RESEARCH ARTICLE

SEED GERMINATION BEHAVIOUR OF *CANNABIS SATIVA* L. UNDER DIFFERENT TEMPERATURE REGIMES

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A**bstract:** *Cannabis sativa* L. (Cannabaceae) is one of the earliest cultivated plant, containing many of the valuable natural components useful for health as well as livelihood. Cultivation of *Cannabis* is done by sowing its seeds in the field provided with favourable physical and chemical parameters for germination. In this study, optimum temperature and time required for germination of *Cannabis* seeds collected from Kausani, Uttarakhand have been studied at various temperatures under the controlled laboratory conditions. The percentage of germination, germination energy and seedling vigor index I and II was reported maximum at a constant temperature of '25˚C' with having 3rd-4th and 6th day as its first and final count day, respectively. Therefore, it is suggested to the researchers/cultivators to raise the nursery of *Cannabis sativa* L. seed at '25˚C' to achieve healthy and maximum seedlings of the crop.

Keywords: Hemp, THC, CBD, Germination potential, Seedling vigor

REFERENCES

Bonini, S. A., Premoli, M., Tambaro, S., Kumar, A., Maccarinelli, G., Memo, M. and Mastinu, A. (2018). *Cannabis sativa*: A comprehensive ethnopharmacological review of a medicinal plant with a long history. *Journal of Ethnopharmacology* 227: 300–315. https://doi.org/10.1016/j.jep.2018.09.004

Fortenbery, T. R. and Mick, T. B. (2015). Industrial hemp: Opportunities and challenges for Washington. http://ses.wsu.edu/wp-content/ uploads/ 2015/02/ WP2014-10.pdf.

Huaran, H., Hao, L. and Feihu, L. (2018). Seed germination of hemp (*Cannabis sativa* L.) cultivars responds differently to the stress of salt type and concentration. *Industrial Crops and Products* 123:254–261.

ISTA (International Seed Testing Association) Rule (2010). International Rules for Seed Testing, Zurich, Switzerland, International Seed Testing Association.

Johnson, R. (2019). *Defining Hemp: A Fact Sheet* (PDF). Washington, DC: Congressional Research Service. Retrieved 29 March 2019.

Keller, N.M. (2013). The Legalization of Industrial Hemp and What it Could Mean for Indiana's Biofuel Industry . *Indiana International & Comparative Law Review* 23(3): 555. doi:10.18060/17887

Khatun, A., Kabir, G. and Bhuiyan, M. A. H. (2009). Effect of harvesting stages on the seed quality of lentil (*Lens culinaris* L.) during storage. *Bangladesh Journal of Agricultural Research* 34:565–576.

Kumar, B. (2012). Prediction of germination potential in seeds of Indian basil (*Ocimum basilicum* L.), *Journal of Crop Improvement* 26:532-539. http://dx.doi.org/10.1080/15427528.2012.659418

Kumar, B., Gupta, A. K., Verma, A. K., Saini, R.K. and Khanuja, S.P.S. (2008). Comparative germination kinetics and efficiency in marigold (*Tagetes erecta* L.) accessions over storage. *Journal of Medicinal and Aromatic Plant Sciences.* 30:142–145.

Kumar, B., Gupta, E., Mali, H., Singh, H. P. and Muhanad, A. (2013). Constant and alternating temperature effects on seed germination potential in *Artemisia annua* L. *Journal of Crop Improvement* 27:636-642. http://dx.doi.org/10.1080/15427528.2013.832458

Kumar, B., Gupta, E., Yadav, R., Singh, S.C. and Lal, R.K. (2014). Temperature effects on seed germination potential of Holy Basil (*Ocimum tenuiflorum*). *Seed Technology* 36:75-79.

Kumar, B., Verma, S.K., Ram, G. and Singh, H. P. (2012). Temperature relations for seed germination potential and seedling vigor in Palmarosa (*Cymbopogon martinii*). *Journal of Crop Improvement* 26: 791-801. http://dx.doi.org/10.1080/15427528.2012.689799

Kumar, B., Verma, S.K. and Singh, H.P. (2011). Effect of temperature on seed germination

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parameters in Kalmegh (*Andrographis paniculata* Wall. Ex. Nees). *Industrial Crops and Products* 34: 1241–1244.

Matthews, S. (1973). The effect of time of harvest on the viability and pre-emergence mortality in soil of pea (*Pisum sativum* L.) seeds. *Annals of Applied Biology* 73:211–219.

Official Gazette of Uttar Pradesh (2018). The Uttar Pradesh Excise (Research Oriented Cultivation of Hemp to Develop Medicinal and Industrial Grade Plant of Hemp) Rule, 2018. Office of the Excise Commissioner, Uttar Pradesh, Pryagraj, Notification No.: 4607/Two-Pra.D-218/Shodh/Bhang/2018-19 dated November 16, 2018.pp.1-11.

Ramin, A. A. (2006). Effects of salinity and temperature on germination and seedling establishment of sweet basil (*Ocimum basilicum* L.). *Journal of Herbs, Spices & Medicinal Plants* 11:81–90.

Salentijn, E. M. J., Zhang, Q. Y., Amaducci, S., Yang, M. and Trindade, L. M. (2015). New developments in fiber hemp (*Cannabis sativa* L.) breeding. *Industrial Crops and Products* 68: 32–41. 10.1016/j.indcrop.2014.08.011

Sera, B., Sery, M., Gavril, B. and Gajdova, I. (2017). Seed germination and early growth responses to seed pre-treatment by non-thermal plasma in hemp cultivars (*Cannabis sativa* L.). *Plasma Chemistry and Plasma Processing* 37:207-221. DOI 10.1007/s11090-016-9763-9

The Narcotic Drugs and Psychotropic Substances, Act (1985). Section 10 (Power of state government to permit, control and regulate) and section 14 (Special provision relating to cannabis) of Chapter III (Prohibition, Control and Regulation). Published by Department of Revenue under Ministry of Finance, Government of India. pp. 1-49.

Uttarakhand Hemp Cultivation Rule (2016-17). Section 14 of The NDPS Act for cultivation of hemp in Uttarakhand OM No.: 639/XXIII/2016/04(02)2016 Dehradun dated December 05, 2016.pp.1-4 and Excise Commissioner Uttarakhand OM No.: 2641/Chha:Pra.-159/Hemp Cultivation Rule/2016-18 dated August 17, 2017 pp.1-8.

Verma, S. K., Kumar, B., Ram, G., Singh, H. P. and Lal, R. K. (2010). Varietal effect on germination parameter at controlled and uncontrolled temperature in Palmarosa (*Cymbopogon martinii*). *Industrial Crops and Products* 32: 696-699.

Yaklich, R.W. and Kulik, M.M. (1979). Evaluation of vigor tests in Soybean seeds: Relationship of the standard germination test, seedling vigor classification, seedling length, and tetrazolium staining to field performance 1. *Crop Science* 19: 247-252. doi:10.2135/cropsci1979.0011183X001900020019x

Yan, Z.L., Wanga, H., Lau, K.T., Pather, S., Zhang, J.C., Lin, G. and Ding, Y. (2013). Reinforcement of polypropylene with hemp fibres. *Composites*: Part B. 46:221-226.