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Enhancement of Germination of *Berberis lycium* Royle. by Different Pre Sowing Seed Treatments

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Abstract: The study was carried out in the laboratory of the Department of Silviculture and Agroforestry, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan-173230 (HP) during 2017-2018. *Berberis lycium* seeds were obtained from plants growing in district Solan of Himachal Pradesh. The freshly harvested seeds were stratified in perforated poly bags. Three batches of seeds were stratified for 15, 30 and 45 days at four distinct temperature ranges *viz.,* 11-22˚C, +5˚C, 0±1˚C and -5˚C. Gibberellic acid (GA_3) was applied to seeds at three concentrations (100, 200 and 300ppm) with untreated seeds serving as control. Significant results were obtained when stratification duration and temperature were coupled with GA_3 treatments. Stratification period of 30 days (P_2) at 0±1˚C (T_3) combined with application of 200ppm GA_3 showed maximum germination percent (70.00%), germination energy (60.00%), mean daily germination (2.33) and peak value (4.30) while the minimal germination percent (26.67%), germination energy (21.67%), mean daily germination (0.89) and peak value (1.48) were observed in untreated seeds (control), stratified for 15 days (P_1) at +5˚C (T_2).

Keywords: Stratification, Dormancy, Germination, Growth regulators

According to IUCN (International Union for Conservation of Nature and Natural Resources) *Berberis lycium* (Kashmal) is having a vulnerable status of conservation. It occurs in the Himalayan region between the altitudes of 850-3500 meters amsl on moderate to steep slopes. It is an evergreen shrub belonging to the family Berberidaceae and is a vertical flowering bush that grows to a height of 3-4 meters, having a solid stem, which is enclosed in a slight fragile bark. The plant blooms from May to June and produces bright red/purplish coloured berries. In one kg of a seed lot, there are around 1,59000- 2,00000 seeds. Fruits of this plant are very nutritious and are rich source of vitamins, minerals, antioxidants, anthocyanin etc. Further the seeds have cancer suppressing properties. Like many other wild fruit species that are over exploited in nature which have not been domesticated yet, *Berberis lycium* also belongs to the same category (Sood et al 2013). It is utilized as fuel wood species as it owes high calorific value. Berberine present in rhizomes has marked antibacterial effects (Bhattacharjee 2008). The natural regeneration in this species through seed gives little success as the seeds show around 34.00 per cent germination. The main reason for the lower germination is seed dormancy (Kumari et al 2017). Considering the importance of this vulnerable shrub species with poor propagation by sexual approaches, the present study was undertaken to evaluate the effect of different stratified temperatures, periods of stratification and growth regulators, on seed germination of *Berberis lycium* Royle.

MATERIAL AND METHODS

The present investigation was at Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during the year 2017-2018. The freshly harvested seeds of *Berberis lycium* collected from vicinity of Nauni in district Solan during the month of June 2017. The seeds were stratified with sand as a stratifying media. Stratification of seeds was done in perforated polythene bags in order to allow seed respiration. The seeds were kept moist during the entire stratification period. In November to December, 2017, three seed lots were kept for stratification for 15 (P_1), 30 (P_2) and 45 (P_3) days. Stratification of seeds were carried out at four different temperatures *viz.,* T_1 (11-22˚C), T_2 (+5˚C), T_3 (0±1˚C) and T_4 (-5˚C). After stratification, the seeds were further treated with gibberellic acid at three different concentrations *i.e.* GA_3 (100, 200, 300ppm), prior to sowing and the untreated seed lot was used as control. The observation on germination percent (as per ISTA rules), mean daily germination, peak value and the germination energy were recorded. The data generated from the investigation were subjected to OPSTAT software.

RESULTS AND DISCUSSION

The maximum seed germination in *Berberis lycium* Royle. was observed maximum when the seeds stratified at 0±1˚C for 30 days combined with application of 200ppm gibberellin (T_3×P_2×G_3) (70.00%) which was statistically at par when the seeds stratified in -5˚C for 45 days combined with application of 200ppm gibberellin (T_4×P_3×G_3) showed 66.67 per cent germination, 65.00 per cent germination in 0±1˚C for 45 days combined with the application of 300ppm gibberellin (T_3×P_3×G_4), 65.00 per cent germination in 0±1˚C for 15 days combined with the application of 200ppm gibberellin (T_3×P_1×G_3), 63.33 per cent germination in 0±1˚C for 45 days combined with the application of 200ppm gibberellin (T_3×P_3×G_3). Seeds treated with GA_3 enhance the performance and germination because GA_3 treated seed reduced the germination time, which could be due to more rapid uptake of water in seed treated with GA_3 than the control. GA_3 increasing the growth potential of embryo, during seed germination embryonic GA_3 is released that triggers the weakness of seed coat by stimulation of many genes which results in cell expansion as in *Arabidopsis thaliana* (Finkalstein et al 2008). Understanding the proper chemical mechanism of GA_3 transport in plant cells is a difficult task for scientists. The precise mechanism of gibberellic acid in plant development and seed germination remains a mystery. The appropriate elucidation of GA_3 transport mechanism is essential for the survival of plant species and successful crop production. Seed priming with GA_3 has been demonstrated to be a useful tool for activating metabolic germination processes and facilitating increments in physiological process during seed germination (Gupta and Chakrabarty 2013). The promotion of germination by GA_3 has been demonstrated in many seed species. Seed dormancy prevents seeds from germinating even when germination circumstances are ideal, such as enough water supplies and

Table 1. Interaction effect of stratification temperature, period and gibberellic acid (T×P×G) on germination percent of *Berberis lycium*

Gibberellic acid (ppm)	Interaction between(T×P×G)															
	T_1 (11-22˚C)				T_2 (+5˚C)				T_3 (0±1˚C)				T_4 (-5˚C)			
	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
Control	30.00 (33.15)	43.33 (41.15)	36.67 (37.21)	36.67 (37.17)	26.67 (31.06)	35.00 (36.36)	38.33 (38.23)	33.33 (35.18)	33.33 (35.20)	36.67 (37.24)	38.33 (38.21)	36.11 (36.89)	30.00 (33.15)	36.67 (37.21)	33.33 (35.10)	33.33 (35.15)
100	36.67 (37.24)	33.33 (35.24)	45.00 (42.10)	38.33 (38.19)	46.67 (43.07)	38.33 (38.19)	36.67 (37.19)	36.67 (37.08)	36.11 (36.84)	30.00 (33.15)	43.33 (41.05)	33.33 (35.09)	36.67 (37.19)	33.33 (35.15)	38.33 (38.18)	36.11 (36.84)
200	41.67 (40.18)	31.67 (34.17)	41.67 (40.18)	38.33 (38.18)	56.67 (48.82)	46.67 (43.06)	50.00 (44.98)	51.11 (45.62)	65.00 (53.74)	70.00 (56.82)	63.33 (52.72)	66.11 (54.43)	50.00 (44.98)	41.67 (40.18)	66.67 (54.81)	52.78 (46.66)
300	31.67 (34.22)	33.33 (35.20)	38.33 (38.23)	34.44 (35.88)	48.33 (44.03)	43.33 (41.14)	46.67 (43.03)	46.11 (42.73)	51.67 (45.95)	55.00 (47.86)	65.00 (53.74)	57.22 (49.18)	30.00 (33.15)	33.33 (35.20)	55.00 (47.86)	39.44 (38.74)
Mean	35.00 (36.20)	35.42 (36.44)	40.42 (39.43)		44.58 (41.74)	37.92 (37.86)	42.92 (40.86)		44.17 (41.49)	47.92 (43.77)	52.50 (46.43)		36.67 (37.12)	36.25 (36.94)	48.33 (43.99)	

CD (p=0.05) T= 2.61, P = 2.26, G = 2.61, T×P = 4.52, T×G = 0.22, P×G = 4.52, T×P×G = 9.04
Values in parenthesis are angular transformation

Table 2. Interaction effect of stratification temperature, period and gibberellic acid (T×P×G) on germination energy of *Berberis lycium*

Gibberellic acid (ppm)	Interaction between(T×P×G)															
	T_1 (11-22˚C)				T_2 (+5˚C)				T_3 (0±1˚C)				T_4 (-5˚C)			
	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
Control	25.00 (28.40)	31.67 (34.22)	30.00 (33.15)	27.78 (31.69)	21.67 (27.70)	28.33 (32.13)	33.33 (35.24)	27.78 (31.69)	28.33 (32.08)	25.00 (29.99)	33.33 (35.20)	28.89 (32.42)	25.00 (29.99)	30.00 (33.15)	28.33 (31.92)	27.78 (31.68)
100	25.00 (29.91)	26.67 (31.06)	35.00 (36.22)	28.89 (32.40)	33.33 (35.24)	23.33 (28.84)	31.67 (34.13)	29.44 (32.74)	23.33 (28.84)	23.33 (28.84)	38.33 (38.18)	27.78 (31.57)	28.33 (31.92)	23.33 (38.53)	36.67 (37.21)	29.44 (32.55)
200	36.67 (37.24)	23.33 (28.84)	30.00 (33.15)	30.00 (33.08)	48.33 (44.03)	38.33 (38.18)	48.33 (44.03)	45.00 (42.08)	55.00 (47.86)	60.00 (50.77)	56.67 (48.85)	57.22 (49.16)	43.33 (41.15)	31.67 (34.01)	58.33 (49.88)	44.44 (41.68)
300	23.33 (28.84)	26.67 (30.93)	28.33 (32.13)	26.11 (30.63)	36.67 (37.11)	36.67 (37.24)	40.00 (39.13)	37.78 (37.83)	40.00 (39.20)	43.33 (41.14)	55.00 (47.86)	46.11 (42.73)	28.33 (32.13)	28.33 (32.08)	50.00 (44.98)	35.56 (36.40)
Mean	26.67 (30.92)	27.08 (31.26)	30.83 (33.66)		35.00 (36.02)	31.67 (34.10)	38.33 (38.13)		36.25 (36.71)	37.92 (37.68)	45.83 (42.52)		31.25 (33.80)	28.33 (31.94)	43.33 (41.00)	

CD (p=0.05) T = 2.78, P = 2.41, G = 2.78, T×P = 4.81, T×G = 5.56, P×G = 4.81, T×P×G = 9.61
The values in parenthesis are transformed values (angular transformation)

Table 3. Interaction effect of stratification temperature, period and gibberellic acid (T×P×G) on mean daily germination of *Berberis lycium*

Gibberellic acid (ppm)	Interaction between(T×P×G)															
	T_1 (11-22˚C)				T_2 (+5˚C)				T_3 (0±1˚C)				T_4 (-5˚C)			
	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
Control	1.00	1.44	1.22	1.22	0.89	1.17	1.28	1.11	1.11	1.22	1.28	1.20	1.00	1.22	1.11	1.11
100	1.22	1.11	1.50	1.28	1.56	1.05	1.22	1.22	1.08	1.00	1.44	1.11	1.22	1.11	1.28	1.20
200	1.39	1.06	1.39	1.28	1.89	1.56	1.67	1.70	2.17	2.33	2.11	2.20	1.67	1.39	2.22	1.76
300	1.06	1.11	1.28	1.15	1.61	1.44	1.56	1.54	1.72	1.83	2.17	1.91	1.00	1.11	1.83	1.31
Mean	1.17	1.18	1.35		1.49	1.27	1.43		1.47	1.60	1.75		1.22	1.21	1.61	

CD (p=0.05) T = 0.09, P = 0.07, G = 0.09, T×P = 0.15, T×G = 0.17, P×G = 0.15, T×P×G = 0.30

Table 4. Interaction effect of stratification temperature, period and gibberellic acid (T×P×G) on peak value of *Berberis lycium*

Gibberellic acid (ppm)	Interaction between(T×P×G)															
	T_1 (11-22˚C)				T_2 (+5˚C)				T_3 (0±1˚C)				T_4 (-5˚C)			
	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
Control	1.79	2.42	1.92	2.04	1.48	2.00	1.96	1.82	2.13	2.10	2.38	2.21	1.81	2.30	1.82	1.97
100	2.22	1.95	2.58	2.25	2.75	1.71	2.11	2.19	1.55	1.70	2.65	1.97	2.06	2.19	2.29	2.18
200	2.21	2.02	2.45	2.23	3.32	2.69	2.79	2.93	3.44	4.30	4.04	3.93	2.75	2.37	3.41	2.84
300	2.11	1.75	2.29	2.05	2.38	2.35	2.99	2.57	2.99	3.52	3.43	3.31	1.88	1.90	3.27	2.35
Mean	2.08	2.04	2.31		2.48	2.19	2.46		2.53	2.90	3.12		2.13	2.19	2.70	

CD (p=0.05) T = 0.22, P = 0.19, G = 0.22, T×P = NS, T×G = 0.43, P×G = 0.37, T×P×G = 0.74

a proper temperature. GA_3 treated seeds breach the seed dormancy by either enhancing embryo development potential or weakening the seed coat, allowing the seeds radicle to burst through. The enhanced seed germination in *Berberis lycium* observed under GA_3 seed treatment might be due to increased cell elongation and cell division activities along with better supply of nutrients under the low temperature. The property of GA_3 to induced better and quicker germination (Dalip et al 2017). Similarly the effect of GA_3 has been reported by Garaniya and Bapodra (2015) in Abrus precatorius and Shreesty et al (2019) in *Carrisa carandus*.

CONCLUSION

The higher seed germination in *Berberis lycium* was observed after GA_3 seed treatment which is attributed to the increased cell elongation and cell division activities and better nutrition delivery from the seed at the low temperature. The interaction effect of stratification temperature, period and seed treatment with gibberellic acid revealed that when the seeds stratified at 0±1˚C (T_3) for 30 days interval (P_2) combined with soaking of seed in 200ppm gibberellic acid surpassed all other treatment combination.

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