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SHORT COMMUNICATION

Note on True Seed and Tuber Characteristics of Soh-phlang (*Flemingia procumbens* Roxb.)

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Soh-phlang (*Flemingia procumbens* Roxb.) was studied for seed germination for long time conservation. The dormancy breaking protocols were developed for germination and propagation through seed was attempted to throw light on regeneration potential of the germplasm through seed and long-term storage. Tuber size and seed size were compared and data was presented.

Introduction

Majority of the domesticated legumes are propagated by true seed. However, some of the leguminous species of well-known crops used for edible tubers viz, *Pachyrhizus erosus*, *Vigna vexillata* and *V. subterranea* that produce seeds, while many others like winged beans (*P. tetragonolobus)* also called Goa beans have edible highly nutritious seeds as well as leaves, pods and tubers.

There is a growing recognition of the fact that vegetative and seed propagation are complementary rather than competitive and are used for breeding programmes. The *ex-situ* conservation through seed bank is a crucial complement to the *in-situ* conservation and restoration of species and habitats (Chapman *et al*., 2019). Poor synchrony of flowering, flower and fruit drop during pod development and rapid shattering of ripe seed in many legumes might be the major cause of its poor seed yield and so will be difficulty in seed conservation.

Some of the less-known species of *Flemingia species are*, *F. semialata* and *F. macrophylla* are used for rearing of lac insect in Jharkhand, Chhattisgarh, West Bengal and Odisha but have remained ignored of their genetic improvement (Kumar *et al*., 2017). Through use of different plant growth regulators on morpho-physiological and biochemical characters study demonstrated improved seed set and yield in *Flemingia semialata* (Sinha *et al*., 2016).

One of the lesser-known species, *Flemingia procumbens* Roxb. locally called soh-phlang, is an indigenous species propagated only by the root tubers (Pandey *et al*., 2018). There are meager studies on the genetic resource value except a few latest sudies on nematicidal properties (Pandey *et al*., 2018; Gawade *et al*., 2019). Soh-phlang (*Flemingia procumbens* Roxb.) is propagated by tubers and has not been reported for multiplication through true seeds. The propagation and conservation aspects through seed are not worked out. There are no reports on propagation through seed nor is there any study on the genetic improvement or seed set attempted.

To support the genetic resources study on *Flemingia procumbens* Roxb. the present work was undertaken with the objective to investigate: 1) the variation in seed vs seed tubers; and 2) the seed germination methods. The information generated here will be used by the soh-phlang growers to create variability and researchers for seed conservation under long-term storage.

Materials and Methods

The mature tubers collected during an exploration to Jaintia and Khasi hills in 2017 were conserved using standard procedures for conservation (Nivedhitha *et al*., 2018). The tubers of a total of 26 accessions were replanted in 2018 at experimental farm at NBPGR, RS Umiam, Shillong in raised bunds of size 1 x 2m in the month of April 2018. The crop after 6 months yielded

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pods and mature seeds were harvested in December 2018. Data were recorded for all accessions at various stages of flowering and seeding. Healthy pods were harvested and data on seed size, number of seeds/pod, tuber number per plant was interpreted for all the accessions. Data on seed size and 100 seeds weight was noted using Vernier caliper and weighing balance respectively. Vouchers of the herbarium specimens with seeds were deposited in the NHCP (HS23620-45).

Since many accessions did not produce healthy seeds/pods, the data on germination study is taken in the pooled samples. The mature seeds were separated from the pods and classified on the basis of seed coat colour and size and divided into three lots: on the basis of seed colour and shape. The first lot with the shrivelled seeds were not included in the germination experiment as they appeared immature; only fully mature seeds of black and brown colour were subjected to germination test.

To address the germination procedures, the harvested seeds were mechanically scarified and plated on germination paper. First count was taken on the 7th day when radicle emerged and final count on 21st day. At the end, the results were expressed as percentage by number of normal and abnormal seedlings and hard, fresh and dead seeds (ISTA, 2015).

Results and Discussion

Morphological Data

The size of the flower ranged from 0.53-0.87cm. The original size of the collected tubers and those harvested for study were examined for length x diameter (Table 1a,b). The reduced diameter of the tubers may be accounted for due to the soil conditions and cultivation procedures. During pod maturation stage there was high rate of pod fall that resulted in poor pod harvest. It was a general observation that before the seeds could mature fully there was pods senescence. The number of aborted seeds in the species is directly related to domestication, which confirms that it can be one of the characters associated with the quality of fruit (Simmonds, 1997). In wild soh-phlang there are no reports on propagation methods and seed number per pod to support these observations.

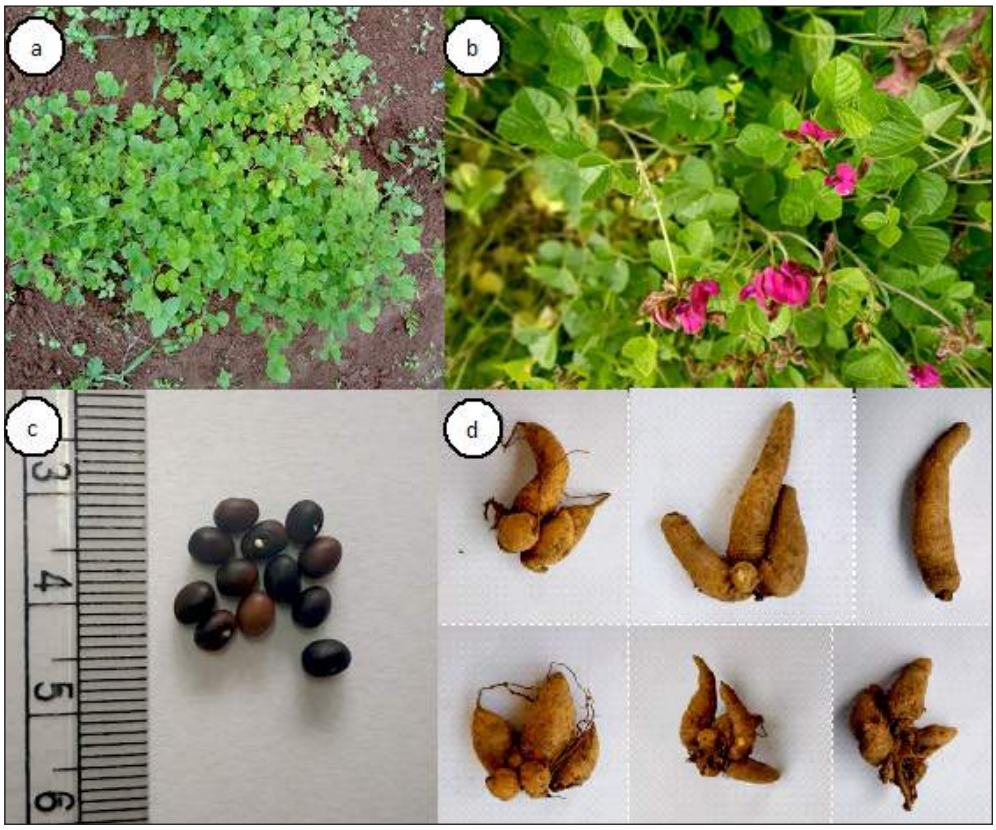

Fig. 1. Soh-phlang at various stages of study: a) crop grown in NBPGR Regional Station, Shillong experimental field; b) close-up view of vegetative and flowering stage; c) the black mature seeds harvested and d) tuber variation in harvested germplasm at NBPGR Regional Station Shillong, Umiam

Table 1a. Descriptive statistics of quantitative characters of Soh-phlang

Traits	Minimum	Maximum	Range	Mean	Std. Deviation	CV
Flower size (cm)	0.33	0.87	0.54	0.69 ± 0.02	0.13	18.28
Pod size (cm)	0.37	0.6	0.23	0.55 ± 0.01	0.06	10.87
Seed size (cm)	0.23	0.53	0.3	0.41 ± 0.01	0.06	14.39
10 seed weight (g)	0.19	0.44	0.25	0.38 ± 0.01	0.07	17.63
Tuber size (cm)	10.07	20.83	10.76	14.91 ± 0.63	3.2	21.45

Table 1b. Flower pod and seed size and average tuber size of 26 accessions of Soh-phlang

Accession No	Flower size (cm)	Pod size (cm)	Seed size (cm)	10 seed weight (g)	Average tuber size (length x width in cm)
IC627400	0.33	0.53	0.27	0.23	7.166 x 1.76
IC627401	0.47	0.50	0.40	0.40	7.16 x 2.23
IC627402	0.49	0.37	0.23	0.19	6.66 x 1.60
IC627403	0.70	0.53	0.37	0.38	7.83 x 2.66
IC627404	0.70	0.60	0.43	0.42	9.50 x 1.93
IC627405	0.67	0.60	0.40	0.38	5.66x 2.10
IC627406	0.73	0.53	0.40	0.41	6.33 x 2.16
IC627407	0.73	0.60	0.53	0.39	7.66x 1.63
IC627408	0.73	0.60	0.43	0.44	7.50 x 1.56
IC627409	0.73	0.60	0.40	0.40	6.00 x 2.10
IC627410	0.67	0.57	0.40	0.42	4.33 x 2.63
IC627411	0.67	0.50	0.37	0.39	6.50 x 2.06
IC627412	0.60	0.53	0.43	0.24	4.66 x 2.16
IC627413	0.63	0.53	0.40	0.33	6.66 x 2.06
IC627414	0.83	0.60	0.43	0.44	9.50x 2.16
IC627415	0.87	0.53	0.43	0.33	6.16 x 2.26
IC627416	0.73	0.57	0.47	0.43	5.16 x 2.16
IC627417	0.83	0.57	0.43	0.43	7.50 x 1.93
IC627418	0.70	0.60	0.43	0.33	7.33 x 2.50
IC627419	0.53	0.53	0.37	0.39	8.00 x 2.50
IC627420	0.77	0.57	0.40	0.40	7.16 x 2.50
IC627421	0.73	0.60	0.47	0.43	6.83 x 2.20
IC627422	0.73	0.57	0.43	0.36	7.33 x 2.23
IC627423	0.80	0.60	0.47	0.42	6.66 x 2.30
IC627424	0.87	0.40	0.40	0.43	8.33 x 2.00
IC627425	0.80	0.60	0.43	0.38	8.00 x 2.33
Range	0.54	0.23	0.30	0.25	10.76
Minimum	0.33	0.37	0.23	0.19	10.07
Maximum	0.87	0.60	0.53	0.44	20.83
Mean	0.69	0.55	0.41	0.38	14.91
SE	0.02	0.01	0.01	0.01	0.63
Std. Deviation	0.13	0.06	0.06	0.07	3.20
CV	18.28	10.87	14.39	17.63	21.45

There was poor seed yield in all the studied accessions; in some of them the senescence at various stage of flowering to seeding was observed in Vmiam conditions. The plants produced small pods that turned brown on ripening and after dehiscence each pod yielded one-two seeds and pod size (0.3-0.6cm). The seeds were globular, 2-3 mm in diameter and shiny brown-black. The seed ranged in size from 0.23-0.53cm. The seed coat colour varied from dark black, shiny to dull brown on maturity. The seed size and seed number was not variable; most mature pods had two seeds but in some only one seed was formed; 100 seed weight was 1.9-4.4g. The hilum was 1mm diameter, white, depressed/ sunken, and orbicular in shape. The seed with moderately hard coat, taste somewhat like rice bean, soybean, and had good palatable.

There was no correlation between the tuber size and seed size. The tubers used for study ranged in size from 4.66-9.50 cm size and 1.60-2.66 cm in diameter. As compared to the original size of tubers they were narrower in diameter only. This may be accounted for soil conditions in the experimental site which are very different from the soil conditions in the farmers' field (jhoom farming).

Seed Germination

The seeds of *F. procumbens* Roxb. were orthodox and were black-brown, non bitter, palatable like soybean, and have thick hard seed coat. In the accessions with black seed coat there was 100% germination where as in seeds with brown seed coat the germination was only 50-60%. Result suggested that seed physiological maturity played a role in this species and seed coat colour is one of the indexes of seed maturity.

The seeds in control plates did not germinate even after 20 days. Therefore, the selected seeds were scarified with due safety and germination was reported in many legumes.

The seed germination was enhanced by seed scarification of the seed coat. Mechanical scarification

is a technique to physically create scars on seed surface to increase water imbibition (Uzun and Aydin, 2004; Rostami and Shasavar, 2009; Olisa *et al*., 2010; Jayasuriya *et al*., 2012). The seed germination data could not be recorded accession-wise as number of seeds per accession required were very low to facilitate the study on dormancy breaking methods. Among the important less-known tuber legume, *Vigna vexillata* is primarily used for their storage roots, is propagated by seeds, required no scarified seeds for good germination and formed non-dehiscent pods (Karuniawan *et al*., 2006).

In related species, *Flemingia macrophylla,* the seed was hard and small, soaking seeds in cool water for 12 hours improved germination (Roshetko, 1995). Harvested pods were sun dried for 2 days are gently pound in a sack with a stick and winnowed to separated seeds from debris. Seeds were dried by pouring a small amount of nearly boiling water for 2-3 minutes on the seeds and then soaked them in cool water for 12-24 hours in warm water. This resulted in germination in 7-14 days (being careful not to damage the embryo) and soaked for a further 12 hours before sowing. https://pfaf.org/user/Plant.aspx?LatinName=Flemingia%20macrophylla.

Despite the great importance of legume seeds as human diet, establishment is difficult due to major constraints of hard seediness. Hard seed coat can cause delayed or decreased seedling emergence. Seed scarification, a technique to break the hard seed coat without lowering the quality of seeds has been studied in various crops (Stanwood, 1980; Rutar *et al*., 2001; Zeng *et al.*, 2005; Dittus and Muir, 2010).

Conclusions

Study demonstrated that the variation in tuber size is not linked to the seed size in *F. procumbens*. There was poor variation reported in the pod and seed characters of soh-phlang despite the good variation in the tuber traits (Nivedhitha *et al*., 2018). Since there is poor seed formation hence, there is need to study *in vitro* conservation methods. The study demanded further working on large sample size of variable seed maturity and also on diverse soil conditions to throw light on these findings.

The research thrusts is in the context of soh-phlang breeding and can be applied to the improvement of other clonally propagated crops. There is a need to study seed propagation techniques for commercial production in place of the stranded clonal propagation techniques.

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