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Effect of Temperature, Media and Light on Germination of *Prinsepia utilis* Royle Seeds

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ABSTRACT

Effect of temperature and media was studied on seed germination of *Prinsepia utilis* Royle (bhekal). Germination tests were conducted at four different temperatures viz. 5±1 °C, 15±1 °C, 25±1 °C and ambient room temperature with three germination media viz. top of germination paper (TP), between of paper (BP) and quartz sterilized sand at 90±5% relative humidity in a seed germinator for 21 days. Media and Temperature significantly affected seed traits. Seeds germinated well over wide range of temperature 15±1 °C, to ambient room. Significantly, higher germination percentage, germination value (GV) and minimum mean germination time (MGT) were obtained at 25±1 °C. lower than 25±1 °C and higher temperature (ambient room temperature) had adverse effect on germination of bhekal seeds. Among media, between paper (BP) was found the best in which maximum germination percentage, minimum MGT and maximum GV was recorded. Sand media was found inferior as compared to between and top of paper. Seed germination was unaffected with light.

Key words : *Seed, Germination, MGT, GV, BP, Temperature, Light*

Introduction

Prinsepia utilis Royle (bhekal) belongs to family Rosaceae. It is an attractive, unique, and deciduous multipurpose shrub for both rural and urban population of Himalayan region. Geographically the whole genus Prinsepia is confined primarily to continental eastern Asia. Its area of distribution ranges here from western Pakistan and N. W. India to southern and central China, E. Mongolia, Russia, Manchuria, and Korea. Only the *P. utilis* Royle is reported in India among all reported four species. In India, it is distributed throughout the Himalayan region. Generally found from 1600 to 2500m altitude of ranges in Jammu and Kashmir, Uttarakhand, Himachal Pradesh, Sikkim, Khasi and Jayantia hills and Meghalaya (Maikhuri *et al.,* 1994). *P. utilis* is generally propagated by seeds in nurseries, however, the seeds have a short storage life and rapid loss in seed viability is a major problem in propagating bhekal for plantation programmes. *P. utilis* seeds shown more or less recalcitrant behaviour during the storage. *P. utilis* seed is short lived and start deteriorating fast after harvesting and during storage

(Bhagat and Singh, 1989; 1991).

It is indispensable to follow standard pattern for testing seeds for germination in order to ensure uniformity and reproducibility of results. Testing of seeds under field conditions is normally unreliable and therefore, laboratory methods have been developed (ISTA, 1976). The important factors affecting germination under laboratory conditions are temperature, media and light, which need standardization for each species. Temperature is one of the most critical factorsand there is usually an optimum temperature below and above which germination is delayed or prevented. Artificial media are much more easily standardized and hence, ISTA (1976) recognized three germination media as top of the paper (TP), between paper (BP) and sand. The effect of light on germination has been known to vary considerably with the seeds of different species. Some seeds germinate after being given a brief illumination, while some are indifferent to the presence or absence of light during the seed germination. According to Baskin and Baskin (2014), plants can be classified in terms of their responses to light for germination as positive photoblastic (those that require light to germinate), negative photoblastic (those that require darkness to germinate) and neutral photoblastic (those that have large percentage of seeds neutral to light.

The present study was undertaken to explore an optimum germination condition for testing of bhekal seeds and it is expected that the reported temperature and media in this study will provide reliable practical guidelines for seed testing.

Materials and Methods

Collection, Extraction and Processing of seed: The mature fruits were collected during May 2017 directly from branches of *P. utilis* shrub from Chakrata Forest Division (Dehradun) Uttarakhand, India (30°31' to 31°3'N and 77°42 'to 78° 05'E). Mean minimum and maximum temperature of -4±2 °C and 22±2 °C and relative humidity between 10.29±5% - 64.13±5% was recorded during the experiment period. Fruits were kept in gunny bags at ambient room temperature for one day to soften the pulp. All fruits became soft within one day. Seed were depulped by macerating into small gunny bag (size 30cm x 30cm) to remove pulp completely. Cleaned seeds were shade dried at ambient room temperature upto EMC (equilibrium moisture content) of 7%. Since after one day drying in laboratory, per cent moisture content (mc%) of seeds was determined as per ISTA (2010) till EMC. Seeds were tested for germination at four different temperatures viz., 5±1 °C, 15±1 °C, 25±1 °C and ambient room temperature with three germination media viz. top of paper (TP), between of paper (BP) and quartz sterilized sand at 90±5% relative humidity in a seed germination for 21 days.

An another test for the determination of effect of light on seed germination was observed at 25±1 °C at 1000 lux light intensity on top of paper (TP). Light was provided for 8 hours daily. Seeds were sown in four replications with 100 seeds in each replicate. Data were recorded daily. Seed was considered germinated when radicle became 1cm in length. Germination percentage and mean germination time (MGT) were calculated using ISTA (1993) and Rawat and Thapliyal (2003), while germination value (G.V.) was calculated as described by Djavanshir and Pourbeik (1976). The percentage germination, time taken to complete germination in term of mean germination time (MGT) and germination value (GV) was analyzed through ANOVA using SPSS 14.

Results

The effect of various incubation temperature showed on seed germination (Table 1), mean germination time (Table 2) and Germination value (Table 3) of *P. utilis* seeds.

Effect of temperature on germination: Temperature affected seed germination. The temperature at 25±1°C exhibited the highest mean germination percentage (92.66%) followed by ambient condition and temperature of 15±1 °C with 79.83% and 50.66% respectively. Seeds incubated at 15±1 °C exhibited poorer mean germination as compared to 25±1 °C, and ambient room temperatures tried (Table 1), whereas seeds incubated at 5 ± 1 °C were failed to show germination. The mean MGT was significantly affected by temperature. The minimum mean MGT was recorded at 25±1 °C (11.04 days) followed by ambient and 15±1 °C with 13.40 and 19.37 days respectively.

The temperature 5±1 °C exhibited significantly poorest mean MGT due to failure of germination followed by temperature 15±1°C (Table 2). The same trend was observed for the mean germination value (GV). It was highest at 25±1 °C (49.22) followed by

ambient room temperature and 15±1 °C with 37.60 and 9.70 respectively (Table 3). However, seeds incubated at 5±1 °C were not recorded due to hindering germination.

Effect of media on germination: The sown media affected the mean germination percentage. Seeds incubated between paper exhibited the highest mean germination percentage (66.13) followed by media top of paper (58.63) and sterilized sand (42.63). Table 1 showed the effect of incubation media on seed germination under varying temperatures. The media also affected the mean MGT of sown seeds. The between paper media exhibited significantly lowest MGT (14.32) followed by the top of paper and sand media with 15.28 and 19.77 days, respectively (Table 2). The highest mean GV exhibited by the between paper (34.59) followed by the top of paper (29.28) and sand media (8.52). Seeds sown in sand media perform poorer as compared to the remaining media (Table 3).

Effect of temperature and media interaction on seed performance: A significant interaction was observed between incubation temperature and media. Between paper and temperature 25±1 °C exhibited significantly highest germination (98.5%) followed by temperature 25±1 °C with media top of paper (98.00%) (Table 1). Another higher germination percentage was exhibited by ambient room temperature in between paper (94.00%) was closely followed by sand media at 25±1 °C with 81.50 % of germination (Table 1). The interaction of temperature with sand exhibited poorer performance, whereas all kinds of media with temperature 5±1 °C failed to show germination. Overall, incubation of seeds at 25±1 °C between paper showed maximum activity followed by the top of paper and sterilized sand.

The interaction of temperature and media affected the MGT of seeds. MGT exhibited at 25±1 °C/

Table 1. Effect of incubation temperature and seeds germination media on seed germination percentage of fresh seeds under controlled environment. Values are means of four replications and each replication contains 100 seeds. Values in parenthesis are arc sin transformed.

Germination Media	5±1 °C	15±1 °C	25±1 °C	Ambient	Mean
Top of paper (TP)	0.00 (0.00) ^{h}	57.00(49.17) ^{f}	98.00(84.28) ^{a}	79.50(63.20) ^{c}	**58.63 (49.16)** ^{b}
Between Paper (BP)	0.00 (0.00) ^{h}	72.00(58.37) ^{d}	98.50(86.50) ^{a}	94.00(77.80) ^{b}	**66.13 (55.69)** ^{a}
Sterilized sand	0.00 (0.00) ^{h}	23.00(28.67) ^{g}	81.50(64.57) ^{c}	66.00(54.59) ^{e}	**42.62 (36.96)** ^{c}
Mean	**0.00 (0.00)** ^{h}	**50.66(45.40)** ^{c}	**92.66(78.45)** ^{a}	**79.83(65.22)** ^{b}	

In each row values not followed by the same letter are significantly different (P> 0.05)

Table 2. Effect of incubation temperature and seed germination media on means germination time (MGT) (days) of fresh seeds under controlled environment. Values are means of four replications and each replication contains 100 seeds.

Germination Media	5±1 °C	15±1 °C	25±1 °C	Ambient	Mean
Top of paper (TP)	22 ^{a}	19.15 ^{a}	08.56 ^{e}	11.76 ^{d}	**15.27** ^{b}
Between Paper (BP)	22 ^{a}	17.42 ^{b}	08.20 ^{e}	09.30 ^{e}	**14.32** ^{c}
Sterilized sand	22 ^{a}	21.54 ^{a}	16.39 ^{c}	19.14 ^{a}	**19.76** ^{a}
Mean	**22** ^{a}	**19.37** ^{b}	**11.04** ^{d}	**13.40** ^{c}	

In each row values not followed by the same letter are significantly different (P> 0.05)

Table 3. Effect of incubation temperature and seed germination media on germination value (GV) of fresh seeds under a controlled environment. Values are means of four replication and each replication contains 100 seeds.

Germination Media	5±1 °C	15±1 °C	25±1 °C	Ambient	Mean
Top of paper (TP)	0 ^{g}	11.88 ^{f}	65.28 ^{a}	39.94 ^{c}	**29.28** ^{b}
Between Paper (BP)	0 ^{g}	15.47 ^{e}	63.19 ^{a}	59.70^{b}	**34.59** ^{a}
Sterilized sand	0 ^{g}	01.74 ^{g}	19.18 ^{d}	13.15 ^{f}	**08.52** ^{c}
Mean	**0** ^{d}	**09.70** ^{c}	**49.22** ^{a}	**37.60** ^{b}	

In each row values not followed by the same letter are significantly different (P> 0.05)

BP was minimum as compared to all interaction combinations. However, there was a nonsignificant difference at 25±1 °C in top on paper (TP), between paper, and ambient temperature with between paper showed 8.20, 8.56 and 9.30 days respectively. The interaction of the other temperature and media were at ambient/TP, 25±1 °C/sand, 15±1 °C/BP media with showed 11.76, 16.39, 17.42 days respectively (Table 2).

The interaction of media and temperature affected GV of the seed. It was significantly higher at 25±1°C, followed by an ambient condition in between paper and top on paper with 59.70 and 39.94 respectively and followed by 15±1 °C BP/ TP/ sand media with 15.47, 11.88 and 1.74 respectively. This is quite clear in the present study on bhekal, which showed 25±1 °C is the ideal temperature for germination of seeds (Table 1). However, comparable seed germination can also be achieved at ambient room temperature. At 25±1 °C, MGT was minimum, and GV was maximum (Table 2 and 3). Statistically, a significant difference was recorded at a temperature below and above 25±1 °C; the germination was reduced and delayed.

Effect of light on germination: there was a non-significant difference in germination percentage (G%), mean germination time (MGT) and germination value (GV) of freshly collected seeds sown under light and dark conditions (Table 4).

Discussion

Temperature, media and light are the most important factors affecting the germination of seed in laboratory conditions. These vary from species to species; hence, these conditions need to be standardized for every species. Temperature is one of the most critical factors in the laboratory germination. Optimum temperature for germination varies with species because at optimum temperature seed is biochemically very active and a minor fluctuation above and below, checks the rate of biochemical activity which shows results in inhibition or slowing down of germination as well as growth of plants (Travlos *et al*., 2020; Jia *et al.*, 2020). This is observed in present study, which showed that 25±1°C was the ideal temperature for germination of bhekal seeds. However, comparable seed germination can be achieved at ambient temperature also. At 25±1 °C was minimum and GV was maximum. Statistically significant difference was recoded at temperature below or above 25±1 °C not only the germination was reduced but also delayed. Similar, critical temperature of 25±1 °C has been reported to be ideal for many indigenous tree species (Kumar (2005) in neem, Bhagat and Singh (1989) and Thapliyal *et al*. (2006) in *Prinsepia*. ISTA (2015) recommended that alternate temperature 20/30±1 °C and TP is best for germination for small tropical seeds in general.

Under laboratory conditions, generally germination paper, (singly or folded) wet cotton and pure river sand are used as germination media. In our study maximum germination was observed on between paper (BP) followed by top of papers (TP). Sand gave poorer germination as compared to others. Similar results have been documented by Kumar and Bhatnagar (1976), in *Dalbergia sissoo* and Ghyare (2005) in *Albizia lebbek*. In contrast to the present results, Shringirshi *et al.* (2001) in Neem and Ramchandra (1996) in *Acacia catechu*, Ghyare (2005) in *Cassia siamea* and *Prosopis juliflora* showed that TP was best substratum for seed germination. ISTA (1993) also recommends the use of between paper for large seeds.

The interaction of temperature and media showed that the maximum germination percentage with minimum MGT and higher germination value (GV) was recorded at 25±1 °C on between papers nonsignificantly followed by the top on paper (TP) with 25±1 °C. Similar findings were reported by Thapliyal *et al*. (2006). In contrast to our results, Guo *et al*., 2020; Guo *et al*., 2018 find 25 °C temperature is not a suitable incubation condition for germination in *Pinus bungeana* Zucc. ex Endl. However, the na-

Table 4. Effect of light on seed germination percentage, mean germination time (MGT), germination value (GV) under controlled environment. Values are means of four replications and each replication contains 100 seeds. Values in parenthesis are arc sin transformed.

Germination		MGT		GV	
Light	Dark	Light	Dark	Light	Dark
95.50 (79.85) [a]	93.50 (75.74) [a]	9.43 [a]	9.98 [a]	52.51 [a]	48.92 [a]

In each row values not followed by the same letter are significantly different (P> 0.05)

ture of *P. utilis* seed is differ to *P.bungeana.*

Conclusion

The present investigation concluded that temperature of 25±1 °C and germination media of between paper (BP) was found best in all treatments. Presence or absence of light could not affect the germination as results of present study showed non-photodormancy of bhekal seed.

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References

Baskin, C. C. and Baskin, J.M. 2014. *Seeds: Ecology, Biogeography and Evolution of Dormancy and Germination*, (2nd edn) (Academic Press: San Diego, CA, USA).

Bhagat, S. and Singh, O. 1989. A note on germination and longevity of *Prinsepia utilis* Royle seed. *Indian For*. 113 (5): 442-443

Bhagat, S. and Singh, O. 1991. Studies on Determination of Optimum Sowing Method of Prinsepia utilis Royle Seed in the Field. *Indian Forester.* 117(2): 117-119.

Djavanshir, K. and Pourbeik, H. 1976. Germination valuea new formula. *Silvaegenetica*. 25(2): 79-83.

Ghyare, B. P. 2005. Testing of seeds of some forest tree species for germination and seed born fungi. *Indian Forester.* 131 (1): 121-123.

Guo, C., Shen, Y. and Shi, F. 2018. Investigating seed dormancy in *Pinus bungeana* Zucc. ex Endl.: understanding the contributions of enclosing tissues and temperature on germination. *Forests*. 9(7): 401.

Guo, C., Shen, Y. and Shi, F. 2020. Effect of temperature, light, and storage time on the seed germination of Pinus bungeana Zucc. ex Endl.: The role of seed-covering layers and abscisic acid changes. *Forests*. 11(3): 300.

ISTA 1993. International Rules for Seed Testing. *Seed Science and Technology,* 21, Supplement.

ISTA 2015. International Rules for Seed Test. Zurich, Switzerland.

ISTA. 2010. International rules for seed testing. International Seed Testing Association, Switzerland.

ISTA. 1976. International rule for seed testing. Seed Sci. Technol. 4: 3-49.

Jia, X., Wang, Y., Jiang, J., Xiong, R., Zhang, Z., Yang, R., and Cao, G. 2020, November). Effects of Different Light and Temperature Treatments on Seed Germination and Seedling Growth of Vegetables. In *IOP Conference Series: Earth and Environmental Science* (Vol. 598, No. 1, p. 012108). IOP Publishing.

Kumar, A. and Bhatnagar, H. P. 1976. Effect of temperature and substratum on the germination the germination of D. sissoo seeds. *Indian Forester.* 102 (9):608-613.

Kumar, A., Tomer, R. P. S., Kumar, R. and Chaudhary, R. S. 2005. Seed size studies in relation to yield attributing parameters in Indian mustard (*Brassica juncea* (L) Czern and Coss). *Seed Research-New Delhi.* 33(1): 54.

Maikhuri, R. K., Singh, A. and Semwal, R. L. 1994. *Prinsepia utilis* Royle: a wild, edible oil shrub of the higher Himalayas. *Plant Genet. Resources Newslett*. 98: 5-8.

Ramchandra, N.G. 1996. *Provenance variation in seed and seedling parameters in Acacia catechu Willd.* Ph.D. Thesis, FRI (Deemed University), Dehradun.

Rawat, M. M. S. and Thapliyal, R. C. 2003. Endogenous rhythm in seed germination of *Dendrocalamusstrictus*. *Seed Science and Technology*. 31(1): 21-27.

Shringirishi, Nikhil, Narendra K. Shukla and Ram Jee Srivastava, 2001. Studies on germination of Neem (*Azadirachta indica* A. Juss) seeds at different temperature and substarte. *Indian Forester.* 127(4) : 466-473.

Thapliyal, M., Tewari, R. and Bahar, N. 2006. Oil seed of forest origin: Potential source of Biofuel. *Proceedings of 12th Silvicultural conference,* 292-298.

Travlos, I., Gazoulis, I., Kanatas, P., Tsekoura, A., Zannopoulos, S. and Papastylianou, P. 2020. Key factors affecting weed seeds' germination, weed emergence, and their possible role for the efficacy of false seedbed technique as weed management practice. *Frontiers in Agronomy*. 2: 1.