

Print ISSN : 0972-8813
e-ISSN : 2582-2780

[Vol. 20(3), September-December, 2022]

Pantnagar Journal of Research

(Formerly International Journal of Basic and
Applied Agricultural Research ISSN : 2349-8765)



G.B. Pant University of Agriculture & Technology, Pantnagar



ADVISORYBOARD

Patron

Dr. Manmohan Singh Chauhan, Vice-Chancellor, G.B. Pant University of Agriculture and Technology, Pantnagar, India

Members

Dr. A.S. Nain, Ph.D., Director Research, G.B. Pant University of Agri. & Tech., Pantnagar, India
Dr. A.K. Sharma, Ph.D., Director, Extension Education, G.B. Pant University of Agri. & Tech., Pantnagar, India
Dr. S.K. Kashyap, Ph.D., Dean, College of Agriculture, G.B. Pant University of Agri. & Tech., Pantnagar, India
Dr. N.S. Jadon, Ph.D., Dean, College of Veterinary & Animal Sciences, G.B. Pant University of Agri. & Tech., Pantnagar, India
Dr. K.P. Raverkar, Ph.D., Dean, College of Post Graduate Studies, G.B. Pant University of Agri. & Tech., Pantnagar, India
Dr. Sandeep Arora, Ph.D., Dean, College of Basic Sciences & Humanities, G.B. Pant University of Agri. & Tech., Pantnagar, India
Dr. Alaknanda Ashok, Ph.D., Dean, College of Technology, G.B. Pant University of Agri. & Tech., Pantnagar, India
Dr. Alka Goel, Ph.D., Dean, College of Home Science, G.B. Pant University of Agri. & Tech., Pantnagar, India
Dr. Mabolica Das Trakroo, Ph.D., Dean, College of Fisheries, G.B. Pant University of Agri. & Tech., Pantnagar, India
Dr. R.S. Jadoun, Ph.D., Dean, College of Agribusiness Management, G.B. Pant University of Agri. & Tech., Pantnagar, India

EDITORIALBOARD

Members

Prof. A.K. Misra, Ph.D., Chairman, Agricultural Scientists Recruitment Board, Krishi Anusandhan Bhavan I, New Delhi, India
Dr. Anand Shukla, Director, Reefberry Foodex Pvt. Ltd., Veraval, Gujarat, India
Dr. Anil Kumar, Ph.D., Director, Education, Rani Lakshmi Bai Central Agricultural University, Jhansi, India
Dr. Ashok K. Mishra, Ph.D., Kemper and Ethel Marley Foundation Chair, W P Carey Business School, Arizona State University, U.S.A
Dr. B.B. Singh, Ph.D., Visiting Professor and Senior Fellow, Dept. of Soil and Crop Sciences and Borlaug Institute for International Agriculture, Texas A&M University, U.S.A.
Prof. Binod Kumar Kanaujia, Ph.D., Professor, School of Computational and Integrative Sciences, Jawahar Lal Nehru University, New Delhi, India
Dr. D. Ratna Kumari, Ph.D., Associate Dean, College of Community / Home Science, PJTSAU, Hyderabad, India
Dr. Deepak Pant, Ph.D., Separation and Conversion Technology, Flemish Institute for Technological Research (VITO), Belgium
Dr. Desirazu N. Rao, Ph.D., Professor, Department of Biochemistry, Indian Institute of Science, Bangalore, India
Dr. G.K. Garg, Ph.D., Dean (Retired), College of Basic Sciences & Humanities, G.B. Pant University of Agric. & Tech., Pantnagar, India
Dr. Humnath Bhandari, Ph.D., IRRI Representative for Bangladesh, Agricultural Economist, Agrifood Policy Platform, Philippines
Dr. Indu S Sawant, Ph.D., Director, ICAR - National Research Centre for Grapes, Pune, India
Dr. Kuldeep Singh, Ph.D., Director, ICAR - National Bureau of Plant Genetic Resources, New Delhi, India
Dr. M.P. Pandey, Ph.D., Ex. Vice Chancellor, BAU, Ranchi & IGKV, Raipur and Director General, IAT, Allahabad, India
Dr. Martin Mortimer, Ph.D., Professor, The Centre of Excellence for Sustainable Food Systems, University of Liverpool, United Kingdom
Dr. Muneshwar Singh, Ph.D., Project Coordinator AICRP- LTFE, ICAR - Indian Institute of Soil Science, Bhopal, India
Prof. Omkar, Ph.D., Professor, Department of Zoology, University of Lucknow, India
Dr. P.C. Srivastav, Ph.D., Professor, Department of Soil Science, G.B. Pant University of Agriculture and Technology, Pantnagar, India
Dr. Prashant Srivastava, Ph.D., Cooperative Research Centre for Contamination Assessment and Remediation of the Environment, University of South Australia, Australia
Dr. Puneet Srivastava, Ph.D., Director, Water Resources Center, Butler-Cunningham Eminent Scholar, Professor, Biosystems Engineering, Auburn University, U.S.A.
Dr. R.C. Chaudhary, Ph.D., Chairman, Participatory Rural Development Foundation, Gorakhpur, India
Dr. R.K. Singh, Ph.D., Director & Vice Chancellor, ICAR-Indian Veterinary Research Institute, Izatnagar, U.P., India
Prof. Ramesh Kanwar, Ph.D., Charles F. Curtiss Distinguished Professor of Water Resources Engineering, Iowa State University, U.S.A.
Dr. S.N. Maurya, Ph.D., Professor (Retired), Department of Gynecology & Obstetrics, G.B. Pant University of Agric. & Tech., Pantnagar, India
Dr. Sham S. Goyal, Ph.D., Professor (Retired), Faculty of Agriculture and Environmental Sciences, University of California, Davis, U.S.A.
Prof. Umesh Varshney, Ph.D., Professor, Department of Microbiology and Cell Biology, Indian Institute of Science, Bangalore, India
Prof. V.D. Sharma, Ph.D., Dean Academics, SAI Group of Institutions, Dehradun, India
Dr. V.K. Singh, Ph.D., Head, Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi, India
Dr. Vijay P. Singh, Ph.D., Distinguished Professor, Caroline and William N. Lehrer Distinguished Chair in Water Engineering, Department of Biological Agricultural Engineering, Texas A&M University, U.S.A.
Dr. Vinay Mehrotra, Ph.D., President, Vinlax Canada Inc., Canada

Editor-in-Chief

Dr. Manoranjan Dutta, Head Crop Improvement Division (Retd.), National Bureau of Plant Genetic Resources, New Delhi, India

Managing Editor

Dr. S.N. Tiwari, Ph.D., Professor, Department of Entomology, G.B. Pant University of Agriculture and Technology, Pantnagar, India

Assistant Managing Editor

Dr. Jyotsna Yadav, Ph.D., Research Editor, Directorate of Research, G.B. Pant University of Agriculture and Technology, Pantnagar, India

Technical Manager

Dr. S.D. Samantray, Ph.D., Professor, Department of Computer Science and Engineering, G.B. Pant University of Agriculture and Technology, Pantnagar, India

CONTENTS

Morphological characterization for leaf architecture in Teosinte (<i>Zea mays</i> subssp <i>parviglumis</i>) derived BC₁F₂ population of maize	370
VARALAKSHMI S., NARENDRA KUMAR SINGH, SENTHILKUMAR V, SMRUTISHREE SAHOO, PRABHAT SINGH and PRIYA GARKOTI	
Effect of plant growth regulators on seed germination of wild fruit of Kilmora (<i>Barberis asiatica</i> Roxb. exDC.)	378
NIKESH CHANDRA and GOPALMANI	
Geographic Information System (GIS) assisted mapping and classification of the soils of Akoko Edo Local Government Area, Edo State	382
AGBOGUN, L., UMWENI A.S., OGBOGHODO, I.A. and KADIRI, O.H.	
Major insect pest abundance diversity in the Nainital foothill rice Agro-ecosystem	392
SHIVENDRA NATH TIWARI and PRAMOD MALL	
Distribution pattern of major insect pests of cabbage in Udham Singh Nagar District of Uttarakhand	397
MANOJ JOSHI and AJAY KUMAR PANDEY	
Population dynamics of insect pests and influence of weather parameters on their population in cabbage crop	402
MANOJ JOSHI, AJAY KUMAR PANDEY and LAXMI RAWAT	
Long-term efficacy of nineteen essential oils against <i>Corcyra cephalonica</i> (Stainton), <i>Sitotroga cerealella</i> (Olivier) and <i>Callosobruchus chinensis</i> (Linnaeus)	412
DEEPA KUMARI and S. N. TIWARI	
Long - term efficacy of some herbal fumigants against <i>Sitophilus oryzae</i> (Linnaeus), <i>Rhyzopertha dominica</i> (Fabricius) and <i>Tribolium castaneum</i> (Herbst)	425
DEEPA KUMARI and S. N. TIWARI	
Evaluation of finger millet germplasm for morpho-metric traits, seed quality parameters and against important endemic diseases in mid hills of Uttarakhand	435
LAXMI RAWAT, DEEPTI AND SUMIT CHAUHAN	
Effect of partial substitution of potato by fresh pea shells (<i>Pisum sativum</i>) in tikki development and their quality evaluation	457
AMITA BENIWAL, SAVITA SINGH, VEENU SANGWAN and DARSHAN PUNIA	
Comparative evaluation of nutritional anthropometry and dietary recall methods for assessing the nutritional status of population	466
ANURADHA DUTTA, ARCHANA KUSHWAHA, NEETU DOBHALL and JYOTI SINGH	

Estimation of breeding value of sires using first lactation traits by BLUP method in crossbred cattle	473
VINEETA ARYA, B. N. SHAHI, D. KUMAR and R. S. BARWAL	
Genetic variation of Beta-Lactoglobulin gene and its association with milk production in Sahiwal and crossbred cattle	477
A.K. GHOSH and R.S. BARWAL	
Evaluation of efficiency of sire model and animal model in crossbred cattle using first lactation and lifetime production traits	483
MANITA DANGI, C.V. SINGH, R.S. BARWAL and B.N. SHAHI	
Assessment of faecal shedding of salmonellae in poultry farms of Uttarakhand	490
MAANSI, IRAM ANSARI, A.K. UPADHYAY, NIDDI ARORA and MEENA MRIGESH	
Effect of plant-based feed additives(<i>Ficus racemosa</i>) on growth performance and blood parameters of Indian major carps fingerlings	496
LOVEDEEP SHARMA and EKTA TAMTA	
Comparative analysis of Traditional Method and Mechanical Method of Cotton Sowing	500
ABHISHEK PANDEY, A. L. VADHER, R. K. KATHIRIA, S. A. GAIKWAD and JAGRITI CHOUDHARY	
Field evaluation of Walking Behind Self-Propelled Vertical Conveyor Reaper-cum-Windrower for harvesting losses in green gram crop	507
M. KUMAR and S.KUMARI	
Design of a Tractor Operated Carrot Digger	512
RAUSHAN KUMAR and R. N. PATERIYA	
Feasibility study of pine needles as a potential source of bio-energy	519
DEEPSHIKHA AZAD, RAJ NARAYAN PATERIYA and RAJAT KUMAR SHARMA	
Monitoring of Okhla Bird Sanctuary using Temporal Satellite Data: A case study	524
RAJ SINGH and VARA SARITHA	

Effect of plant growth regulators on seed germination of wild fruit of kilmora (*Barberis asiatica* Roxb. exDC.)

NIKESH CHANDRA and GOPALMANI*

Department Horticulture (Fruit Science), College of Agriculture, G.B.Pant University of Agriculture and Technology, Pantnagar-263145 (U. S. Nagar, Uttarakhand)

**Corresponding author's email id: gaurgm97@gmail.com*

ABSTRACT: The current study aimed to assess the impact of GA3 and NAA at various concentrations on seed germination and seedling growth in kilmora. Seven treatments and three replications made up the experiment's randomised block design. Regarding improving seed germination, plant height, and the number of leaves per plant, the kilmora seed treated with GA3 at 75 ppm was the most successful treatment compared to other treatments.

Key words: *Barberis asiatica*, concentration, germination, leaf area, seedling

Over 675 wild edibles are known to exist in the Indian Himalayan Region (Samant and Dhar, 1997). *Barberis asiatica* DC. is a member of the Berberidaceae family, also referred to as kilmora. Of the 675 species, 55 were found in India (Rao *et al.*, 1998), 24 of which are *Barberis* species, which are found in Uttarakhand (Tiwari *et al.*, 2012). *B. asiatica* is a hard woody spiny shrub that grows to 1.8-3.6 meters in height and is typically upright and evergreen. The spines are 1-2 cm long and triplex in shape. Typically 7–10 mm in diameter, globose, enclosed in a persistent green calyx, green when unripe and turning aconite violet when mature, and containing 2–5 seeds, berries are fruits (Parmar and Kaushal, 1982; Prajapati *et al.*, 2003). Kilmora seeds have a hard seed coat or endocarp, which hinders water absorption and limits seed germination. Another element that affects seed germination is the presence of seed dormancy, a physiological state in which the seed is inactive until specific environmental conditions are met. The purpose of the study is to look into how a growth regulator affects kilmora seed germination. As an alternative, it is anticipated to offer data helpful in management plans to safeguard its endangered populations. Therefore, an investigation on the effect of a growth regulator on the seed germination of kilmora was conducted to facilitate its management and conservation strategies.

MATERIALS AND METHODS

A field experiment was conducted at the College of Horticulture, VCSG, UHF, Bharsar, Pauri Garhwal, Uttarakhand, India in 2020. The experimental site is located at an altitude of 1900 metres above mean sea level at a longitude of 78.990 E and a latitude of 30.0560 N (Bisht and Sharma, 2014). The seeds were collected from forest areas of Bharsar, Pauri Garhwal district of Uttarakhand. The collected seeds were cleaned by rubbing all the extraneous materials off and then dipped in water. All the floating seeds were discarded, and only the healthy seeds that settled down were used. The solution of Gibberellic acid (GA3) and Naphthaleneacetic acid (NAA) was prepared by weighing quantities of the chemical with the help of an electronic balance. After weighing, GA3 and NAA were transferred into a glass beaker with the help of a soft brush and a small amount of acetone was added, followed by distilled water to make the final volume. The extracted seeds were soaked in various concentrations of Gibberellic acid and NAA for 24 hours. A freshly prepared solution of different Gibberellic acid and NAA concentrations was added separately to each glass beaker as per treatment.

Observations recorded

Days taken for initial germination (days): Daily after sowing up until the time of the subsequent

emergence of seedlings, the data on days required for initial germination were recorded. The time taken for seed germination to begin was calculated as the interval between the date of sowing and the appearance of the first seedling.

Seed germination per cent (%): This observation was made after the seedlings stopped emerging further. When the plumule had just begun to appear on the soil's surface and the radical had grown to a length of 2 mm, the seeds were deemed to have germinated. Based on how many seeds out of the total sown germinated, the percentage of seed germination was calculated. The following formula was used to determine the germination percentage (GP) at the conclusion of the germination period: $GP = \frac{\Sigma G}{N} \times 100$ GP stands for germination percentage, G for a number of germinations, and N for total number of seeds.

Plant height (cm): At 45 days after sowing, the data on plant height was collected. The length was measured from the soil's surface to the main axis' terminal bud, and it was expressed as the average length per shoot in centimetres.

Number of leaves per plant: After sowing, the observation was noted 45 days later. The average number of leaves per plant was calculated by taking into account all unfolded leaves, regardless of their size.

Leaf area on average: Randomly selected fully expanded leaves from the seedlings were measured using a leaf area metre (LI-COR Model-3100), and their area was expressed in square centimetres (sqm). The statistical analysis was carried out for each observed character under the study using MS-Excel, OPSTAT. The mean values of data were subjected to analysis of variance and ANOVA was set as per Statistical Procedures for Agricultural Research by Gomez and Gomez (1984) for Randomized Block Design (RBD).

RESULTS AND DISCUSSION

Days have taken for initial germination

The days required for initial germination varied

significantly, as shown in Table 1. The minimum days taken for initial germination were observed in GA3 75 ppm (9.40 days), followed by NAA 75 ppm (10.86 days). However, the maximum number of days taken for initial germination was recorded in the control (19.53 days). The reduction in days to initial seed germination might be because GA3 plays an important role in two stages of germination, one at initial enzyme induction and the other in the activation of the reserve food mobilizing system, which helps in the enhancement of germination (Jha *et al.*, 1997). Meshram *et al.* (2015) also observed that the seed germination of acid lime was significantly influenced by GA3 and NAA, which started after 21 days of sowing and continued up to 67 days.

Percentage of seed germination

The data regarding this trait is presented in Table 2. It is evident from the data that seed germination is significantly influenced by the gibberellic acid concentration. The data revealed that the maximum value recorded in the single treatment with GA3 75% was followed by NAA 75% at 69.00%, while the minimum seed germination per cent was recorded with control at 35.00%. All the treatments were found to be significant as compared with control. It might be due to the fact that GA3 is involved in the activation of cytological enzymes which stimulate the α -amylase enzyme that converts insoluble starch into soluble sugars and it also initiates radical growth by removing some metabolic

Table 1: Days taken for initial germination by using different media concentrations

Treatment details		Initiation of Seed germination (days) ± SE(m)
T ₁	Control	19.53±0.63
T ₂	NAA 100 ppm	13.06*±0.29
T ₃	NAA 75 ppm	10.86*±0.29
T ₄	NAA 50 ppm	14.40*±0.41
T ₅	GA3 100 ppm	11.73*±0.43
T ₆	GA3 75 ppm	9.40*±0.11
T ₇	GA3 50 ppm	12.93*±0.35
	CD _(0.05)	1.28
	SE(d)	0.58
	CV	5.43

*Significant at 5% level of significance as compared with control

blocks (Babu *et al.*, 2010). GA3 also plays an important role in the leaching out of the inhibitors, which in turn helps in breaking the seed dormancy. Dilip *et al.* (2017) observed in Rangpur lime that the maximum seed germination (90%) was observed under the treatment at GA3 80ppm. Meshram *et al.* (2015) recorded in acid lime that the maximum seed germination was observed in GA3 @ 200ppm (81.63%), which was found at par with NAA @40ppm.

Plant height

Results revealed a significant effect of GA3 and NAA on plant height (Table 3). Plant height was maximum in GA3 75 ppm (2.68 cm), followed by NAA 75 ppm (2.36 cm), while the minimum was recorded in control (1.98 cm). Plant height was the highest in GA3 because the GA3 hormone increases cell size by stimulating the cell wall to release and transmit calcium into the cytoplasm, allowing for water absorption and cell growth. GA3 is inactivated after growth, and calcium returns to the cell wall to stiffen it. After the absorption of water by the seed and following the active absorption stage, the embryo produces GA3 and stimulates aleuronic cells to produce hydrolytic enzymes such as α and β -amylase that hydrolyse starch to glucose, which can be absorbed by the embryo. GA3 activated α -amylase, which digested available carbohydrates into simpler sugars, allowing faster-growing seedlings to easily access energy and nutrition. GA3 affects the proteins that produce mRNA, thereby increasing DNA replication and inducing the analysis of endospermic materials in the seed (Lahuti

Table 2: Seed germination per cent

Treatment details	Seed germination % \pm SE(m)
T ₁ Control	35.00 \pm 1.00
T ₂ NAA 100 ppm	53.00* \pm 1.52
T ₃ NAA 75 ppm	69.00* \pm 1.73
T ₄ NAA 50 ppm	45.86* \pm 1.18
T ₅ GA3 100 ppm	58.13* \pm 1.73
T ₆ GA3 75 ppm	80.46* \pm 2.40
T ₇ GA3 50 ppm	49.66* \pm 1.21
CD _(0.05)	4.26
SE(d)	1.93
CV	4.24

*Significant at 5% level of significance as compared with control

et al., 2003). Dilip *et al.* (2017) also recorded that GA3 80 ppm exhibited a significant increase in plant height (4.49 cm) over control at 45 days after sowing.

Number of leaves

The number of leaves significantly varies among treatments, as shown in Table 4. The maximum number of leaves per plant was recorded at GA3 75 ppm (5.46), followed by NAA 100 ppm (5.06). The minimum number of leaves per plant was recorded in the control (4.46). The production of a greater number of leaves in gibberellic acid treatments may be due to the various growths induced by the GA3, which in turn facilitates a better harvest of sunlight by the plants and a greater number of leaves (Lahuti *et al.*, 2003). Our finding is in line with the report of Meshram *et al.* (2015) who observed that the maximum number of leaves in acid lime was recorded with GA3 @200ppm followed by GA3

Table 3: Plant height after 45 days of seed germination

Treatment details	Plant height (cm) \pm SE (m)
T ₁ Control	1.98 \pm 0.01
T ₂ NAA 100 ppm	2.15* \pm 0.10
T ₃ NAA 75 ppm	2.36* \pm 0.09
T ₄ NAA 50 ppm	2.02* \pm 0.08
T ₅ GA3 100 ppm	2.44* \pm 0.14
T ₆ GA3 75 ppm	2.68* \pm 0.15
T ₇ GA3 50 ppm	2.23* \pm 0.17
CD _(0.05)	0.39
SE(d)	0.18
CV	9.72

*Significant at 5% level of significance as compared with control

Table 4: Number of leaves 45 days after seed germination

Treatment details	Number of leaves per plant(sq. m) \pm SE (m)
T ₁ Control	4.46 \pm 0.24
T ₂ NAA 100 ppm	5.06* \pm 0.13
T ₃ NAA 75 ppm	5.00* \pm 0.11
T ₄ NAA 50 ppm	4.67 \pm 0.17
T ₅ GA3 100 ppm	5.00* \pm 0.11
T ₆ GA3 75 ppm	5.46* \pm 0.67
T ₇ GA3 50 ppm	5.00* \pm 0.20
CD _(0.05)	0.52
SE(d)	0.23
CV	5.87

*Significant at 5% level of significance as compared with control

Table 5: Leave area

Treatment details		Leave area (sq. m.) \pm SE(m)
T ₁	Control	0.26 \pm 0.02
T ₂	NAA 100 ppm	0.37* \pm 0.01
T ₃	NAA 75 ppm	0.35* \pm 0.00
T ₄	NAA 50 ppm	0.27 \pm 0.02
T ₅	GA3 100 ppm	0.40* \pm 0.02
T ₆	GA3 75 ppm	0.49* \pm 0.02
T ₇	GA3 50 ppm	0.41* \pm 0.00
	C.D.	0.05
	SE(d)	0.02
	C.V.	7.94

*Significant at 5% level of significance as compared with control @150ppm.

Leaf area

Results showed a significant different among treatment for leaf area (Table 5). The maximum number of leaves recorded in GA3 75 ppm (0.49 sp. m.) followed by GA3 50 ppm (0.41 sp. m.), while the minimum number of leaves was observed in control. The higher number of leaves under treatment might be due to the synthesis of protein in plants accelerating, which was indirectly exhibited by the increase in the size of different plants Vasthana *et al.* (2014).

CONCLUSION

It is concluded that GA3 75 ppm was the most effective seed treatment for enhancing seed germination and seedling growth of Kilmora.

REFERENCES

- Babu, K.D., Patel, R.K., 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 Horticulturae*, 851(46): 299-306.
- Bisht, A.S. and Sharma, K.D. (2014). Plant utilization by the communities of Bharsar and adjoining area of Pauri Garhwal district, Uttarakhand, India. *Bio Diversitas*, 15 (1): 94-100
- Dilip, W.S., Singh, D., Moharana, D., Rout, S. and Patra, S.S. (2017). Effect of Gibberellic acid different concentrations at different time

intervals on seed germination and seed growth of Rangpur lime. *Journal of Agroecology and Natural Resource Management*, 4:2: 157-165

- Jha, B.N., Kumar, V., Singh, R.P., Kumari, R. and Sinha, M. (1997). Dormancy in groundnut: Standardization of procedure of breaking. *Journal of Applied Biology*, 7: 23-25.
- Lahuti, M., Zare-hasanabadi, M. and Ahmadian R. (2003). Biochemistry and Physiology of Vegetables Hormones. Ferdowsi University Mashhad.
- Meshram, P.C., Joshi, P.S., Bhoyar, R.K. and Sahoo, A.K. (2015). Effect of different regulators on seedling growth of acid lime. *Research in Environment and Life Sciences*, 8:4: 725-728
- Rao, R.R., Husain, T.B., Dutt. and Garg. A. (1998). Revision of the family Berberidaceae of India II. *Rheedea* 8(2): 109-143.
- Samant, S.S. and Dhar, U. (1997). Diversity, endemism and economic potential a wild edible plants of Indian Himalaya, India. *International journal of sustainable development and world ecology*. 4: 179-191
- Tiwari, U.L., Adhikari, B.S. and Rawat, G.S. (2012). A checklist of Berberidaceae in Uttarakhand, Western Himalaya, India. *Check List*, 8(4):610-616
- Parmar, C. and Kaushal, M.K. (1982). *Berberisaristata*. In: Wild fruits. Kalyani publishers, New Delhi, India. pp 10-1
- Prajapati, N.D., Purohit, S.S., Sharma, A.K. and Kumar, T.A. (2003). Handbook of medicinal plants. Agro bios, Jodhpur, 210p.
- Vasanth, P.T., Kumar, R.C.V., Guruprasad, T.R., Mahadevamma, M. and Santhosh, K.V. (2014). Studies on effect of growth regulators and biofertilizers on seed germination and seedling growth of Tamarind (*Tamarindus indica* L.). *Plant Archive*, 14(1): 155-160.

Received: December 01, 2022

Accepted: December 30, 2022