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Effect of different dormancy breaking treatments on seed germination and seedling growth in Shankhapushpi (*Clitoria ternatea* L.)

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Abstract
One of the primary issues associated with propagation of Shankhapushpi (*Clitoria ternatea*) seeds is an occurrence of physical dormancy (hard seed coat) which hamper the water imbibition and germination process. An experiment was designed with the aim to break the dormancy of seeds and to improve the germination. Various physical and chemical dormancy breaking treatments was adapted *viz.*, water soaking for 12, 24, 36 and 48 hours, hot water treatment in 60 and 80 °C for 2, 4, 6, 8 and 10 minutes each, acid scarification with concentrated H_2SO_4 @ 100 and 200 ml/kg of seeds for 5 and 10minuteseach along with control which was untreated. The results of the experiment revealed that all the physical and acid scarification treatments had influence on the dormancy and seed germination of Shankhapushpi. However, treating with conc. H_2SO_4@ 200ml/kg for the duration of 5 minutes recorded the highest germination (91 %), speed of germination (5.0) root length (19.5 cm), shoot length (12.0 cm) and vigour index (2879) as compared to other treatments and untreated control which recorded the lowest germination (65 %), speed of germination (3.0), root length (12.6 cm), shoot length (10.6 cm) and vigour index (1447).

Keywords: shankhapushpi – *Clitoria ternatea*, dormancy, acid scarification, hot water treatments, germination

Introduction
Shankhapuspi (*Clitoria ternatea* L.) is an attractive perennial climber with obvious blue or white blooms belonging to the family fabaceae also known as Shankhapushpa, Butterfly pea, Asian pigeon wings and Aparajita. Shankhapushpi is outstanding medicinal herb classified under Medhya in Ayurveda. Medhya are herbs which help to enhance memory and learning. Therefore, it is very good for children suffering from developmental problems of the brain and impaired cognitive function. All the parts of shankhapuspi have been used as a brain tonic and is known to advance memory and intelligence (Mukherjee *et al.*, 2008) [4] and also remedy for body aches, infection, urogenital disorders and as an anthelmintic and antidote to animal stings (Nirmal *et al.*, 2008) [5].
Seeds are used as the propagating material for production of shankhapushpi. Seed germination is a key stage in the life cycle of any plant and is known to be influenced by several interior factors like nature of the seed coat, embryo or by the occurrence of inhibitors and furthermore by environmental factors like light, temperature, soil moisture content and so on (Qu *et al.*, 2008, Agarwal and Dadlani, 1995) [6, 1]. Seed dormancy is the most constraining variable for the germination of Shankhapushpi seeds as it suffers from presence of a thick seed coat that prevents water and oxygen from reaching and activating the embryo. Hence there is a need for identification of suitable seed dormancy breaking treatments to improve seed germination and seedling growth in Shankhapushpi.

Materials and Methods
Shankhapushpi (*Clitoria ternatea*) seeds were obtained from University of Agricultural Sciences, Bengaluru. The laboratory experiment was conducted during 2017-18 at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore. The following dormancy breaking treatments were imposed with three replications.

Treatments
T_0 - Control
T_1 - Water soaking for 12 hours
T_2 - Water soaking for 24 hours

T_3 - Water soaking for 36 hours
T_4 - Water soaking for 48 hours
T_5 - Hot water treatment at 60 °C for 2 minutes
T_6 - Hot water treatment at 60 °C for 4 minutes
T_7 - Hot water treatment at 60 °C for 6 minutes
T_8 - Hot water treatment at 60 °C for 8 minutes
T_9 - Hot water treatment at 60 °C for 10 minutes
T_{10} - Hot water treatment at 80 °C for 2 minutes
T_{11} - Hot water treatment at 80 °C for 4 minutes
T_{12} - Hot water treatment at 80 °C for 6 minutes
T_{13} - Hot water treatment at 80 °C for 8 minutes
T_{14} - Hot water treatment at 80 °C for 10 minutes
T_{15} - Acid scarification with H_2SO_4 @ 100 ml/kg for 5 minutes
T_{16} - Acid scarification with H_2SO_4 @ 100 ml/kg for 10 minutes
T_{17} - Acid scarification with H_2SO_4 @ 200 ml/kg for 5 minutes
T_{18} - Acid scarification with H_2SO_4 @ 200 ml/kg for 10 minutes

In water soaking treatment, seeds were soaked in water for the period of 12, 24, 36 and 48 hours followed by shade drying at room temperature. For hot water treatment, seeds were soaked in hot water at 60 and 80°C for the period of 2, 4, 6, 8 and 10 minutes with constant stirring and the seeds were removed from water and dried at room temperature in shade. For acid scarification treatment, seeds were treated with concentrated H_2SO_4 @ 100 and 200 ml/kg of seed with constant stirring and then washed thoroughly with water and dried under shade. After imposing the treatments, standard germination test was conducted as per ISTA (2013) and the observations were recorded germination, speed of germination, root length (cm), shoot length (cm), dry matter production and vigour index.

Results and Discussion

In this present study, acid scarification with concentrated H_2SO_4 @ 200 ml/kg of seeds for 5 minutes recorded the highest germination of 91 per cent accompanied with speed of germination (5.0), higher root length (19.5 cm), shoot length (12.2 cm), dry matter production (401.0mg 10 seedling^{-1}) and vigour index (2879). Whereas, the control seeds showed only 65 per cent of germination, speed of germination (3.0), root length (11.8 cm), shoot length (10.64 cm), dry matter production (268.3mg 10 seedling^{-1}) and vigour index (1447) (Table 1 & 2 and Fig. 1).

The higher germination due to acid scarification might be due to the weakening of seed coat by disturbing and dissolving the lignin and pectin present on the epidermal layer by the chemical property of the acid which render them permeable to water and oxygen. Longer period beyond 5 minutes was harmful as it could be seen from more of abnormal seedlings and dead seed percentages. The similar observations were also recorded by Dhillon and Singh (1996) [2], Sivakumar (2005) [7] in *Abelmoschus moschatus* and Makasana *et al*. (2016) [3] in shankhapushpi (*Clitoria ternatea*).

Though hot water treatment at 80 °C for 4 minutes improved the seed germination (80%) over untreated control seeds (65 %), development of dead seeds (7 %) and hard seeds (11 %) were noticed to an increased level, which might be due to the injury caused to the embryo by the hot water. Similarly, even though the seed germination was significantly improved (76 %) over control in cold water soaking for 48 hours, the treatment was not effective as that of acid scarification treatment.

Table 1: Effect of dormancy breaking treatments on speed of germination, seed germination percentage and hard seed content in Shankhapushpi (*Clitoria ternatea*) seeds.

Treatments (T)	Speed of germination	Germination (%)	Abnormal seedlings (%)	Hard seed (%)	Dead seed (%)
T_0	3.0	65 (53.51)	9 (17.09)	23 (28.69)	4 (9.32)
T_1	3.4	68 (55.32)	13 (20.84)	17 (24.48)	3 (7.69)
T_2	3.8	71 (57.61)	5 (13.16)	18 (25.44)	5 (10.95)
T_3	3.7	72 (58.24)	7 (14.89)	20 (26.84)	1 (3.84)
T_4	4.2	76 (60.65)	6 (14.04)	12 (20.66)	6 (13.62)
T_5	3.2	73 (58.48)	8 (16.42)	10 (18.85)	9 (17.78)
T_6	3.5	74 (59.33)	8 (16.42)	12 (20.96)	6 (14.09)
T_7	3.5	76 (60.43)	8 (13.51)	11 (19.45)	5 (10.95)
T_8	3.7	76 (60.91)	3 (7.69)	11 (20.01)	9 (17.70)
T_9	3.7	79 (62.94)	7 (14.79)	9 (17.60)	5 (13.16)
T_{10}	4.1	76 (60.87)	5 (13.16)	11 (19.80)	7 (15.25)
T_{11}	3.8	80 (63.43)	3 (5.47)	11 (18.28)	7 (14.79)
T_{12}	4.1	75 (60.20)	8 (16.42)	8 (16.63)	9 (17.09)
T_{13}	3.6	74 (59.54)	8 (16.42)	9 (17.28)	9 (17.70)
T_{14}	3.5	73 (58.46)	5 (13.16)	9 (17.88)	13 (20.65)
T_{15}	4.8	88 (69.72)	5 (13.29)	2 (8.41)	5 (12.92)
T_{16}	4.8	84 (66.40)	8 (16.20)	1 (7.41)	7 (14.92)
T_{17}	5.0	91 (72.26)	5 (13.16)	0 (4.05)	4 (11.99)
T_{18}	4.9	85 (67.46)	9 (17.09)	0 (4.05)	6 (13.62)
Mean	3.9	77 (61.36)	7 (14.38)	10 (17.78)	6 (13.58)
SEd	0.197	3.442	3.442	4.737	3.766
CD(P=0.05)	0.401	6.996	6.996	2.331	7.654

(Figures in parentheses indicate arcsine transformed values)

Table 2: Effect of dormancy breaking treatments on root length, shoot length, dry matter production and vigour index in Shankhapushpi (*Clitoria ternatea*).

Treatments (T)	Root length (cm)	Shoot length (cm)	DMP (mg 10 seedling^{-1})	Vigour index
T_0	11.8	10.6	268.3	1447
T_1	12.6	11.5	306.5	1628
T_2	13.5	11.4	329.1	1774
T_3	12.5	11.7	340.7	1750

T_4	12.1	11.5	304.5	1796
T_5	13.4	11.6	314.9	1883
T_6	13.6	11.0	316.7	1855
T_7	14.4	11.6	319.3	1891
T_8	14.5	10.6	322.4	1989
T_9	14.3	11.5	312.3	1953
T_{10}	15.9	11.7	309.2	2108
T_{11}	14.9	11.2	316.8	2092
T_{12}	14.4	11.1	303.8	1916
T_{13}	13.4	10.7	296.0	1788
T_{14}	13.0	10.5	288.0	1710
T_{15}	15.3	10.9	323.9	2301
T_{16}	15.5	11.0	328.7	2227
T_{17}	19.5	12.2	401.0	2879
T_{18}	16.6	11.8	340.5	2426
Mean	14.3	11.3	318.0	1969
SEd	1.863	0.471	12.012	183.432
CD (P = 0.05)	3.787	0.958	24.524	372.776

DMP - Dry matter production

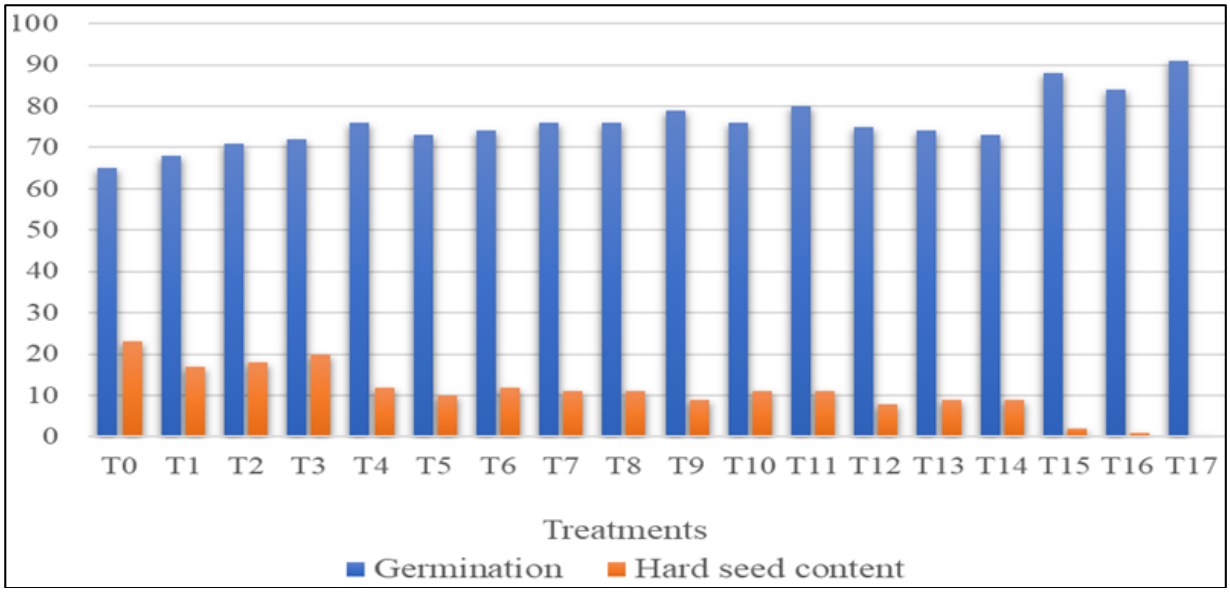

Fig 1: Effect of dormancy breaking treatments on seed germination and hard seed content in Shankhapushpi (*Clitoriaternatea*)

Conclusion

From the present investigation, it could be concluded that the acid scarification treatment by using concentrated H_2SO_4 @ 200 ml/kg of seed for 5 minutes could be recommended to overcome the problem of hard seed ness in Shankhapushpi (*Clitoria teranatea*), since this treatment recorded the minimum hard seed content, maximum germination and other vigour parameters.

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