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ENHANCING STORED SEED GERMINATION OF *PSOPHOCARPUS TETRAGONOLOBUS* (L.) DC. [WINGED BEAN]

Blessymole K Alex[1], Eapen P Koshy[2] and Philip John[3]

1 Department of Molecular and Cellular Engineering, Jacob School of Biotechnology and Bioengineering, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad. 211007.

2 Department of Tissue Engineering, Jacob School of Biotechnology and Bioengineering, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad. 211007.

3 Department of Science, Walthamstow Science Academy, Walthamstow E17 5DP, London.

ABSTRACT

Psophocarpus tetragonolobus(L.) DC., a potential backyard crop, has immense agricultural possibilities. An outstanding feature of this plant is that, it contains significant amount of protein in all the parts of the plant, i.e. seeds, pods, leaves and roots, all of which are edible. One of the major problems in achieving rapid propagation of this wonder crop is the very low rate of germination of the stored seeds. There are many controversial reports regarding the germinability of the seeds of winged bean on storage. It was observed that there is a loss in germination potential of Psophocarpus tetragonolobus and the present study was conducted to assess the loss of viability and find out methods of increasing germination of the stored seeds. The germination was found to be decreasing from the first month of storage and completely ceased after six months of storage. The germination of four month stored seeds normally was 15%, but upon various treatments it could be increased. Since the poor germination is attributed to the very hard seed coat, various chemical treatments at different temperature regimes were given to overcome the problem. Seeds stored for more than six months could not be germinated even after scarification. Maximum seed germination of 100% was observed when the seeds were treated in 0.5% KNO_3 at 50^0C and 90% H_2SO_4 at 60^0C.

Keywords: Psophocarpus tetragonolobus, Winged bean, seed viability, seed germination, scarification.

[I] INTRODUCTION

The worldwide output of agriculture is unable to meet even the most basic needs of a sizable fraction of humanity suffering from hunger and malnutrition. Yet, global food security is increasingly based on a narrow range of animal and plant species. About 95% of the worlds' food energy needs is provided by just 30 plant species and 50% of the requirement for protein and calories is met just by maize, wheat and rice [1]. But there are many underutilized crops that can make important contributions to the nutrition and health of people in developing countries. The species of leguminosae includes very important vegetable crops due to its high protein content in seeds as well as in tubers and the moderate oil content in its seeds. *Psophocarpus tetragonolobus* (L.) DC., commonly known as 'winged bean' is an underutilized leguminous crop, which received less research attention since emphasis has been on cash crops [2].

The attractive features of the plant are, the whole plant is edible and all the parts are

highly protenaceous when compared to other plants. The tubers contain 20% protein in dry weight. This amount is superior to other tubers such as Yam (2%), Cassava (1%), and Sweet potato (2%). The percentage of crude protein of the seeds (29.8-37.5%) is comparable to that of other legumes [3].

It grows well in the hot and humid tropics, where heavy rains create unfavourable conditions to cultivate other food crops. But the delayed and poor germination of seeds is a serious problem experienced by the growers. The low percentage of seed germination is attributed to its hard seed coat rather than to seed dormancy [4].

[II] MATERIALS AND METHODS

2.1. Assessment of viability loss in stored seeds

Seeds were collected from the Botanical garden of Kerala Agricultural University, Trichur, and stored in normal room temperature. For checking the loss of viability of seeds on storage at room temperature, experiments on seed germination were conducted at monthly intervals with seeds stored for six months. Seeds were soaked in water for 24 hrs and then sown in pots. The germination percentage was calculated on the fifth day of sowing the seeds.

2.2. Enhancement of germination potential

In order to find out the ways for circumventing seed dormancy, the seeds were divided into batches of 25 and each batch was subjected to various treatments. The seeds were treated with ordinary tap water, 100% HCl, 80% H_2SO_4, 0.1% KNO_3, 0.5% KNO_3 and 1.0% KNO_3 solutions in different containers. Each treatment was tried in four different temperatures such as 40^0C, 50^0C, 60^0C and 70^0C. Appropriate temperature mileu were given to each treatment for five minutes utilizing a hot air oven.

After the treatments the seeds were thoroughly washed in tap water to remove all traces of the chemicals on the seed coat. They were then sown in polythene bags filled with potting mixture. The bags were irrigated at intervals with special care to prevent water logging and maintained in green house. Observations were recorded regularly.

[III] RESULTS

3.1. Viability loss in stored seeds

Immediately after harvesting, 96% seed germination was observed. The viability of the seeds declined, by keeping at room temperature, to 15 % after four months of storage **[Figure-1].** There was a decline in the viability of the seeds from the initial 96 % to 88% after the first month, 72% after two months, 52% after three months, 15% after four months and the germination was found to cease completely after six months. It was also observed that the seed coat binds onto the cotyledon more firmly from the fourth month onwards that makes it difficult to peel off the seed coat from the cotyledons.

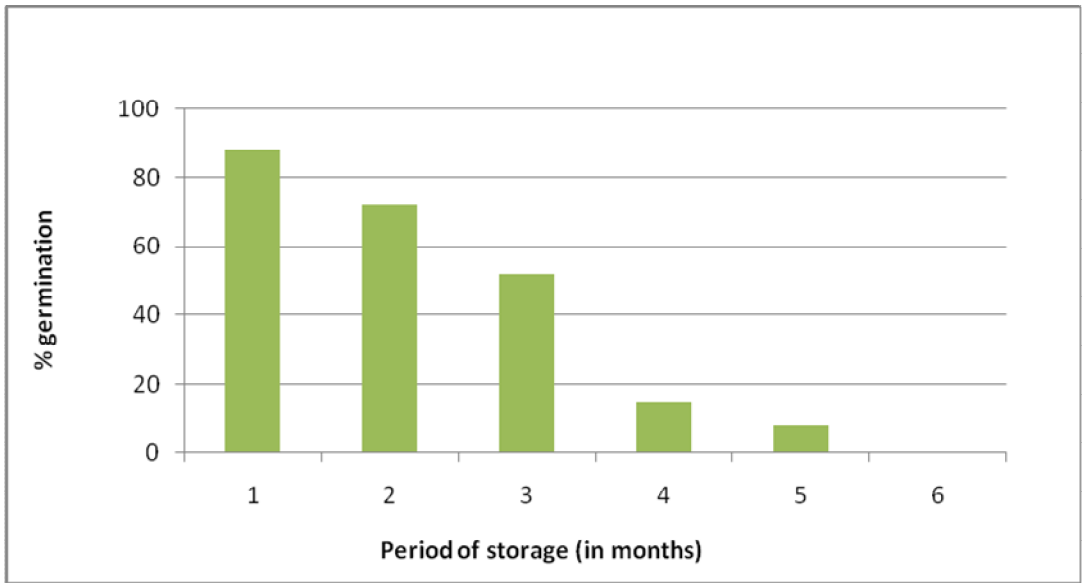

Fig: 1. Reduction in seed germination on storage

3.2. Improvement in germination potential

Seed germination studies were conducted for enhancing the germination at the fourth	Mean No. of seeds germinated ± S.E			
	40 ^{0}C	50 ^{0}C	60 ^{0}C	70 ^{0}C
H_2O	3.43± 0.4^{k}	10.29± 0.2^{g}	11.14± 0.3^{fg}	8.29± 0.3^{hi}
HCl (100%)	4.71± 0.2^{j}	13.43± 0.3^{e}	15.29± 0.3^{d}	9.00± 0.5^{h}
H_2SO_4 (80%)	16.00± 0.4^{d}	20.86± 0.3^{b}	24.86± 0.1^{a}	20.14± 0.1^{b}
KNO_3 (0.1%)	5.00± 0.2^{j}	10.86± 0.6^{fg}	11.57± 0.4^{f}	15.29± 0.5^{d}
KNO_3 (0.5%)	18.86± 0.3^{c}	24.43± 0.3^{a}	13.71± 0.4^{e}	7.29± 0.4^{i}
KNO_3 (1.0%)	5.57± 0.5^{j}	7.57± 0.4^{i}	11.86± 0.5^{f}	5.43± 0.4^{j}
Control	2.86± 0.3^{k}			

Table: 1. Effect of various treatments on seed germination of *Psophocarpus tetragonolobus* (L.) DC:

Each treatment consisted of 25 seeds; Values are means of 7 replicates. Mean values followed by the same letters are not significantly different at $p \geq 0.05$ DMRT

[IV] DISCUSSION

The most common and reliable method of testing seed viability is the germination test. In seed testing, germination is defined as the "emergence and development from the seed embryo of those essential structures which, for the kind of seed tested indicate its ability to develop into normal plant under favourable conditions in the soil" [5].

Seeds generally germinate readily on imbibition of water if they are harvested at the right time, dried properly and aptly stored, either immediately or after a period

of dormancy depending on the species. Even though, generally legumes do not show seed dormancy, there are reports, that dormancy exists in some varieties of *P. tetragonolobus* (L.) DC. [6].

A perusal of literature revealed that the germination percentage of seeds of *P. tetragonolobus* varied in different varieties (40- 80 %) [7,8]. However, in the present study, a germination percentage of 96% was achieved immediately after harvesting. This difference existing in different varieties of *P. tetragonolobus* substantiates that the genotype of the plant has a role in determining the germinability of the seeds. There was a decline in the percentage of germination of the seeds of *P. tetragonolobus* on storage and was found to cease completely after six months. However, Hew and Lee [9], observed that in a local cultivar of Sri Lanka, the seed germination was reduced by 50% when fresh seeds were stored for two weeks and no germination was observed after two months of storage. But the report of Senanayake and Thiruketheeswaran [10] was in paradox to this observation. According to them, seeds stored in dry pods at room temperature for 12 months had comparable viability and better vigour than fresh seeds.

For increasing the percentage of seed germination, the seeds (four months after harvest) were treated with various chemicals at different temperatures in the present study. There are reports on the use of various physical and chemical treatments for increasing the germination of seeds [4,6,7,8,11,12,13,14,15].

Ninety to hundred percentage germination could be achieved when seeds were treated with 80% H_2SO_4 at 60^0C and 0.5 % KNO_3 at 50^0C for 5 minutes. An increase in temperature upto 50^0C for all treatments was found to be effective for increasing the germinability of the seeds. 70^0C was found to be supraoptimal for seed germination except in 0.1 % KNO_3, which gave the maximum response of 60 % at 70^0C. Solanki and Joshi [4], has reported the detrimental effect of temperature above 65^0C on germination when H_2SO_4, GA_3 and KNO_3 were used.

In the present study, chemical treatment was found to be necessary for enhancing seed germination rather than depending on temperature difference alone. Only a slight increase of germination (maximum of 45%) was observed when tap water was used at different temperatures.

Various workers have reported the low seed germination percentage (40-60%) of *P. tetragonolobus* [4,7]. Increase in hardness of the seed coat as well as hard binding of the seed coat to the cotyledons has been observed in seeds as storage progressed. In the present study, increase in the percentage of seed germination observed while on chemical and temperature treatment may be due to the increased penetration of water into the seeds, and consequently triggering of the physiological processes in the seeds leading to germination.

[V] CONCLUSION

The conclution drawn from the present study is that the germination of stored seeds of *Psophocarpus tetragonolobus* (L.) DC. can be increased by employing chemical as

well as temperature treatments. Treatments with 0.5% KNO_3 at 50^0C and 80% H_2SO_4 at 60^0C gave 100% seed germination in seeds stored for four months. These treatments can thus be advocated for increasing the germination of stored winged bean seeds.

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