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Seed Priming Effects on Germination of *Aeschynomene histrix* Poir

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Abstract: ***Aeschynomene histrix*** **Poir. commonly known as porcupine jointvetch is a member of the fabaceae family with the potentials to contribute to both livestock-forage and improved fallow systems in the tropics. One of the major problems associated with *A. histrix* is its hard seed coat which results in poor stand establishment because of reduced germination and non-uniform seedling emergence. An experiment was conducted to evaluate the effect of seed priming on germination and seedling establishment of *A. histrix*. The seeds were subjected to mechanical, chemical, halo and hydro-thermal priming prior to sowing. The pre-treatments involved puncturing the seed coats, immersing seeds in concentrated sulfuric acid (H_2SO_4) for 5 - 120 minutes, treating seeds with ImM, 10mM and 100mM potassium nitrate (KNO_3) and soaking seeds in hot water (80℃) at different time intervals. Primed seeds were incubated in 9cm Petri dishes at room temperature in a completely randomized design with four replications and germination percentages recorded for a period of fourteen days. The result obtained indicate that the various seed priming methods effectively enhanced the germination percentage of *A. histrix* when compared with the control. The percentage germination of mechanically punctured seeds was 50% while that of intact seeds was 0%. Treatment with H_2SO_4 for 60mins enhanced germination by 70%. The germination percentage of halo-primed punctured seeds with KNO_3 was 0mM (30%), 1mM (52.5%), 10mM (42.5%) and 100mM (32.5%) while it was 0% for intact seeds irrespective of the concentration. The highest germination of 80% which was recorded in hydro-thermal primed seeds at 80℃ for 5 minutes can be recommended for enhancing seed germination and uniform nursery establishment for this species.**

Keywords: ***Aeschynomene histrix*****, seed priming, germination.**

1. INTRODUCTION

Legumes are members of the Fabaceae family which comprises of about 700 genera and 19,000 species (Tungmunnithum *et al*., 2021). They possess a unique floral structure with a pod-like fruit and nodule formation system in the root. About three thousand years ago, many species of this family have been of great economic importance to man (Liu, 2020). According to Li *et al.* (2021), the cultivation of legumes has approximately occupied 15 % of the earth's surface. Forage legumes are commonly used as cut fodder or grand pasture. Fodder may either be fed directly to livestock or used after conservation as fermented green matter (silage) or dried for products like hay. Pastures may also be grazed directly or cut and used in feed rations for livestock. Forage also has an important role in marginal areas; maintaining the natural resource base through soil stabilization, preventing soil erosion, and contributing to soil fertility through microbial nitrogen fixation and organic matter. Some forage legumes are also used to control the leaching of nutrients from soils and pests and diseases of other crops. The search for legumes to improve ruminant production and maintain soil fertility in agricultural cropping systems is an important challenge in tropical pasture research (Martin *et al*., 2020). In the West African savanna where the natural vegetation is dominated by grasses that are low in crude protein and digestibility particularly during the dry season, the introduction of well adapted legumes seems to be a viable option to overcome feed

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constraints and to increase the efficiency of fallow periods. Increasing intensity of agriculture in this region prevents long fallow period, causes reduction in grazing lands and forces livestock and crop production to compete for the same resources (Chen *et al.*, 2021). Since being identified in the 1980s as a species with potential medium for dry to dry mass and well drained soils (Houndjo *et al.*, 2018), the tropical legume, *A. histrix*. has been of interest in pasture research.

Aeschynomene histrix, commonly known as porcupine jointvetch is a member of the legume family and it is characterized by papilionaceous flowers and jointed fruits or loments. Its species ranges from herbaceous annuals to woody perennials. They are mostly found in the savannah, grassland, pine woods, rocky hill sides and dumpsite. *A. histrix* appears to have potentials to contribute to both livestock-forage and improved fallow systems in the tropics (Yapi and Kimse, 2019). It can also act as a fast-decomposing green manure and also a threat to some pests that attack plant. However, one of the major problems associated with *A. histrix* is its hard seed coat which results in poor stand establishment because of reduced germination and non-uniformed seedling emergence. It is therefore important to reduce the hard seed coat and improve germination for successful stand establishment of this species. This study aimed at enhancing seed germination of *A. histrix* using different seed priming methods.

2. MATERIALS AND METHODS

The matured dried seeds of *A. histrix* were obtained from the International Institute of Tropical Agriculture (IITA), Onne, Rivers State and subjected to flotation test to determine seed viability. The experiment which was carried out at the Majors Laboratory of the Plant Science and Biotechnology Department, University of Port Harcourt, Rivers State, was laid out in a completely randomized design (CRD) with 4 replicates and 10 seeds per rep. The seeds were sown in a 9 cm Petri-dish lined with cotton wool and regularly moistened with 3 ml of distilled water to prevent desiccation. The seeds were observed daily and germination recorded at the emergence of the radicle for fourteen days.

Seed Priming (Treatment) Methods

Mechanical Priming: This was carried out by carefully puncturing the seed coat with a sharp needle. The seeds were then germinated as already described in the germination procedure. Another set of seeds which served as the control were not punctured (intact seeds).

Chemical Priming with Sulfuric Acid (H_2SO_4): Seeds were chemically scarified by immersing intact seeds in concentrated sulfuric acid at different time intervals of 5, 15, 30, 60, 90 and 120 minutes. The seeds were removed, thoroughly rinsed in distilled water and incubated.

Halo-priming with Potassium Nitrate (KNO_3): The effects of potassium nitrate on the germination of *A. histrix* seeds was evaluated on both punctured and intact seeds using different concentrations of 0mM, 1mM, 10mM and 100mM.

Hydro-thermal priming: The temperature of water for treating seeds varies from 115 to 125 ^oF depending on the crop with a treatment duration of 10 to 60 minutes. Seeds of *A.* histrix were soaked in hot water with a temperature of 80^{o}C for 5, 15, 30 and 60 minutes prior to sowing.

3. RESULTS

Germination response of *A. histrix* seeds to mechanical scarification

The percentage germination of punctured and intact seeds incubated for 14 days at room temperature revealed that the germination of punctured seeds was 50% while that of the control (intact seeds) was 0%.

Germination of *A. histrix* seeds treated with sulfuric acid (H_2S0_4)

The germination of *A. histrix* seeds soaked in H_2S0_4 revealed that H_2S0_4 enhanced germination at different time duration over the control. The results for 60 minutes was 70%, 30 minutes was 67.5%, 15 minutes was 52.5% while 5 minutes was 47.5% . Increasing the treatment duration to 90 and 120 minutes had a negative effect and was 0% as the control. (Figure 1).

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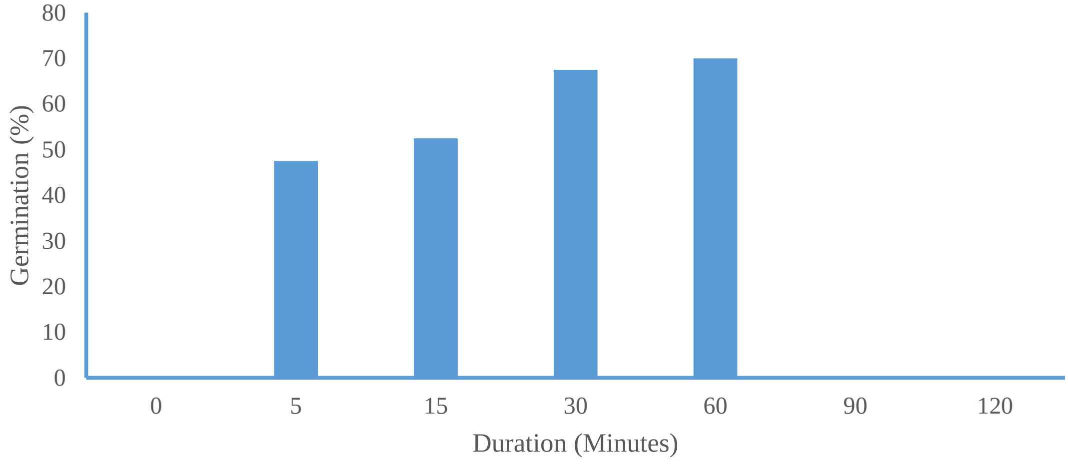

Figure 1: Germination percentage of *A. histrix* seeds soaked in sulphuric acid at different time intervals

Germination of *A. histrix* seeds primed with Potassium Nitrate (KNO_3)

The germination of the seeds showed that potassium nitrate enhanced germination only on punctured seeds of *A. histrix* with 1mM having 52.5 % while 10mM, 100mM and control had 42.5%, 32.5% and 30% germination, respectively (Figure 2). The intact seeds treated with the same concentration of potassium nitrate had 0% germination.

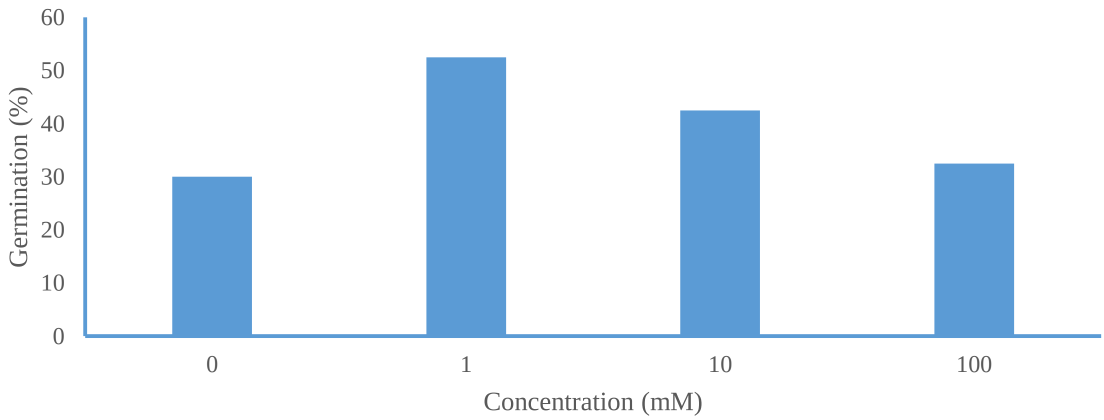

Figure 2: Germination percentage of *A. histrix* seeds treated with different concentrations of potassium nitrate.

Germination of *A. histrix* seeds primed in hot water at 80°C.

The percentage germination of intact seeds of *A. histrix*; soaked in hot water at a temperature of 80 °C revealed that the highest percentage (80%) germination was recorded at 5 minutes followed by 37.5% at 15 minutes, 27.5% at 30 minutes and 2.5% 60 minutes as indicated in Figure 3.

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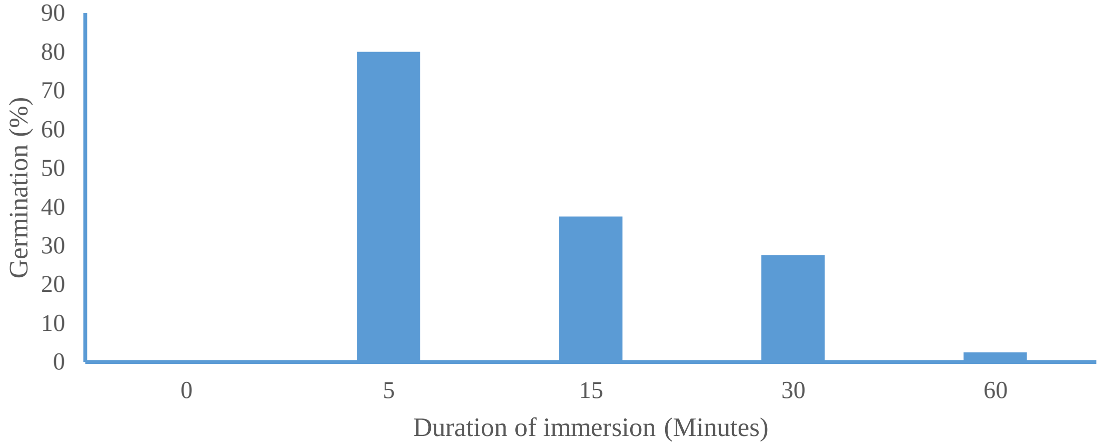

Figure 3: Germination percentage of *A. histrix* seeds soaked in hot water at different time interval

4. DISCUSSION

In this study, the effects of chemical, mechanical halo and hydro-thermal priming treatments were investigated on the germination of *Aechynomene histrix* seeds. The results showed that the various treatments used increased the rate and percentage germination of the seeds significantly. However, the effectiveness of mechanical scarification may vary depending on the genus and species of the seeds. The percentage germination of mechanically scarified seeds of *A. histrix* were high (50%) and low for the intact seeds (0%). According to the findings of (Houndjo et al., 2021) mechanical scarification with sandpaper was seen to be the greatest of all other techniques with 96% germination. Similarly Gao et al., (2020) reported that cracked seeds of *Cercis chinensis* absorbs more water by 85.6% compared to intact seeds with 21.8% for the period of 120hrs.

Chemical priming of *A. histrix* seeds with concentrated sulfuric acid increased percentage germination progressively from 5 minutes (47.5%), 15 minutes (52.5%), 30 minutes (67.5%) to 60 minutes (70%); while for 90 and 120 minutes, it led to the damaging of the seed coat and embryo. In relation to other results, it was recorded that immersion of seeds for the period of 18minutes is best obtained for uniform and fast germination in seeds of *Centrosema pubescens* compared to the control (Rusdy, 2015). The Seeds of *A. muricata* treated with sulfuric acid (50%) for 5 seconds was seen to produce highest germination percentage of 60% when compared to the control (Dada *et al.*, 2019).

According to Asaadi (2017), potassium nitrate induced germination of *Lepidium latifolium* and the seeds were released from physical dormancy while Utami *et al.* (2021) reported that at 10% of KNO_3 the seed dormancy of candle-nut was shortened to 2weeks. In this study, the percentage germination of scarified seeds, treated with different concentrations of potassium nitrate were high with the following results; 1mM (52.5%), 10mM (42.5%) and 100mM (32.5%) when compared to unscarifed seeds indicating that scarification improves germination.

The seeds of *A. histrix* soaked in hot water at 80^{o}C showed a decrease in percentage germination with increase in treatment duration with 5 minutes (80 %), 15 minutes (37.5 %), 30 minutes (27.5 %) and 60 minutes (2.5 %) over the control; indicating that hot water is more effective in improving the germination of *A. histrix* seeds. The results of Alasa, 2021 states that to break dormancy of *A. histrix,* hot water scarification for 2 minutes at 80℃ maybe more beneficial when compared to cattle digestion. Also the results of Jones et al., 2016 shows that thermal scarification was effective on slivery lupine for the period of 60 seconds at 95℃.

5. CONCLUSION

Forage legumes are highly valuable crops. However, the hard seed coat in many of these forage legumes is one of the major constraints in the cultivation of these crops. The seeds of *A. histrix* can be said to be permeable to water uptake at a very slow rate thereby inhibiting germination because of the hard seed coat which is the major cause of poor germination in seeds. Treatments such as mechanical, chemical and thermal scarification promotes germination of *Aeschynomene histrix* as observed in this study. The results showed that hydro-thermal scarification (hot water treatment at 80°C for 5 minutes) was more effective in enhancing germination than chemical and mechanical scarification.

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