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Seed Germination and Growth Parameters of Firethorn (*Pyracantha crenulata* M. Roem.) as Influenced by Different Sowing Date and Gibberellic Acid Concentrations

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ABSTRACT

A field experiment was conducted at Farm area of IMAP, Gairsain, Chamoli during the crop growing season of 2020-21 to study the response of three different date of sowing (15th October, 30th October and 15th November) and five Gibberellic acid concentrations (50, 100, 150, 200 and 250 ppm) on germination and growth parameters of Firethorn. The experiment was conducted in Factorial Randomized Complete Block Design with 3 replications and 15 treatment combinations. The findings of the investigation indicated that seeds treated with 150 ppm Gibberellic acid and sown on 15th November resulted in maximum germination (60.0), survival percent (88.0), shoot length (28.22 cm), shoot diameter (9.95 mm), number of leaves (628.80), number of branches (42.0), shoot fresh weight (21.77 g), shoot dry weight (10.91 g), root length (28.22 cm), root diameter (9.73 mm), number of roots (58.87), root fresh weight (6.25 g), root dry weight (3.40 g), total fresh weight (28.02 g) and total dry weight (14.31 g) as compared to other treatment combinations.

Key words: *Firethorn, Germination percent, Gibberellic acid, Sowing date*

Introduction

Wild fruits constitute an important component of traditional diets of local communities in hilly region of Uttarakhand. Many of these wild fruits are underutilized and seldom eaten. These wild fruits have profitable utility in terms of being a rich source of carbohydrates, proteins, fats, vitamins, minerals, fibers, etc. (Deshmukh and Waghmode, 2011). In addition to cultivated fruit crops there are large number of edible wild fruit plants which are found growing naturally in the region. Uttarakhand due to its varied eco-geographical and eco-climatic conditions is one such state which is highly enriched with its vegetation including wild edible fruits such as firethorn, wild fig, *kaphal*, wild apricot, wild pomegranate, wild raspberry *etc.* (Saklani *et al*., 2011) and these are utilized by rural and urban people, espe-

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cially rural poor people for nutritional and medicinal purpose. Among these edible wild plants, firethorn commonly known as *ghingharu* is a shrubby perennial mostly found growing around the villages in the wastelands and in the cultivated fields of Uttarakhand.

Pyracantha crenulata M. Roem. syn. *Crataegus crenulata* Roxb. is a member of Rosaceae family is a thorny and bushy plant, found growing in Himalayan hills ranging from 900 to 2400 m altitude locally known as *ghingharu*. It is also known as Himalayan firethorn, Nepalese firethorn, Nepalese whitethorn, Indian howthorn, *chota seb* etc. It is native to temperate Himalaya (Weber, 2003). In hilly regions of Uttarakhand, it is generally found in the Chamoli, Uttarkashi, Tehri, Almora, Nainital, Bageshwar, Champawat and Pithoragarh districts. The fruits are good source of food for wild animals' viz., birds & *Langur* (*Presbytis species*) in rainy season. The wood is used for making walking sticks and fuel (Chauhan, 1999). The flowers and berries of the hawthorn plant are reported to be useful in the treatment of irregular heartbeat, high blood pressure, chest pain, hardening of the arteries and heart failure (Tassell *et al*., 2010). It contains leucocynidine flavanoids vitexin 4 rhamnoside, vitexin glycoside and oligomeric leocoatocyanidin. The fruit of this plant has been used in traditional medicine in the treatment of serious health conditions like heart disorders, hypertension, diabetes, blood pressure and circulation system especially in case of angina.

Propagation by seeds is the major method by which plant produce in nature and one of the most efficient and widely used propagation methods for cultivated crops (Hartmann *et al*., 2010). *Ghingharu* can be propagated by both sexual and vegetative method. The germination leads to production of seedling plants (Singh, 2018). To get higher and proper germination with vigorous seedling growth, seed needs pre-treatments before sowing which helps in promotion of early and higher percentage of germination in order to produce healthy and vigorous seedlings (Chadha, 2010). Germination of seeds may require Gibberellins for several possible steps such as the activation vegetative growth of the embryo, the weakening of a growth constraining endosperm layer surrounding the embryo and the mobilization of stored food reserves of the endosperm (Taiz and Zeiger, 2003). Gibberellic acid is used to weaken seed coat so that the emergence of the radical and plumule is positively influenced for root and shoot formation. The convenient sowing time of each type of crop is considerable basic requirements to yield. The total crop yield is significantly affected by the sowing times (Mahmoud *et al*., 2019). For vegetative propagation, there is a need of healthy, quick growing and attainable buddable/graftable size of seedlings in short span of time from their sowing time (Singh *et al*., 2015).

In the lead of commercialization of main fruit crops, wild species are so often being neglected. These wild crops have assumed a huge role in providing nutritionally and dietary prerequisites of people of local areas. Indigenous fruits play an important role in the nourishment of rural and ethnic communities from the very beginning. There is a need to exploit these wild crops not only for their nutritional values, but also for their utilization for cultivated plants. These plants can be proved as a good rootstock for the cultivated plants. There is also a need of conservation of these wild edible fruit crops as to maintain the ecosystem and also for their exploitation and utilization.

Materials and Methods

The experiment was carried out during crop growing seasons of October, 2020-August, 2021 at the research farm of the Institute of Medicinal and Aromatic Plants, VCSG Uttarakhand University of Horticulture & Forestry, Hargarh, Mehalchauri situated in Garhwal mandal nearby the centre of the Garhwal and Kumaon mandal situated at 29º 97′ N latitude and 79º 29′ E longitude at a height of 1640 meters above the mean sea level in the hilly region of Uttarakhand and western Himalayan agro-climatic zone of India. The soil of the experimental field was loamy sand with pH 6.8. It was moderately fertile being low in organic carbon (0.21%), available nitrogen (63.5 kg ha^{-1}) and available phosphorus (8.1 kg ha^{-1}) and medium in available potassium (250.5 kg ha^{-1}). The experiment was laid out in a factorial randomized block design with five Gibberellic acid concentrations solution i.e. 50, 100, 150, 200, 250 ppm and at three different dates of sowing viz. 15th October, 30th October and 15th November, replicated three times, sowing of *ghingharu* seeds was done in poly bags under open field conditions. Before sowing seeds were soaked in Gibberellic acid concentrations solution as per treatments for 24 hours.

Selection of seeds: The seeds were collected from

forest areas of Mehalchauri, Chamoli district of Uttarakhand. The seeds were cleaned by rubbing all the extraneous materials and then dipped in water. All the floating seeds were discarded and only the healthy seeds which settled down were taken for use in these studies.

Seed Treatment: The solution of Gibberellic acid was prepared by dissolving the known quantities of the chemical in a small amount of ethyl alcohol and then adding distilled water to make up the volume. Firethorn seeds were soaked in the solution of Gibberellic acid for 24 hours and used for sowing.

Filling of poly bags and sowing of seeds: Poly bags having a length of 15 cm and diameter of 10 cm with 200 gauge thickness were used and filled with growing media containing FYM and Soil in the ratio of 2:1. The firethorn seeds treated with Gibberellic acid solution @ 50, 100, 150, 200 and 250 ppm were sown in the poly bags at 15 days interval i.e. 15th October, 30th October and 15th November 2020. One seed per poly bag was sown at 1-2 cm depth in each replication. Manual irrigation was applied on alternate days and hand weeding was done as and whenever needed.

Results and Discussion

Days taken for initial germination, germination and survival percent

The result obtained in the present study indicated that days taken for initial germination, germination and survival percent (Table 1) were significantly influenced by different sowing date and Gibberellic acid concentration. Crop sown on 15th November recorded significantly higher value of germination (54.0) and survival percent (82.7) as compared to another date of sowing. This might be due to presence of favorable temperature, humidity and available moisture for seed germination. Similar findings have been reported by Shrivatsava *et al*., (2002) in mango; Kumar *et al*., (2018) in papaya. Seed treatment with the Gibberellic acid @ 150 ppm recorded maximum germination (47.2) and survival percent (80.6) which were statistically at par with Gibberellic acid @ 100 ppm (44.4 and 77.6 percent) as compared to other Gibberellic acid treatments. This may be due to the fact that Gibberellic acid acts on embryo and causes synthesis of hydrolyzing enzymes particularly for growth of embryo and this hydrolyzed food is utilized for growth of embryo and there by enhanced the germination and survival of firethorn seeds. The increase in the concentration up to 150 ppm increased the rate of germination and then there was a decline by increasing the Gibberellic acid concentration beyond the 150 ppm. This might be due to the fact that Gibberellic acid @ 150 ppm was optimum to start the metabolic activity in seeds and therefore further increase in germination process. These results are in conformity with Joshi *et al*. (2010) and Tariyal, (2019) in firethorn; Rout *et al*. (2017) in *Cassia fistula* L; Lalitha *et al*. (2020) in *Aonla*. While, minimum number of days (53.0) taken for initial germination were recorded seed treated with 250 ppm Gibberellic acid solution and crop sown on 15th November.

Table 1. Effect of different sowing date and Gibberellic acid concentrations on days taken to initial germination, germination and survival percent

Treatment	Days taken to initial germination (No.)	Germination (%)	Survival (%)
Sowing date			
15th October	68.1	28.7	67.8
30th October	56.0	43.7	75.9
15th November	42.4	54.0	82.7
$SE_{(m)}$	0.33	1.40	1.35
$CD_{(0.05)}$	0.96	4.07	3.92
Gibberellic acid concentration			
50 ppm	57.5	40.6	72.7
100 ppm	56.5	44.4	77.6
150 ppm	55.5	47.2	80.6
200 ppm	54.8	41.1	74.1
250 ppm	53.0	37.2	72.3
$SE_{(m)}$	0.42	1.80	1.74
$CD_{(0.05)}$	1.24	5.25	5.06

Shoot characters

Shoot characters were markedly influenced by different sowing date and Gibberellic acid concentrations (Table 2). Maximum shoot length (25.9 cm), shoot diameter (9.3 mm), fresh (17.3 g) and dry weight (7.8 g) with respect to sowing date was recorded on 15th November. The increase in seedling height may be due to availability of favorable environmental conditions at the time of growth and development of seedlings. The factors responsible for seedling diameter may be temperature and nutrient uptake by seedlings, sunlight etc. (Kumar *et al*. 2018). Similar results were observed by Babu *et al*.

(2010) and Barche *et al*. (2010) in papaya. Seed treatment with the Gibberellic acid @ 150 ppm was found to be superior as it provided maximum shoot length (25.1 cm), shoot diameter (8.6 mm), fresh (12.2 g) and dry weight (5.9 g) which were statistically at par with Gibberellic acid @ 100 ppm (24.3 cm, 8.4 cm, 11.5 g and 5.7 g) as compared to other Gibberellic acid treatments. The increase in seedling height with Gibberellic acid due to increased osmotic uptake of nutrients, causing cell multiplication and cell elongation in cambium tissue of the inter-nodal region and thus resulting in increased height of plant and stem diameter also increased due to Gibberellic acid promoted cell division and cell elongation in the collar region. The results are in accordance with the result of Kumar *et al*., (2008) and Shaban, (2010) in mango, Harshvardhan and Rajasekhar (2012) in jackfruit; Lalitha *et al*. (2020) in aonla.

Root characters

Crop sowing on 15th November resulted, maximum root length (25.64 cm), root diameter (9.08 mm), number of roots (44.11), fresh (4.41 g) and dry weight (2.10 g) as compared to other sowing date, whereas among seed treatment with different Gibberellic acid concentrations, maximum root length (23.77 cm), root diameter (8.70 mm), number of roots (48.47), fresh (4.10 g) and dry weight (2.18 g) were recorded in Gibberellic acid @ 150 ppm (Table

Table 2. Effect of different sowing date and Gibberellic acid concentrations on shoot characters

Treatment	Shoot length (cm)	Shoot diameter (mm)	Shoot fresh weight (g)	Shoot dry weight (g)
Sowing date				
15th October	19.1	6.8	4.5	2.1
30th October	23.7	8.4	8.8	4.3
15th November	25.9	9.3	17.3	7.8
$SE_{(m)}$	0.41	0.08	0.24	0.14
$CD_{(0.05)}$	1.18	0.24	0.69	0.42
Gibberellic acid concentration				
50 ppm	21.6	7.9	9.0	3.9
100 ppm	24.3	8.4	11.5	5.7
150 ppm	25.1	8.6	12.2	5.9
200 ppm	22.4	8.2	9.8	4.4
250 ppm	21.0	7.8	8.7	3.8
$SE_{(m)}$	0.52	0.11	0.31	0.19
$CD_{(0.05)}$	**1.52**	**0.31**	**0.89**	**0.54**

Table 3. Effect of different sowing date and Gibberellic acid concentrations on root characters

Treatment	Root length (cm)	Root diameter (mm)	No. of roots	Root fresh weight (g)	Root dry weight (g)
Sowing date					
15th October	16.32	6.69	29.83	1.42	0.80
30th October	24.11	8.79	43.45	3.90	1.85
15th November	25.64	9.08	44.11	4.41	2.10
$SE_{(m)}$	0.39	0.07	0.62	0.10	0.07
$CD_{(0.05)}$	1.13	0.19	1.48	0.30	0.19
Gibberellic acid concentration					
50 ppm	21.17	8.01	35.89	2.93	1.40
100 ppm	23.16	8.43	40.36	3.65	1.93
150 ppm	23.77	8.70	48.47	4.10	2.18
200 ppm	21.18	8.14	35.56	3.04	1.24
250 ppm	20.82	7.66	35.38	2.50	1.16
$SE_{(m)}$	0.50	0.08	0.80	0.13	0.09
$CD_{(0.05)}$	1.46	0.24	2.33	0.38	0.25

3). The increase in root length could be due to exogenous application of Gibberellic acid induced the activity of gluconeogenic enzymes during early stages of seed germination and this could be responsible for improved germination and vigour characteristics that is reflected in terms of increase in root length (Hota *et al*., 2018). Gibberellic acid treatment might have resulted into increased production of photosynthates and their translocation through phloem to the root zone might be responsible for increasing the root growth (Vachhani *et al*. 2014). These results are in close agreement with Shaban (2010) and Patel *et al*. (2017) in mango.

Total number of leaves, branches, fresh and dry weight

Seeds sown on 15th November resulted in maximum number of leaves (515.44), branches (34.91), total fresh (21.69 g) and dry weight (9.92 g). Gibberellic acid application @ 150 ppm recorded maximum number of leaves (403.28), branches (27.91), total fresh (16.33 g) and dry weight (8.03 g). The increase in the number of leaves might be due to the fact that activity of Gibberellic acid at apical meristem resulting in more nucleoprotein responsible for increasing leaf initiation and expansion. It may be also due to the vigorous growth induced by the Gibberellic acid treatment, number branches which facilitate better harvest of sunshine by plants to produce more number of leaves. Result obtained on this aspect are in agreement with Meshram *et al*. (2015) in acid lime; Jadhav *et al*. (2015) in custard apple; Patil *et al*. (2017) in jamun, Lalitha *et al*. (2020) in aonla. Increase in fresh and dry weight of plants might be due to influence of Gibberellic acid on different plant parts, which could be due to its effect in stimulating cell division, cell elongation, cell wall plasticity, permeability of cell membrane and improved mobilization of nutrients leading to enhanced growth and development (Hota *et al*., 2018).

Conclusion

On the basis of results obtained from the present investigation, it can be concluded that to obtain higher germination, survival percent, highest growth parameters in firethorn, seeds should be treated with 150 ppm Gibberellic acid and sowing should be done on 15th November.

References

Babu, K.D., Patel, R.K., Singh, A., Yadav, D.S., Singh, A., Yadav, D.S., De, L.C. and Deka, B.C. 2010. Seed germination, seedling growth and vigour of papaya under North East Indian condition. *Acta Horticulture.* 851: 299-306.

Barche, S., Kirad, K.S. and Singh, D.B. 2010. Response of seed treatment on germination, growth survivality and economics of different cultivars of Papaya (*Carica papaya* L.). *Acta Horticulture.* 851(42): 279-284

Chadha, K. L. 2010. *Handbook of Horticulture*, ICAR, New Delhi. 136-137.

Chauhan, N. S. 1999. *Medicinal and Aromatic Plants of Himachal Pradesh*, M.L Gidwani , Indus publishing

Table 4. Effect of different sowing date and Gibberellic acid concentrations on total number of leaves, branches, fresh and dry weight

Treatment	No. of leaves	No. of branches	Total fresh weight (g)	Total dry weight (g)
Sowing date				
15th October	177.00	15.71	5.89	2.91
30th October	353.07	23.84	12.66	6.13
15th November	515.44	34.91	21.69	9.92
$SE_{(m)}$	6.31	0.32	0.24	0.15
$CD_{(0.05)}$	18.39	0.92	0.69	0.45
Gibberellic acid concentration				
50 ppm	322.00	23.99	11.94	5.32
100 ppm	393.58	27.69	14.75	7.64
150 ppm	403.28	27.91	16.33	8.03
200 ppm	326.26	22.73	12.86	5.63
250 ppm	297.04	21.76	11.18	4.99
$SE_{(m)}$	8.15	0.41	0.30	0.20
$CD_{(0.05)}$	**23.74**	**1.19**	**0.89**	**0.58**

company FS-5, Tagore Garden, New Delhi.

Deshmukh, B.S. and Waghmode, A. 2011. Role of wild edible fruits as a food resource: Traditional knowledge. *International Journal Pharmaceutical and Life Sciences*. 2: 919–924.

Harshavardhan, A. and Rajasekhar, M. 2012. Effect of presowing treatments onseedling growth of Jackfruit (*Artocarpus heterophyllus* Lam.). *Journal research of ANGRAU.* 40(4): 87-89.

Hartmann, H. T., Kester, D. E., Davies, F. T. and Geneve, R. L. 2010. The development of seeds. In: Plant Propagation: Priciples and Practices. 8th edition. Prentice Hall Inc. Upper Saddle River, New Jersey, USA. 125.

Hota, S.N., Karna, A.K., Jain, P.K. and Dakhad, B. 2018. Effect of gibberellic acid on germination, growth and survival of jamun (*Syzygium cumini* L. Skeels). *The Pharma Innovation.* 7(8): 323-326.

Jadhav, A.C., Bhagure, Y.L. and Raundal, R.M. 2015. Effect of PGR, chemicals and plantextract on seed germination and seedling growth of Custard apple (*Annona squamosa*). *Asian Journal of Horticulture.* 10(1): 184-186.

Joshi, S.C., Debarati, Preeti, Parihar, S.S. and Negi, H.C.S. 2010. Effect of GA_3 on seed germination of *Pyracantha crenulata* (D. Don.) M. Roem. *New York Science Journal.* 3(9): 55-57.

Kumar, H.S.Y., Swamy, G.S.K., Kanmadi, V.C., Kumar, D. and Sowmaya, B.N. 2008. Effect of organics and chemicals on germination, growth and graft-take in mango. The *Asian Journal of Horticulture*. 3(2): 336-339.

Kumar, R., Beniwal, V.S. and Prince. 2018. Effect of Sowing Time and Seedling Depth on Germination and Growth of Papaya Seedlings. *International Journal Pure & Applied Bioscience.* 6(1): 1442-1448.

Lalitha, K.R., Tank, R.V., Chawla, S.L. and Jena, S. 2020. Effect of chemicals on seed germination and seedling growth of Aonla (*Emblica officinalis* Gaertn.). *The Pharma Innovation.* 9(12): 239-243

Mahmoud, T. M. S., Nabila, E. K., Rayya, M. S. A. and Eisa, R. A. 2019. Effect of Planting dates and different growing media on seed germination and growth of pistachio seedlings. *Bulletin of the National Research Centre.* 43: 133.

Meshram, P.C., Joshi, P.S., Bhoyar, R.K. and Sahoo, A.K. 2015. Effect of different plant growth regulators on seedling growth of Acid lime. *Research in Environment and Life Science.* 8(4): 725-728.

Patel, R.J., Ahlawat, T.R., Patel, A.I., Amarcholi, J.J., Patel, B.B. and Sharma, K. 2017. Growth of mango (*Mangifera indica* L.) rootstocks as influenced by presowing treatments. *Journal of Applied and Natural Science*. 9(1): 582–586.

Patil, H., Tank, R.V., Bennurmath, P. and Patel, M. 2017. Effect of seed treatment on germination and seedling growth of jamun (*Syzygium cumini* L.). *International Journal of Current Microbiology and Applied Sciences*. 7(2): 2654-2659.

Rout, S., Beura, S., Khare, N., Patra, S.S. and Nayak, S. 2017. Effect of seed pre-treatment with different concentrations of gibberellic acid (GA3) on seed germination and seedling growth of *Cassia fistula* L. *Journal of Medical Plants Studies*. 5(6): 135-138.

Saklani, S., Chandra, S. and Mishra, A.P. 2011. Evaluation of Nutritional Profile, MedicinaValue and Qualitative Estimation in Different Parts of *Pyrus pashia*, *Ficus palmata* and ýýýýPyracantha crenulata. *Journal of Global trends in Pharmaceutical Sciences*. 2(3): 350-354.

Singh, R., Negi, P.S. and Ahmed, Z. 2010. Himalayan Red Berry (*Crataegus Crataegus crenulata* Roxb.); A wonder heart tonic. Science Reporter.

Shaban, A.E.A. 2010. Improving seed germination and seedling growth of some mango rootstocks. *American-Eurasian Journal of Agricultural and Environmental Sciences*, 7(5): 535-541.

Shrivastava, A.P., Chandra, R., Saxena, S., Ranjam, S., Ranade, S. and Prasad, V.A. 2002. PCR based assessment of genetic diversity and parentage analysis among commercial mango cultivars and hybrids. *Journal of Horticultural Science and Biotechnology.* 82 : 951-959.

Singh, J. 2018. *Basic Horticulture.* Kalyani Publishers, Ludhiyana. 143.

Singh, S.P., Singh Sarvesh, Singh Priyanka, Tiwari Anupam and Meena Ramkesh. 2015. Effect of Sowing Time on seed germination and seedling growth of Jamun (*Syzyuim cumini* Skeels.). *Research in Environment and Life Sciences.* 8(4): 793-794.

Tariyal, A. 2019. *Effect of Gibberellic Acid on Seed Germination and Seedling Growth of Firethorn* (*Pyracantha crenulata*). Thesis, M.Sc. College of Horticulture, VCSG, UUHF, Bharsar, Pauri Garhwal.

Taiz, L. and Zeiger, E. 2003. *Plant Physiology.* Panima Publishing Corporation, New Delhi. 464-465.

Tassell, M.C., Kingston, R., Gilroy, D., Lehane, M. and Furey, A. 2010. Hawthorn (*Crataegus spp.*) in the treatment of cardiovascular disease. *Pharmacognosy Review.* 4(7): 32-41.

Vachhani, K.B., Gohil, J.H., Pandey, R. and Ray, N.R. 2014. Influence of chemicals, PGR's and cow-dung slurry as seed treatment on germiability, growth and development of khirnee (*Manilkara hexandra* Roxb.) under net house condition. *Trends in Biosciences*. 7(14): 1641-1643.

Weber, E. 2003. *Invasive Plant Species Of The World: A Reference Guide to Environmental Weeds.* CABI Publishing, Wallingford. 352.