Studies In Vitro Gametophyte Development Under Different Light Qualities In Actiniopteris Radiata (S W) Link From Rajasthan.

Dr. RITU JAIN
Associate professor
Department of Botany
K.M.E. Society's G.M. Momin Women's College, Bhiwandi Mumbai Dist. Thane Maharashtra -421302.

Abstract - The present study investigates the growth and development of *Actinopteris radiata*, a widely distributed fern species in Rajasthan that is well-adapted for dry conditions. The study focuses on the effects of different coloured lights on the growth and development of *A. radiata*. The observations include the initiation of 2D growth, the form of gametophytes, and the development of sporelings. The results show that the blue light has a significant effect on the development of the gametophytes, with a 90% frequency of cordate gametophytes. In contrast, the red and yellow lights promote filamentous and irregular forms of gametophytes, respectively. The study concludes that *A. radiata* is well-adapted for dry conditions and that different coloured lights can significantly affect its growth and development.

Index Terms - Gametophytes, sporelings.

INTRODUCTION

Rajasthan state is situated in the north western part of India. The relief features of the state are marked by the Aravalli ranges which run across the state for nearly 692 km. Extremity of climate is the characteristics of Rajasthan. In spite of xeric climate, the adaptability of pteridophytes in drier condition of Rajasthan is remarkable. The term pteridophyte also refers to ferns and a few other seedless vascular plants. The pteridophytes include the fern and fern allies and they are the vascular plants that produce spores rather than seeds. The spores are produced in sporangia borne in sori on the lower or abaxial surface of the leaves. (Singha K.B *et.al.*, 2013)

Ferns are found to provide food, medicine, fiber, crafts and building material, abrasives and of course for decoration. Traditionally, people used pteridophytes as medicine and anti-bacterial agents. (Manjunath M *et.al.*, 2013).

*Actiniopteris radiata*is a shrub plant belongs to the family *Pteridaceae* and grows around tropical regions like Africa, India, Nepal, Srilanka, Madagascar. *A. radiata* has the common names of Morpankhi, Mayurishika and Peacock's tail. The plant possesses different traditional values such as as astringent, anti-inflammatory, useful in cough, bronchitis, asthma, diarrhea, dysentery, dysuria, used internally and externally for infected wounds and ulcers (Khare C. P 2004).

Studies of the whole life cycle of these pteridophytes help us to understand, how ecological factors influence the life cycle. The present paper represents the influence of various light qualities gametophyte development and expression. This study provides a protocol, which could be used for future experimental studies of this particular group.

MATERIAL AND METHODS

Collection of the plant material:

Whole plant of the study species, *A. radiata* was collected from the Hills, & was washed under running tap water, air dried.

The spores lose their viability if stored at room temperature. Therefore, collected spores were preserved at low temperature (4°C) for further studies.

Spore germination:

Sterilization of spore:

Spores of *A. radiata* (SW) Link from nature and dry sporophylls were sterilized in a 3% sodium hypochlorite solution for 2 minutes.

Inoculation of spores on the culture medium:

The spores collected were cultivated on the Knop's solution supplemented with Nitsch trace.

Supply of different light qualities:

Illumination was provided by two 40-watt fluorescent tubes kept at a distance of 1-meter spores were allowed to germinate in a culture chamber maintained at 25-27 C° Red light was obtained by covering Petri dishes with two layers of red gelatin paper, blue and yellow light were obtained by covering the Petri dishes with two layers of blue and yellow gelatin paper respectively elements.

OBSERVATION:

Different events of gametophyte development such as formation of protonemal filament, initiation of 2Dgrowth, development of spatulate and cordate gametophytes and sex organs under different light qualities in *A. radiata* have been studied. The data relating gametophyte development have been presented in Table 1.

Protonemal filaments (1D gametophytes) were found to be 4-5 celled in control, 3-4 celled in red and 2-4 celled in yellow light. While it is 4-6 celled under blue light. 2D growth was started on 12th day in control and yellow light while it occurs earlier by one day in red light and delayed by three days in yellow light.

The percentage of 2D gametophytes on the day of initiation of 2D growth was found to be 29% in control and 19% in red light. The percentage value of 2D gametophytes in blue and yellow light is ranging between these two.

The highest percentage of spatulate gametophytes in between 15-25 days was observed to be 52% under control followed by the percent value of spatulate gametophytes under yellow light. The minimum value of these gametophytes was observed under red light while under blue light percent value of spatulate gametophyte was found to be slightly higher than red light and lower than yellow light. Thus red and blue light do not favour the development of spatulate gametophytes.

Cordate gametophytes were observed in between 25- 35 days from the date of sowing. Percentage of cordate gametophytes was found to be 41% in control and 10% in blue light. Irregular multinotched gametophytes were observed under red, yellow and blue light. Frequency of abnormal gametophytes has been recorded to be highest in this taxon. Regeneration of gametophyte has also been seen in this species.

The gametophytes of *A. radiata* produce sporophytes apogamously without the development of sex organs. Sporophytes were observed after 45 days and their frequency has been recorded upto 95% after 52 days of sowing.

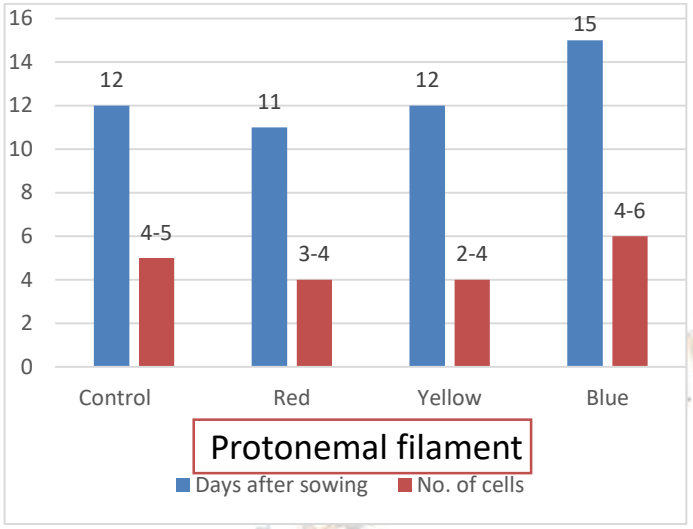
Cordate gametophytes were observed in between 25- 35 days from the date of sowing Percentage of cordate gametophytes was found to be 41% in control and 10% in blue light. Irregular multinotched gametophytes were observed under red, yellow and blue light. Frequency of abnormal gametophytes is higher in this taxon Regeneration of gametophyte has also been seen in this species.

The gametophytes of *A. radiata* produce sporophytes apogamously without the development of sex organs. Sporophytes were observed after 45 days and their frequency has been recorded upto 95% after 52 days of sowing.

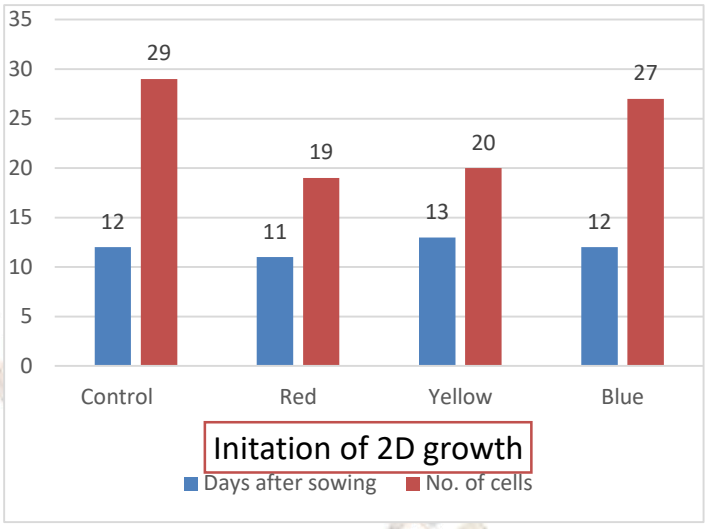
Sr No	Light	Protonemal filament		Initation of 2D growth		Spatulate gametophytes		Cordate gametophyte		Form of gametphytes	Development of sporeling	
		days after sowing	No of Cells	days after sowing	%2D gametophyte	days after sowing	% spatulate	days after sowing	% Cordate		Days after sowing	Freq
1	Control	12	4-5	12	29	15-25	52	25-35	41	Cordate	52	95 %
2	Red	11	3-4	11	19	15-25	29	25-35	-	Filamentous	-	-
3	Yellow	12	2-4	13	20	15-25	41	25-35	-	Irregular	-	-
4	Blue	15	4-6	12	27	15-25	30	25-35	10	Irregular	65	90 %

Table 1: Gametophyte development in *Actinopteris radiata* under different light qualities.

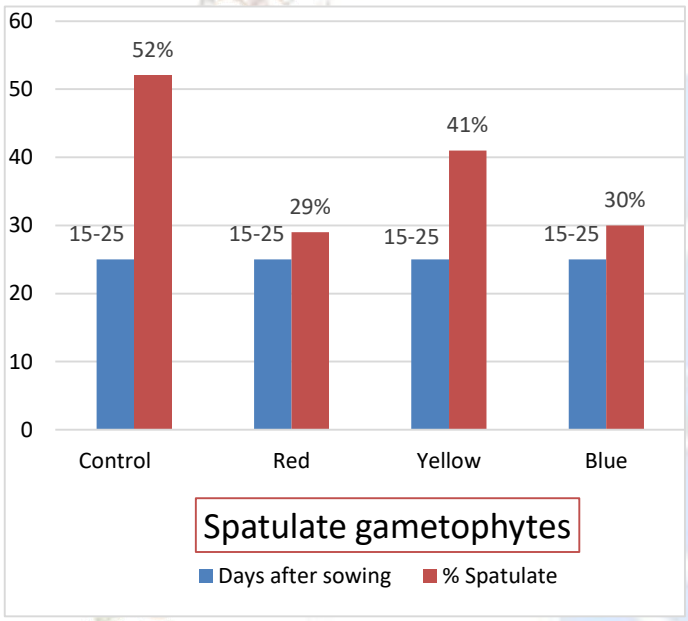
Different events of gametophyte development under different Lights have been presented in Graph.



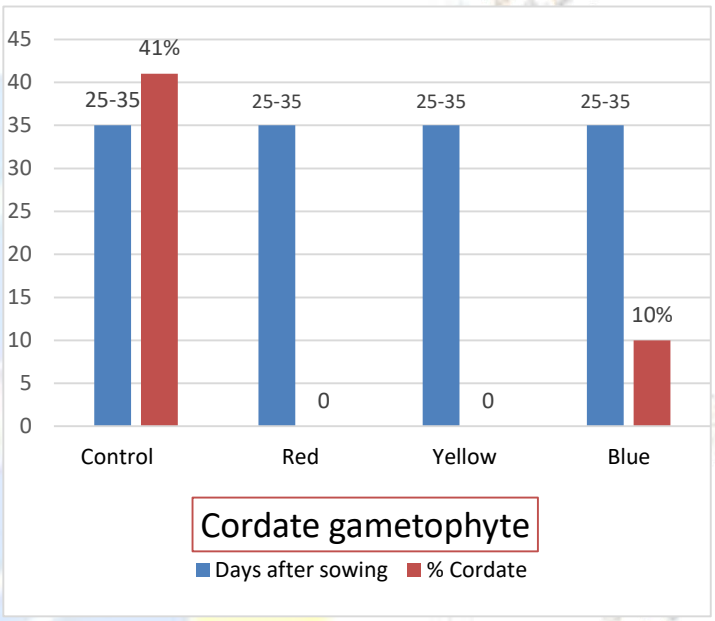
Graph 1: Protonemal filament development under different Lights.



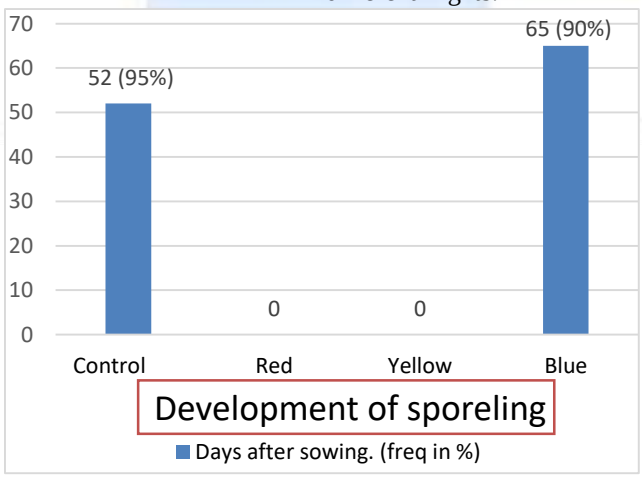
Graph 2: Initation of 2D growth under development different Lights.



Graph 3: Spatulate gametophyte development under different Lights.



Graph 4: Cordate gametophyte development under different Lights.



Graph 5: Development of Sporeling under different Lights.

Result & Discussion:

During present investigation, in addition to spore germination in ferns, light also regulates the initiation and subsequent development of gametophyte

In present investigation the higher percentage of spatulate gametophytes has been observed in between 15-25 days from the date of sowing in control the normal cordate gametophytes have been observed in between 20-35 days in control.

Mohr (1956 a,b), Miller & Wright (1961) and Miller & Miller (1963) have reported that red and far red light were found effective in promoting filament as well rhizoidal elongation.

Irregular gametophytes have been observed under yellow light. These findings are in confirmation with the reports of Mohr (1956) suggesting that after initiation of 2D growth a continuous activation of blue light sensitive system is required for the growth to continue in prothallial form.

To conclude, the red light favours the spore germination but does not favour the 2D growth in protonemal filaments while the reverse is true for blue light. Mohr & Ohlenroth (1962) suggested that blue light induces transition from 1D to 2D growth in gametophytes. Miller & Miller (1964) have also reported a similar effect. Chole *et.al.*,(2017) & Zhang *et.al.*,(2015)

Conclusion:

This study provides important insights into the influence of ecological factors, such as light quality, on the life cycle of pteridophytes, specifically *Actiniopteris radiata*. The results of this study could be used for further experimental studies of this particular group and help us understand the ecological adaptations of pteridophytes in drier conditions of Rajasthan.

Acknowledgement:

Gratefully Acknowledge a deep gratitude to Dr. Tabassum sheikh principal K.M.E. Society's G.M. Momin Women's College Bhiwandi, for providing necessary facilities and encouragement.

REFERENCES:

1. Ballesteros D., Pence V.C., (2018). Fern conservation: Spore, gametophyte, and sporophyte ex situ storage, in vitro culture, and cryopreservation. *Curr Adv Fern Res* 227-249.
2. Choi, H.-G., Lee, C.-H., & Lee, Y.-K. (2017). Effects of light intensity and spectral quality on gametophyte development of *Pyropia tenera* (Bangiales, Rhodophyta). *Journal of Applied Phycology* 29(6), 3095-3102.
3. Fonseka DLCK (2020) Propagation of leather fern (*Rumohra adiantiformis*) from rhizomes by *in vitro* techniques. *Int J Agric Biol Sci* 4:113.
4. Singha K.B., Dutta C.M., & Mazumder P.B., (2013). In vitro propagation in pteridophytes: A review. *International Journal of Research in Ayurveda and Pharmacy* 4(2):297-303.
5. Kuan H. L., Meng Y.H., Wen D.H., Ming H.H., Zhi W.Y, Chi M.Y., (2012). The effects of red, blue, and white light-emitting diodes on the growth and development of gametophytes of Actinopteris radiata (Sw.) Link *Scientia Horticulturae*. 150 (2013) 86–91.
6. Khare CP (2004). Indian herbal remedies, Springer link publishers, Verlag Berlin, Heidelberg, p. 21.
7. Manjunath M., Lavanya G., Budadasari G.N. C., Sivajyothi R., & Vijayasarathi R.O., (2013). Chemical Composition and Antibacterial Activity of Wax from *Actiniopteris radiata* (Sw.). *Journal of essential oil-bearing plants JEOP* 16(3):387-392.
8. Miller J.H., & Miller P.M., (1963). Effect of red and far-red illumination on the elongation of fern protonema and rhizoids. *Plant Cell physiol* 4: 65-72.
9. Miller J.H., & Wright D.R., (1961). An age dependent change in the response of fern gametophytes to red light Science 134: 1629.
10. Mohr H (1956a). Die Beeinflussung der Kelmung von farnsporen durch Licht and andere Factoren *Planta* 46: 534-551.
11. Mohr H (1956b). Die abhangigkeit des Protonemawachstums and der protonemapotariatat biefarmen von Licht *Planta* 47: 127-158.
12. Mohr H., & Ohlenroth K., (1962). Photosynthesis and photomorphogeneses bei Farnvorkeiman von *Dryopteris fifixmas Plants* 57: 656-664
13. Miller J.H., & Wright D.R., (1961). An age dependent change in the response of fem gametophytes to red light *Science* 134: 1629.
14. Shaqufta A., Zishan A.W., Shreekar P., Khullar S.P., (2022). Gametophytic Development and Reproductive Biology of Some Ferns. *The International Journal of Plant Reproductive Biology* 14(1).

15. Wu, X.; Yan, A.; McAdam, S.A.M.; Banks, J.A.; Zhang, S.; Zhou, Y. (2021). Timing of meristem initiation and maintenance determines the morphology of fern gametophytes. *J. Exp. Bot* 72, 6990–7001.
16. Yadav S., Yadav K., Yadava P.K., & Tuteja N., (2019). "Genome-wide identification and expression analysis of the Hsp70 gene family in Pteris vittata L. in response to arsenic stress." *Environmental Science and Pollution Research* 6(13): 13266-13277.
17. Zhang, T., Kong, F., Xu, X., Li, Z., Li, J., Xia, S., & Wang, G. (2015). Effects of different light qualities on the growth, pigment content, and photosynthetic parameters in *Porphyra haitanensis* (Bangiales, Rhodophyta). *Journal of Applied Phycology* 27(2), 717-726.