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Effect of pre-sowing treatments on seed germination and seedling growth of *Annona reticulata* L.

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Abstract
Bullock's heart *(Annona reticulata* Linn.) is one of the traditionally important fruit plant and also used in the treatment of various ailments which belongs to family Annonaceae. The fruits having potent medicinal properties like anti-cancerous, antioxidant, anti-analgesic and anti-inflammatory properties. Natural regeneration by seeds is poor due to seed dormancy. To overcome poor germination problem in *A. Reticulate,* an experiment was carried out in College of Horticulture, Mudigere on the effect of pre sowing seed treatments on germination and seedling growth of bullock's-heart (*Annona reticulate L.*). Seeds were treated with different pre-sowing treatments. The results obtained are significantly maximum in case of seeds soaked in water for 96 hours which recorded highest germination percentage (82.85 %) and seedling growth attributes compared tocontrol. From this experiment it is concluded that seeds soaked in water for 96 hours can be used to induce better germination and seedling growth.

Keywords: bullocks heart, shoot length, root length, fresh weight of shoot, dry weight of root and germination percentage.

Introduction
Annona reticulata Linn. is one of the traditionally important fruit plant and also used in the treatment of various ailments which belongs to family Annonaceae (Saad *et al*., 1991) [9]. The synonyms of plant are Ramphal, Bullock's heart and Custard apple (Nirmal *et al*., 2010) [6]. Near about 119 different species of the annona genus (Annonaceae) are identified. Among which, most of them are shrubs and trees. *A. reticulata* is widely distributed in tropical and subtropical regions. The plant is indigenous to the West Indies. In India it is widely cultivated and naturalized as a fruit crop and deciduous tree. It is distributed in Bengal, Burma and Southern regions of India (Rahman *et al*., 2011) [8].
A. reticulata can grow up to the height of about 6.0 - 7.5 m which contains numerous lateral branches. The stems are cylindrical having lenticels and very short brown coloured hairs on stem.Leaves are oblong, lanceolate, membranous, acute, and rounded or curate at the base. The upper surface of leaves is glabrous and on lower surface it contains spreading hairs (Jamkhande and Wattamwar, 2015) [5]. Two to four flowers may present the pedicel at lateral. Fruits are edible which are heart shaped, rough and yellow in colour which change to yellowish red on ripening (Nirmal *et al*., 2010) [6]. Fruits are sweet, astringent and useful in blood complaints (Saleem *et al.*, 2014) [11]. Seeds are smooth surfaced and blackish in colour. Different parts of the plant have various medicinal properties like leaves extracts are used as anthelminthic and antipyretic (Patil *et al.*, 2009) [7]. Bark is used as Analgesic, anti-inflammatory analgesic and CNS depressant (Bhalke and Chavan, 2011) [2]. Traditionally various parts of the plant have been employed for the treatment of epilepsy, dysentery, cardiac problem, parasite and worm infestations, constipation, haemorrhage, bacterial infection, dysuria, fever, ulcer and as insecticide (Jamkhande and Wattamwar, 2015) [5]. *A. Reticulate* is commonly propagated through seeds but it exhibits poor germination, it may be due to some physical and chemical barriers. So, an experiment was conducted with an objective to improve seed germination and seedling growth by using different pre-sowing treatments.

Materials and Methods

The experiment was carried out under naturally ventilated shade house at college of horticulture, Mudigere, University of Agricultural and Horticultural Science, Shivamogga, Karnataka during 2016-2017. Selected well ripened healthy, disease free fruits of Ramphal were taken and seeds were extracted carefully. Extracted seeds were washed in tap water and dried under shade for 20 minutes. Healthy and well developed seeds were selected and they were treated in the growth regulator solutions and in acids for 20 minutes as per the treatments and sown each seed per polybags. Media was prepared properly by mixing red soil sand and FYM at 2:1:1 and filled in polybags of 5x6 inch size. Treated seeds were sown in polybags.

Treatment details:

T1-H2SO4 (1%)
T2-H2SO4 (2%)
T3 - GA3 (200 ppm)
T4 - GA3 (500 ppm)
T5 – NAA (100 ppm)
T6 - NAA (200 ppm)
T7 - KNO3 (2000 ppm)
T8 - KNO3 (2500 ppm)
T9 – Water soak 96 hours
T10 – Soaked in distilled water for 2 hours

Observations were recorded up to five months from the date of sowing for germination parameters and seedling growth attributes. The different concentrations of acids and growth regulators like H2SO4, KNO3, GA3 and NAA were prepared in the laboratory at College of Horticulture, Mudigere in the Department of Plantation, Spices, Medcinal and Aromatic Crops.

Germination percent

The number of normal seedlings produced in each treatment was counted and average was expressed in percent (ISTA, 2003) [3].

Germination percentage = number of normal seedlings X 100
Total number of seeds sown

Assessment of seedling growth

Morphological data such as leaf length, width, number of leaves, collar girth, seedling height, fresh weight and dry weight of the aerial part and roots were recorded up to 90 days after sowing.

Statistical analysis of data

The experiment was carried out in randomized complete block design. Data were analysed by analysis of variance (ANOVA) to detect significant differences between mean. Significantly differing mean were tested based on F test value at 0.05 probability level. Variance in data has been expressed as mean ± standard error.

Result and discussion

Highest germination percentage is recorded in T9 (seeds soaked in water for 96 hours) followed by T5 (NAA-100 ppm) which showed 82.85 % and 77.14 % respectively than control T10 (45.71%), it is graphically represented in the figure 1. The possible fact for better percent germination by seed soaking may be due to stimulation of series of biochemical change in the seed that are essential to initiate the emergence process like break down dormancy, hydrolysis, metabolism of growth inhibitors, imbibition and activation of enzymes [1, 11].

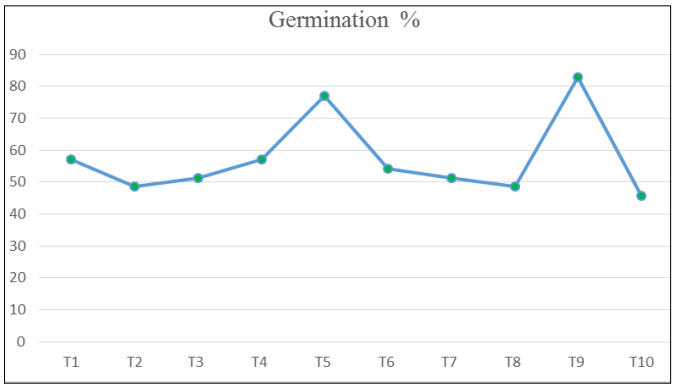

Fig 1: Effect of pre-sowing seed treatments on seed germination percentage

Seedling growth parameters

The effect of seed treatments on seedling characters after six months of sowing showed satisfactory higher result in water soaked seeds for 96 hours for the characters such as seedling height (35.70 cm), Root length (15.67 cm), leaf width (3.8 cm), leaf length (13.5 cm), fresh weight of shoot (7.38 g), fresh weight of root (3.69 g), seedling girth (5.46 mm) which is shown in table 1 and 2. Among all the treatments significantly higher results were recorded in T9 (water soak 96 hours) and also showed highest fresh weight of the seedlings fresh weight of the seedlings (10.14 g) which is graphically shown in figure 2.

This might be due to optimal level of soaking and thought to have enhanced effects on germination and growth. Probably it may due to hydrolysis of complex into simple sugars that are readily utilized in the synthesis of auxins and proteins (Ajouri and Asgedom, 2004) [1]. The auxins produced help to soften cell walls to facilitate growth and the proteins readily utilized in the production of new tissues (Sabongari and Aliero, 2004) [10]. In some cases, prolonged soaking of seeds is can inhibit the germination of seeds due to increase of carbon dioxide, ethanol and lactic acids concentrations inseeds and reduced that of oxygen leading to poor growth (Irwin, 1982, Street and Helji, 1991) [4, 12] but in case of A. reticulate since it has hard seed coat soaking of seeds for longer duration might have been helped in increasing the permeability of seeds to water diffusion and enhanced the germination.

Table 1: Effect of growth regulators on seedling growth of A. reticulata after 6 months

Treatments	seedling height (cm)	Root length (cm)	Leaf width (cm)	leaf length (cm)
T_1-H_2SO_4 1%	31.00	12.17	3.77	12.93
T_2-H_2SO_4 2%	30.33	12.83	3.40	12.03
T_3 - GA_3 200ppm	33.77	13.33	3.67	12.83
T_4 - GA_3 500ppm	31.67	13.33	3.77	13.40
T_5 – NAA 100ppm	32.67	12.17	3.63	12.33
T_6 - NAA 200ppm	26.17	12.33	2.97	10.37
T_7 - KNO_3- 2000ppm	32.67	14.67	3.63	13.20

T_8 - KNO_3- 2500ppm	32.00	15.17	3.10	10.17
T_9 – Water soak 96 hours	35.70	15.67	3.80	13.50
T_{10} – Distilled water	25.17	11.17	2.27	9.57
S.Em±	1.148	0.547	0.223	0.612
C.D. at 5%	3.410	1.625	0.663	1.818

Table 2: Effect of growth regulators on seedling growth of A. reticulata after 6 months

Treatments	seedling height (cm)	Root length (cm)	Leaf width (cm)	leaf length (cm)
T_1-H_2SO_4 1%	31.00	12.17	3.77	12.93
T_2-H_2SO_4 2%	30.33	12.83	3.40	12.03
T_3 - GA_3 200ppm	33.77	13.33	3.67	12.83
T_4 - GA_3 500ppm	31.67	13.33	3.77	13.40
T_5 – NAA 100ppm	32.67	12.17	3.63	12.33
T_6 - NAA 200ppm	26.17	12.33	2.97	10.37
T_7 - KNO_3- 2000ppm	32.67	14.67	3.63	13.20
T_8 - KNO_3- 2500ppm	32.00	15.17	3.10	10.17
T_9 – Water soak 96 hours	35.70	15.67	3.80	13.50
T_{10} – Distilled water	25.17	11.17	2.27	9.57
S.Em±	1.148	0.547	0.223	0.612
C.D. at 5%	3.410	1.625	0.663	1.818

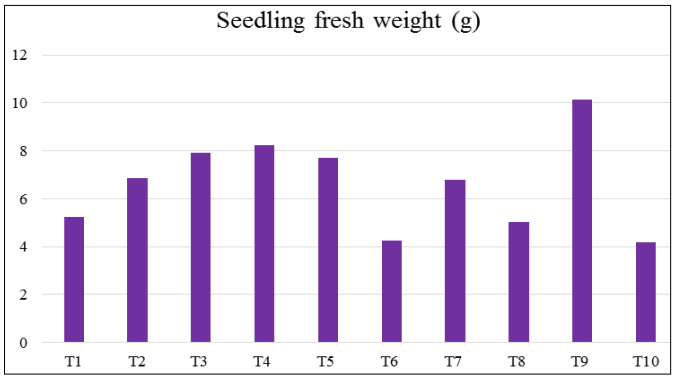

Fig 2: Effect of different seed treatments on seedling fresh weight at six months after sowing.

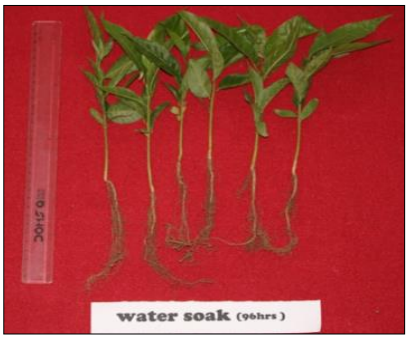

Plate 1: Seedlings of T_9 at after six months of sowing

Plate 2: Seedlings of all the treatments at after six months of sowing

Conclusion

From present findings it can be conclude that pre-sowing treatment of A. reticulate seeds with cold water will effectively increase the seed germination percentage and also effect on seedling growth parameters. So this technique will be helpful for farmers to increase the production of medicinally important plant.

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