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Effect of Various Treatments on Seed Germination and Dormancy Breaking in *Sesamum mulayanum*

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ABSTRACT

Sesamum mulayanum is a wild relative of cultivated sesame and widely used as a donor plant for resistance genes for pests and diseases in sesame breeding programmes. The drawback with this species is it shows deep seed dormancy. The aim of this study was to enhance the germination percentage and rate of *S.mulayanum* seed. The efficacy of different treatments including various levels of GA_3 (500ppm, 1000ppm and 1500ppm), chilling (4^0C) for 4,7 and 10 days, scarification and soaking with running water for germination improvement was tested. Analysis of variance indicated that Cold stratification and GA_3 treatment had significant effects on seed germination percentage. Combined treatments were also tested. Among the combined treatments, maximum germination was obtained at combination treatment, cold stratification (10 days) with 1500 ppm of GA_3 solution with scarified seed by alleviating seed dormancy in a relatively short period of time and minimum germination was at soaking in running water and control treatments. These results suggested that *Sesamum mulayanum* seeds exhibit combined dormancy.

Key words : GA_3, Seed dormancy, Sesamum

Sesamum is the most ancient oilseed crop in the world and used by humans. Sesame oil is highly esteemed for use in food because of its quality and stability, as well as for its medicinal effects. In spite of being the first oilseed crop known to man and its long history, it is a typically neglected crop or an 'Orphan crop' or Underutilized crop because it is not mandated to any one of the CGIAR (Consultative Group on International Agriculture Research) Institutes which could also be one of the reasons for lack of appreciable research efforts.

Seed dormancy can be defined simply as inhibited germination of an intact viable seed to optimise the distribution of germination over time (Bewley and Black, 1983). This inhibition of germination has evolved differently across species for adaptation to the prevailing environment, so that germination occurs when conditions are likely to be suitable for establishment of a new generation.

Seeds of most wild plants tend to be dormant at maturity. They often do not easily germinate when allowed to imbibe soon after collection due to various dormancy mechanisms that often delay germination (Baskin and Baskin, 2004). A number of dormancy release stimuli have been shown to induce germination (Morris, *et al.,* 2000).

During the domestication process, several crops have lost adaptive characteristics such as seed shattering, seed dispersal and dormancy structures (Doebley *et al*., 2006, Purugganan and Fuller 2009). As cultivated sesame continues to exhibit seed shattering (Bedigian 2003), seed dormancy is the crucial difference between domesticated sesame cultivars and their wild ancestors. The germination requirements of the species were not previously studied. In this study, we evaluated the germination requirements of *S.mulayanum* by testing its responses to GA_3, moist chilling, and scarification treatments in relation to the breaking of dormancy.

MATERIAL AND METHODS

S.mulayanum has the same diploid chromosome number (2n= 2x=26) as *S. indicum*, which was previously reported by Morinaga *et al.* (1929). This accession has been commonly cultivated in the Dept. of Genetics and Plant Breeding farm. Harvested seeds were air dried at room temperature for 3 weeks or more and kept at

4^0C until use. *S. mulayanum* is dark brown to black with rough and deeply reticulate texture.

Seeds were surface-sterilised for 3 min with 5% sodium hypochlorite and then rinsed with tap water. Some preliminary treatments were made to determine the moist chilling duration and GA_3 doses. Different concentrations used for the treatment were 500ppm, 1000ppm and 1500ppm GA_3, and control without GA_3 (distilled water). All of the hormone solutions were analytical grade. The hormone solutions were applied as a pre-treatment for 24 hr of imbibition, after which the seeds were rinsed with distilled water. Four replicates of 25 seeds per petri dish were made.

Moist chilling was achieved by incubating seeds under wet and cold (+4 °C) conditions for 4, 7 and 10 days. The number of germinated seeds was counted and the germinated seeds were removed every day for up to 15 days. Seeds were recorded as having germinated when the radicle emerged from the testa reaches 2mm. For scarification 2 mehods were followed. In the first method seed edge at the opposite side of the radical was cut off to remove a part of the seed coat and expose the cotyledon, and in the other method the seed was treated with 70% sulphuric acid for 5, 10 and 15 min then the seed was washed with distilled water incubated as described above. Data collected were analysed statistically in Completely Randomized Design (CRD).

RESULTS AND DISCUSSION

Seeds failed to germinate in control treatments with distilled water. There was a clear difference among GA_3 doses of 500ppm, 1000ppm and 1500ppm. Germination increased with increasing GA_3 dose (Table 1). The highest germination rates were found in the seeds treated with 1500 ppm GA_3. This result is in agreement with Ashri and Palevitch, 1979 who reported the dormancy breaking in a Mexican cultivar of *S. indicum* with GA_3.

GA_3 might enhance the growth potential of the embryo (Karssen *et al*., 1989) or induce degradation of food reserves in endosperm by stimulating hydrolytic enzyme activity (Da Silva *et al.,* 2005).

Scarification promoted the germination. Since the scarification with sand paper would be destructive for small seeds, we treated the seeds with 70% sulphuric acid for 5, 10, or 15 min. The highest germination rate was found with 15 min of scarification.

These results indicate that seed dormancy of *S. mulayanum* is attributable primarily to its thickness, water- resistant seed coat a phenomenon known as "coat-enhanced dormancy" which are in accordance with the results of Eijitanesaka *et al.,* 2011. Increase in imbibitions rate was very clear in scarified seed compared to untreated seed (Fig 1).

A decline in the mechanical resistance of the micropylar endosperm may be a prerequisite for radicle protrusion during seed germination (Kucera *et al.,* 2005). The weakening of endosperm can be promoted by gibberellic acid and is inhibited (at least in part) by abscisic acid (ABA) (Finch-Savage & Leubnermetzger, 2006).

Chilling treatments also found to increase the germination per cent significantly compared to the untreated control. Among the different durations of chilling, 10 days chilling exhibited good germination per cent.

Combined treatments were also tested. Among the combined treatments, maximum germination was obtained at combination treatment, cold stratification (10 days) with 1500 ppm of GA_3 solution with scarified seed by alleviating seed dormancy in a relatively short period of time and minimum germination was at soaking in running water and control treatments. These results suggested that *Sesamum mulayanum* seeds exhibit combined dormancy.

The study reveals that any one of the treatment like scarification, chilling and GA_3 treatments release dormancy in *S. mulayanum* and that the nature of dormancy in this seeds is of combined dormancy (Physical+ Physiological). Since *S. mulayanum* is valuable donor species which widely used in the crossing programmes, dormancy breaking is must in this species by following any one of the suggested treatments.

Fig.1. Imbibition rate of scarified and untreated seed.

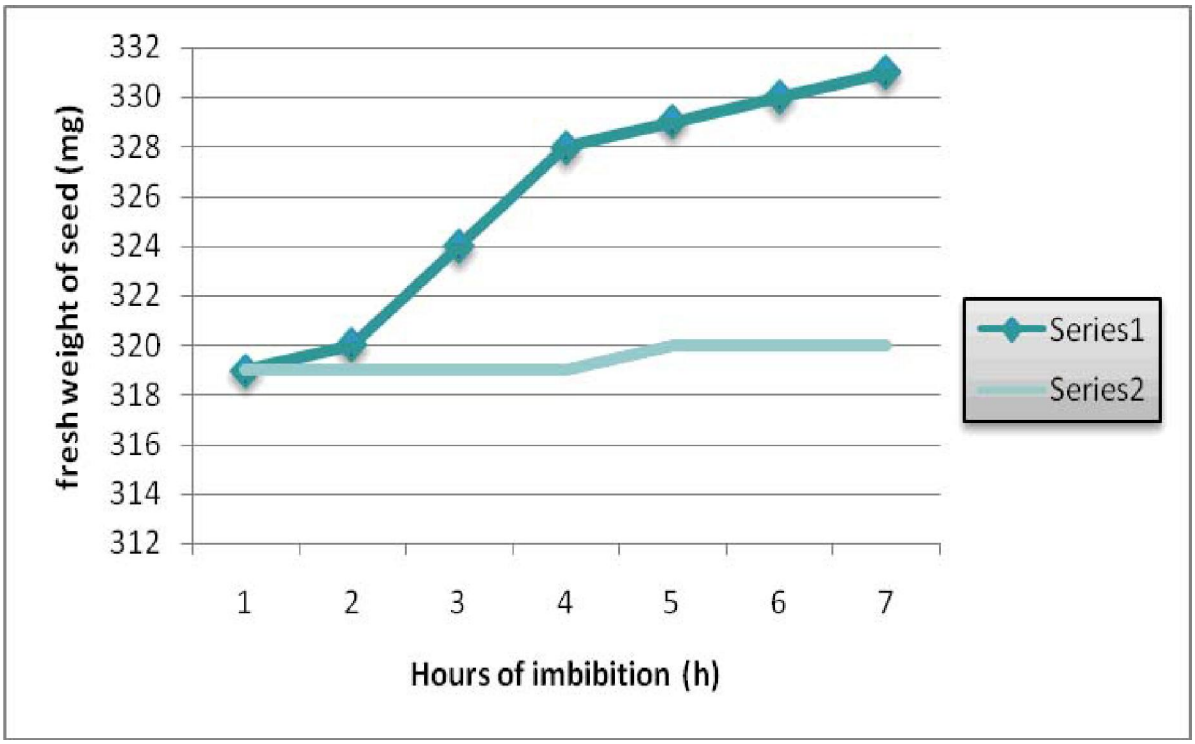

Table1. Germination % recorded with different treatments.

Treatments	Germination %
Control	5
GA_3 (500ppm)	60
GA_3 (1000ppm)	72
GA_3 (1500ppm)	81
Chilling at 4^0C (4 days)	65
Chilling at 4^0C (7 days)	71
Chilling at 4^0C (10 days)	75
Chilling at 4^0C (7 days) + 1500ppm	82
Scarification (Removal of seed coat)	65
Sulphuric acid treatment (5min)	54
Sulphuric acid treatment (10 min)	63
Sulphuric acid treatment (15min)	76
Scarification+ Chilling at 4^0C (7 days) + 1500ppm	86
CD at 0.05	4.88
CV %	3.86

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