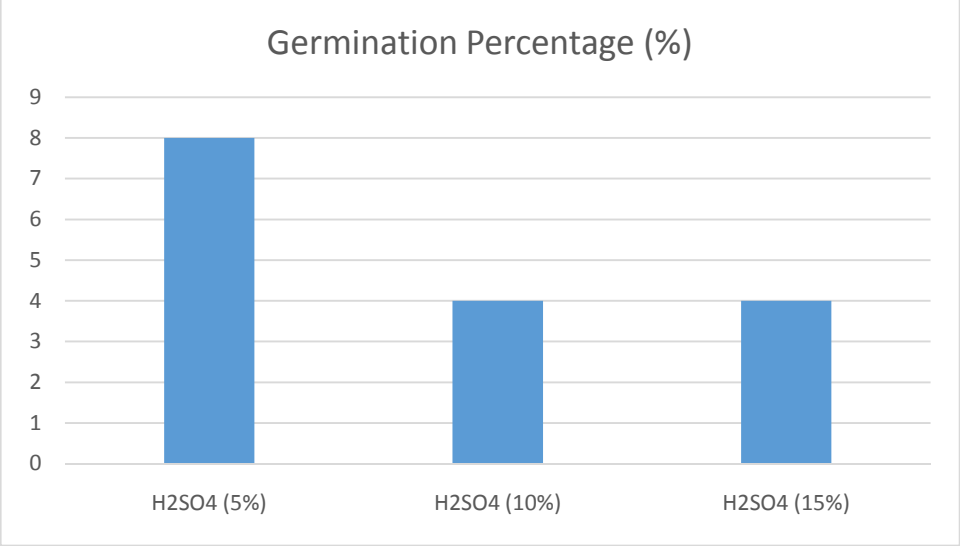

Figure 2: Influence of Sulfuric acid treatments on germination of *S. aethiopicum*

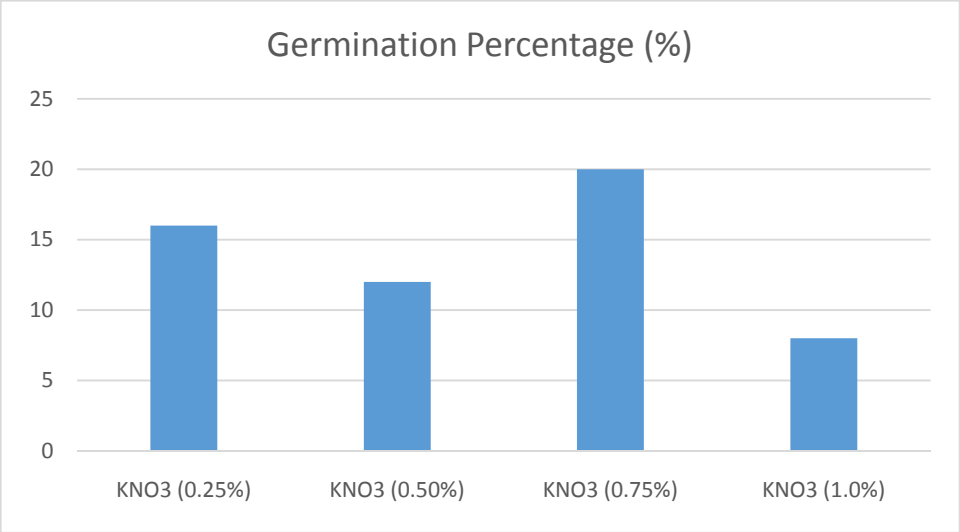

Figure 3: Influence of Potassium nitrate treatments on germination of *S. aethiopicum*

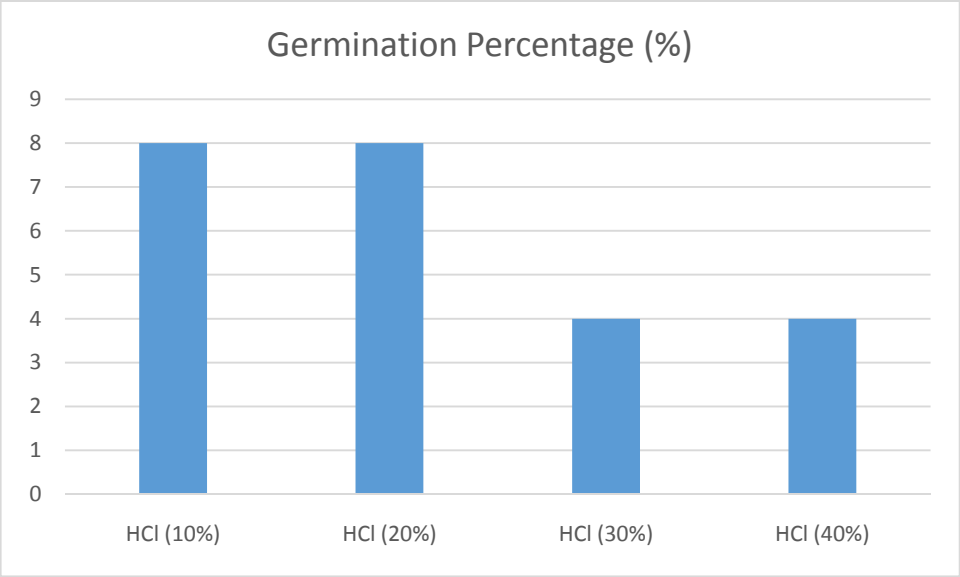

Figure 4: Influence of Hydrogen chloride treatments on germination of *S. aethiopicum*

Discussion

Potassium nitrate (KNO_3), Sulfuric acid (H_2SO_4), Hydrogen chloride (HCl) and Hydrogen peroxide (H_2O_2) at different concentrations were used to improve seed germination in *Solanumaethiopicum*. From the result,it can be deduced that Potassium nitrate (KNO_3) increased

the energy of the seeds thereby enabling the germination of the seeds. Nitrate is a form of nitrogen which plants rely on. Many studies have shown that pre-treatment of seeds with potassium nitrate has been shown to improve germination energy,and total germination percentage in seeds of some eggplants and increase the vigour of the plant (Vanpijlen*et al.*, 1995; Geetharani and Ponnuswamy, 2002; Yoganand*aet al.*, 2004). According to Bethke*et al.*, (2007), nitrogen is an important constituent of amino acids and breaks dormancy which promotes the germination of seeds in a variety of species potentially as a way of showing the availability of nitrogen in the soil. Sulfuric acid in this experiment was able to break the dormancy of the seeds but with a small radicle length. Some researchers have shown that Sulfuric acid has the potential to be used in breaking the dormancy of various plants other than *Solanumaethiopicum* such *as Parkiabiglobosa, Prosopisafricana, Ceibapetandra, Canna indica*L etc.

Pre-chilling treatment was effective in this study. Seeds chilled for 48 hours gave the best result showing that germination growth has occurred. The seeds pre-chilled had longer radicles than the other treatments used in this study. As observed in this study, this finding was in accordance to Jasmina*et al.*, 2013, in which seeds treated with low temperature for 48 hours recorded the best results. Hayati*et al.*, 2005 reported that it took between 1-5 days for dormancy to be broken in seeds of *Solanum* species treated withlow-temperature treatment. This was in tandem with the results obtained in this study, most of the seeds' radicles emerged between the 2^{nd} day to the 5^{th} day.

Hot water treatment had little effect in breaking the dormancy of *Solanumaethiopicum*seeds. This agreed with the findings of Yogeesha*et al.*, (2006) where it was reported that hot water scarification showed little effect in breaking dormancy in seeds of *Solanummelongena* L.

CONCLUSION

In this course of study, it was concluded that seeds of *Solanumaethiopicum* are naturally dormant. This dormancy was broken by pre-chilling treatments which indicated an effective germination growth rate, especially in the seeds of *Solanumaethiopicum* chilled for 48 hours. Also, dormancy was terminated by different chemical treatments such as Potassium nitrate (KNO_3), Sulfuric acid (H_2SO_4), Hydrochloric acid (HCl) and Hydrogen peroxide (H_2O_2) by soaking the seeds at different time intervals. Potassium nitrate (KNO_3) did better in breaking the seeds compared to the other chemical treatments. In the future, using a lesser concentration and soaking the seeds for a lesser amount of time could better increase the emergence of the radicle when using chemical treatments like Sulfuric acid (H_2SO_4) and Hydrogen chloride (HCl).

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