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EFFECT OF CHEMICAL AND PHYSICAL FACTORS ON SEED GERMINATION OF *PENTAPETES PHOENICEA* L.

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ABSTRACT

Green house effects have caused global warming; the earth is getting warmed up slowly. This is bringing a change in climate all over the world and due to climatic change the flora is also being affected. Therefore, it is necessary to study the effect of climate on the vegetation. Light, temperature and acid rain (pH) are few important parameters of climate. They control the distribution of vegetation. Light causes stratification in a forest. The temperature decreases by increase of altitude, hence the flora, also changes. The author has tried to study the effect of these important factors along with a few other factors on germination of a dye yielding plant, *Pentapetes phoenicea* L., belonging to the family Sterculiaceae. To raise the population of this plant, the studies in germination are required. Seed germination has been studied under different ecological conditions. The parameters are physical and chemicals viz., storage, light, temperature, H₂SO₄, KOH, and GA₃. The fresh seeds do not germinate and they require about 12 to 15 months of dry storage, which is called dormancy period. These seeds show 40% of germination when stored for 12 months. 15 months stored seeds when subjected to 12 hours of photoperiod shows 90% of germination on first day and subsequently 100% of germination. At low temperature of 5°C, there is 10% of germination where as at high temperature of 45°C, there is no germination. But at room temperature of 27°C±2°C, there is maximum 100% of germination. H₂SO₄ treatment for 20 minutes gives 98% of germination by breaking the dormancy. 5-10 minutes of KOH treatment shows 80% of germination. GA₃ also gives germination of 100%.

Key Words: - Dormancy, *Pentapetes phoenicea*, seed germination, stratification

INTRODUCTION

Pentapetes phoenicea L., a member of family Sterculiaceae (Hooker J.D. 1875). It grows on moist land as a weed of the rice fields and is also grown as an ornamental plant. It is an annual herb with erect branched stem. Fruits capsule, 5-valved and each valve contains 8 to 12 seeds borne in two rows. The seeds are elliptic in shape but with indistinct angles imposing a rough tetrahedral form (www.malvaceae.info/Genera/Pentapetes/Pentapetes.php). 'Germination is the process of emergence of growth from a resting stage', (<http://encyclopedia.laborlawtalk.com/germination>). Under favourable conditions, the seed begins to germinate and the embryonic tissues resume growth, developing into a seedling.

Ecological studies of some species provided prerequisite information to bring them under cultivation. With this aim in mind studies were undertaken to see the effect of physical and chemical factors on seed germination.

Hypothesis- If the *Pentapetes phoenicea* seeds are treated with concentrated H₂SO₄ for 20 minutes, then the rate at which they germinate will be increased. Also it helps to break dormancy.

MATERIALS AND METHODS

Mature fruits of *Pentapetes phoenicea* were collected and stored in dry bottles at room temperature until use. Seeds were removed from the fruit on the date of each experiment. In this study, effect of physical factors like storage, photoperiod, temperature and chemicals like H₂SO₄, KOH and GA₃ on germination were analysed.

Research Article

To study the effect of storage, freshly collected seeds were kept in petridish at room temperature. The same experiment was repeated after every three months for conclusive results.

To observe the effect of light on germination, five sets of petridishes were kept for germination under total darkness, 6 hours light, 12 hours light, 18 hours light and control (normal day light). Temperature effect was studied by exposing to temperature ranging from 5°C to 45°C before germination.

For effect of chemicals scarification with conc. H_2SO_4 (98%) was done. The seeds were soaked in conc. H_2SO_4 for 5, 10, 10, 20, 25 and 30 minutes and kept for germination after sufficient washings in running water. Untreated seeds were taken as control. To study the effect of KOH, the seeds were shaken with 2% KOH in test tube and then washed in running water for sufficient time. The washed seeds were kept for germination.

For GA3 treatment, seeds were soaked in different solutions of concentration ranging from 50ppm to 500ppm for 24 hours and then washed with running water for sufficient time. The washed seeds were then germinated.

RESULTS AND DISCUSSION

The dormancy of seeds by coat impermeability to water, is often associated to high natural longevity, important for maintenance of soil seed banks (Rolston, 1978). Seed storage behavior is variable in Sterculiaceae. *Rulinga pannosa* is maintained in the long-term seed store but *Theobroma cacao* L. is widely reported as recalcitrant. Seeds of *Cola* spp. are some of the longest-lived recalcitrant species (Ellis et al). Freshly harvested seeds of *Cola nitida* take 3 to 9 months to germinate where as completely ripened seeds are reported to germinate immediately. Though the seed coat is impermeable to water in *Cola acuminata* but the embryos are not underdeveloped. Unspecified period of dry storage of *Cola acuminata* seeds germinated at a higher percentage than the freshly ones and even the embryos of the stored seeds were morphologically well developed than the fresh ones (Oladokun, 1985). A 3 weeks old seeds of *Theobroma cacao* 100% germination rate (<http://www.plantoftheweek.org/week471.shtml>). Seeds of *Guazuma ulmifolia* have dormancy imposed by water impermeable coat. After one year of dry storage, both seed coat impermeability and initial germinability were retained (Correia J. et al).

Seeds of *Pentapetes phoenicea* L. are dormant for about 12 to 15 months. The optimum germination is seen when the seeds have undergone storage of 15 to 18 months. After that the percentage of germination decreases as the period of storage increases. 30 months of storage shows only 20% germination.

Light is considered to be one of the major factors influencing seed germination. Mayer and Mayer (1989) have classified the seeds into three major groups on the basis of light exposure.

- 1-Some seeds require light for germination.
- 2-Germination of some seeds inhibited by light.
- 3-Some seeds have different response to light.

The seeds of *Pentapetes phoenicea* show 100% of germination on second day in normal condition i.e. 8 to 10 hours of light. Effect of light was studied by Ram Krishnan (1963, a, b) on *Achyranthus aspera*. He observed that in continuous light the percentage of germination was higher as compared to diffuse light and total darkness.

The effect of temperature on germination is an important parameter in demography (Stilling, 1999). The seeds of *Pentapetes phoenicea* treated within a range of 5°C to 45°C, germinated on second day while in control, percentage of germination were 100%. Specifically at 5°C the germination is 10% which goes on increasing as the temperature rises but at 45°C it is 0%. A constant temperature of 30°C has been reported as optimal for *Cola* spp. (Ellis R.H. et al).

Concentrated H_2SO_4 has been used with considerable success on many species (Rolston, 1978) and it is reported to be most effective treatment in tree species having hard coat (Airi et al, 1998). In some species, the action of sulphuric acid in softening hard seeds appears to result from the removal of cuticle and dissolving of the macrosclerid caps (Rolston, 1978). In *Guazuma ulmifolia*, better germination occurred when seeds were treated with concentrated H_2SO_4 for 40 to 50 minutes (Correia et al, 2000). The seeds of

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TABLE I: Effect of storage

Age of the seeds	Percentage of germination
Fresh seeds	0 %
3 months	0 %
6 months	10 %
9 months	25 %
12 months	40 %
15 months	100 %
18 months	100 %
21 months	95 %
24 months	50 %
27 months	40 %
30 months	20 %

TABLE II: Effect of Photoperiod

Day	Total dark	6hrs light	12hrs light	18hrs light	Normal Day light control
1	0%	2%	90%	0%	0%
2	30%	60%	100%	72%	100%
3	70%	92%	100%	80%	100%

Albizia lebbeck, *Cassia tora* and *Terminalia chebula* required 5 minutes of scarification in 50% H₂SO₄ while seeds of *Terminalia bellerica* needed 10 minutes of soaking in the same acid for maximum germination (Khanduri and Negi, 2010). In *Solanum nigrum*, treatment with concentrated as well as diluted sulphuric acid reduced the germination percentage as compared to control, which could be due to adverse effect caused by the acid to the embryo (Suthar, A.C.2009). In *Pentapetes phoenicea*, seeds when treated for 20 minutes in concentrated H₂SO₄, rate of germination were 98%. By increasing the treatment time, percentage of germination becomes less.

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TABLE III: Effect of Temperature

Day	5°C	15°C	25°C	35°C	45°C	Control 27°C±2 °C
1	0%	4%	81%	8%	0%	0%
2	10%	77%	85%	92%	0%	100%
3	10%	95%	86%	93%	0%	100%

TABLE IV: Effect of H₂SO₄

Duration of treatment (min)	Percentage of germination
Control	40%
5	80%
10	82%
15	92%
20	98%
25	88%
30	82%
35	80%
40	78%

Effect of KOH shows that in *Pentapetes phoenicea*, seeds when treated for 5 to 40 minutes in 2% KOH, longer the period, greater in the fall in percentage of germination. Similar result has been observed for *Indigofera cordifolia* by Vyas and Agrawal, (1972).

GA₃ is a growth promoting hormone and external supply of GA₃ promotes the percentage of germination. In *Pentapetes phoenicea* it is observed that as the ppm of GA₃ is increased, the germination percentage also increases. Fresh seeds when treated with 50 ppm of GA₃, the rate of germination was 94% and it was increased from 100ppm. Kaesera (1990) studied the effect of GA₃ on some Indian arid zone plants. In *Borreria articularis* and *Plantago ovata*, fresh seeds were treated with 50 ppm of GA₃ and it showed 53% and 66.6% of germination. Fresh seeds show poor germination but when treated with GA₃, the rate of germination increases as GA₃ releases dormancy.

Research Article

TABLE V : Effect of KOH

Duration of treatment (min)	Percentage of germination
Control	100%
5	80%
10	80%
15	60%
20	30%
25	20%
30	10%
35	10%
40	0%

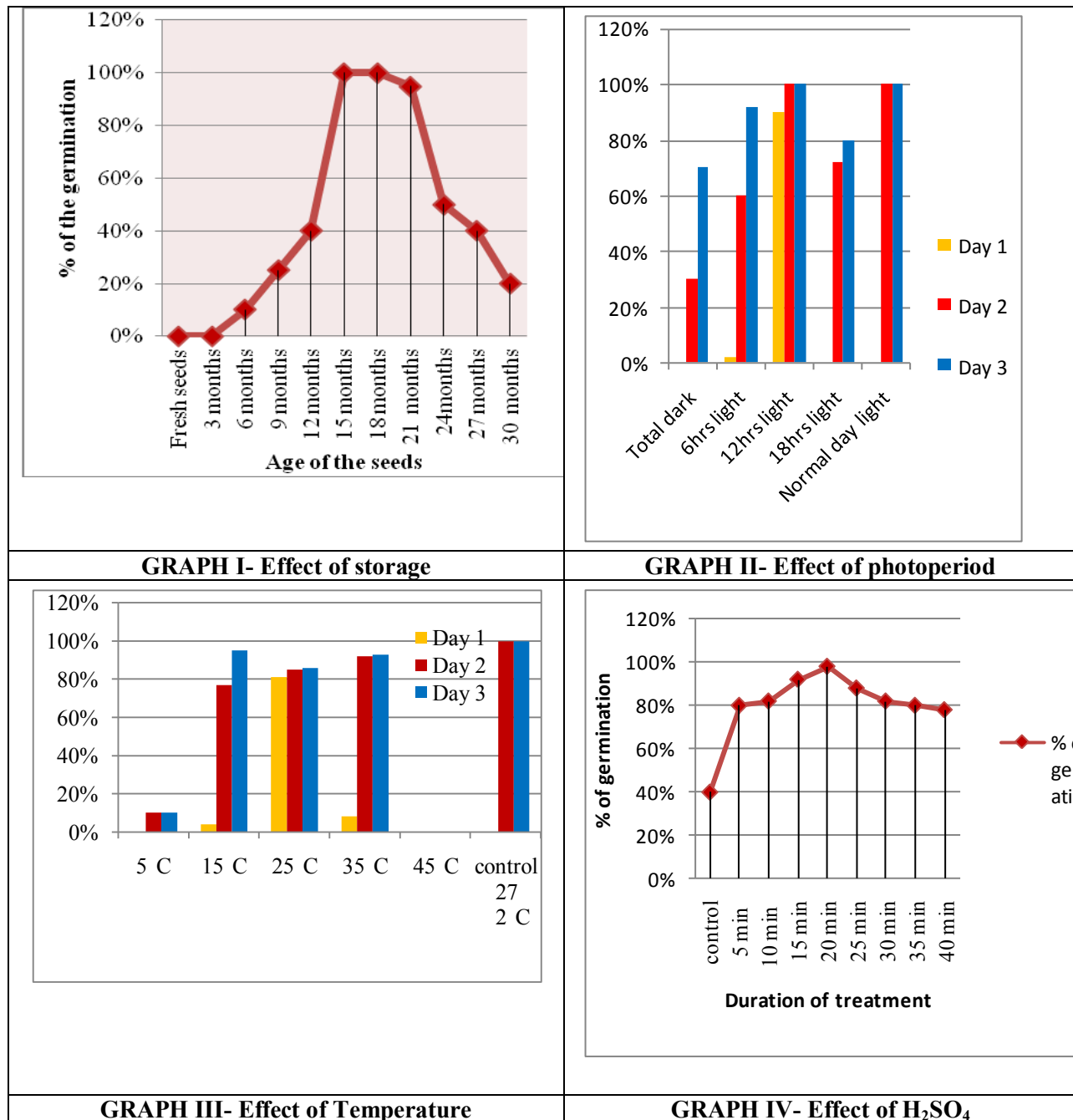
TABLE VI: Effect of GA3

GA conc. in ppm	Percentage of germination
Control	40 %
50 ppm	94 %
100 ppm	100 %
150 ppm	100 %
200 ppm	100 %
250 ppm	100 %
300 ppm	100 %
350 ppm	100 %
400 ppm	100 %
450 ppm	100 %
500 ppm	100 %

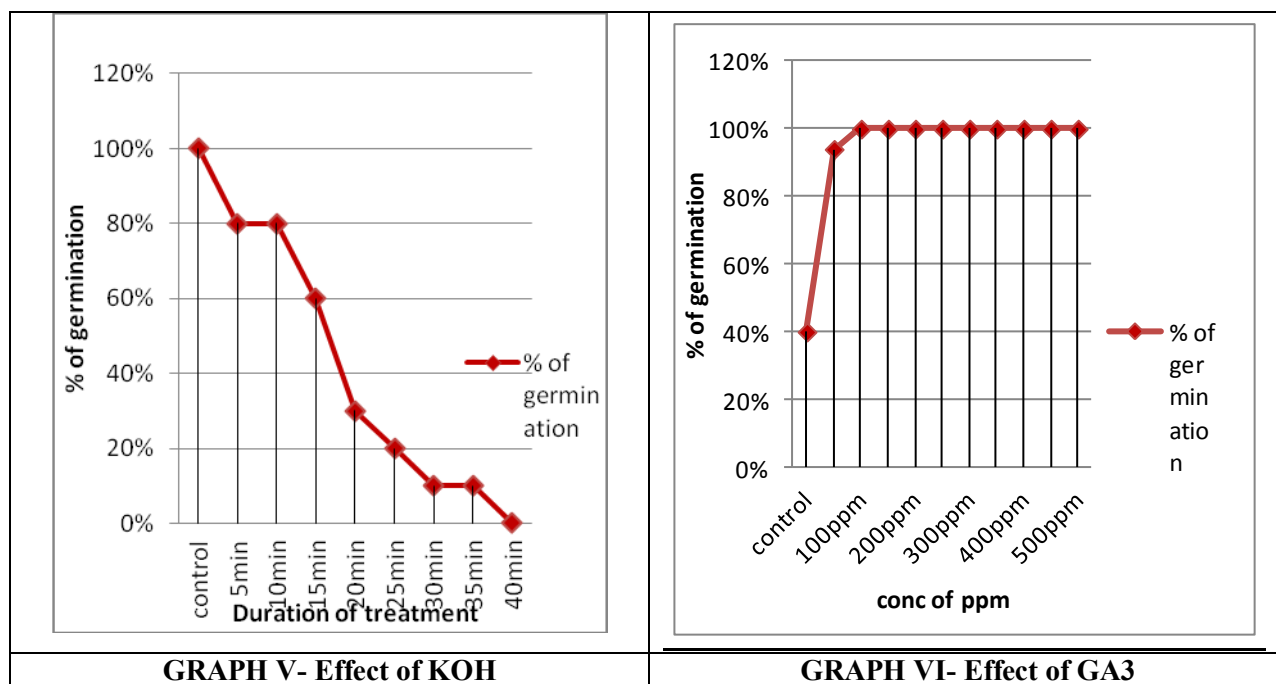
Conclusion

Pentapetes phoenicea are grown from seeds. The plant does not self-pollinate, so intervention is required to obtain seeds. The freshly collected mature air dried seeds failed to germinate under laboratory condition. The above parameters thus help one to conclude that optimum germination occurs only during 15 to 18 months of storage period, with conc. H₂SO₄ treatment for 20 minutes, temperature range of 27±2°C and around 12 hours of photoperiodic induction.

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REFERENCES

- Airi S, Rawal RS, Samant SS, Dhar U (1998).** Treatments to improve germination of four multipurpose trees of central sub Himalaya. *Seed science and technology* **26** (2).347-354.
- Correia J, Neto Araujo (2000).** Germinative pretreatments to dormancy break in *Guazuma ulmifolia* Lam. Seeds, *Scientia Forestalis* **58**, 15-24.
- Ellis RH.,Hong TD, Roberts EH (1985).** *International Board for Plant Genetic Resources Handbooks for Genebanks*: No.3, chapter 68, 162-164.
- Hooker JD (1875)** *The Flora of British India*,(I),371-372
- Kaesera PK (1990).** Effect of GA3 on seed germination of weeds in Indian aride zone *Journal of Indian Botanical Society*, 68-82.
- Kanduri P, Negi KS (2010)** Effect of scarification to enhance seed germination of certain woody plant species *Journal of Indian Botanical Society*. **89** (3 & 4), 308-311.
- Mayer AM and Mayber PA (1989)** *The germination of seeds*. Pengamon Press London.
- Ramkrishnan PS (1963) a,** Problem in Autecology of weed flora of India 1. Ecology of *Achyranthus aspera* Linn. *Symposium on ecological problems in the tropics*, 33 (B) I, 41-44.
- Ramkrishnan PS (1963)b,** Ecological observations on *Achyranthus aspera* Linn., *Symposium on ecological problems in the tropics*, 33(B) I, 45-51.
- Rolston MP (1978).** Water impermeable seed dormancy *Botany Review*. **44**. 365-396.
- Stilling P (1999).** *Ecology: Theories and Applications*, Prentiel Hall Upper Saddle River, New Jersey.
- Suthar AC, Naik VR, Mulani RM (2009).** Seed and seed germination in *Solanum nigrum* Linn. *American-Eurasian Journal of Agricultural and Environmental Science*. **5**(2), 179-183.
- Vyas LN, Agrawal SK (1972).** Studies in the germination behavior of *Indigofera cordifolia* Heyena ex. Roth. *Japanese Journal of Ecology*. **22**, 162-169.