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EFFECT OF TEMPERATURE AND LIGHT ON SEED GERMINATION: A STUDY ON TWO MEDICINAL PLANTS OF BUNDELKHAND REGION IN INDIA

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Abstract

Medicinal plants such as medicinal plants cure several common ailments. These are considered as home remedies in many parts of the country. It is known fact that lots of consumers are using Basil (Tulsi) for making medicines, and other activities in their day-to-day life. Environmental factors are used by plants as spatio-temporal indicators of favorable conditions for seed germination. Light and temperature are among the environmental factors affecting germination of seeds and seedling growth. Thus, the objective of the study was to determine the effect of light (Semi shady (under canopy), Full sunlight (Open), Shady (Diffused light)) and temperature (20, 25, 30, 35 and 40°C) on seed germination of two important medicinal plants of Bundelkhand region of India i.e., Asparagus racemosus and Andographis paniculata. The lowest time for the beginning of germination and the completion of germination time were observed at 3 and 6 days respectively in Asparagus racemosus, where Andographis paniculata showed 2 and 5 days of beginning and completion of germination respectively. Overall, the results showed that full sunlight conditions at 30-35°C improved the physiological characteristics of the plant that can increase germination indices. This research articles to be discussed Effect of Temperature and light on seed germination: A study on two medicinal plants of Bundelkhand Region in India.

Keywords: Germination, Temperature. Light, Asparagus Racemosus, Andographis Paniculata, Medicinal Plants, Ethnomedicinal, Ailments**.**

Introduction

Cultivation of a wider range of medicinal plants at present could make a significant contribution to nutritional and health security of people in the rural areas of India, but information on the herbal medicine requirements of many of these potential medicinal plants is scant (Oelofse and van Averbeke, 2012). Cultivation and commercialization of medicinal plants increase their consumption by broadening and prolonging access (Diouf et al., 2007; van Averbeke et al., 2007). Seed germination is a crucial stage for angiosperm in population settlement and propagation (Volis, 2016). Seeds have to face a variety of abiotic stresses in natural habitats, e.g., temperature, light, salinity, drought, chilling, or heat, which is becoming the major constraints affecting seed germination (Jaganathan, 2016). The complex responses of seeds to stress involve in various morphological, physiological, and cellular changes (Tardieu and Tuberosa, 2010; Wang et al., 2015), which may contribute to their plasticity degree. The accurate prediction of the relationship between germination percentage and environmental responses of seeds in natural habitat has long become an objective of ecological specialist.

Light and temperature are important conditions that affect seed germination and seedling growth. Different temperatures have a great influence on plant growth and germination (Wang et al., 2015, Zhang et al., 2018, Wu et al., 2018). Under the most suitable temperature conditions, the plants grow rapidly and grow well. When the temperature is too high or too low, the seed germination will be inhibited to varying degrees, and the germination rate and germination index will be reduced, indicating that continuous high or low temperature will Activity to inhibit seed germination (Yang et al., 2005). Temperature affects germination in three primary ways: moisture, hormone production, and enzyme activity. For seeds to germinate, they need to imbibe water. For this to occur, sufficient moisture must be present. A warmer climate may increase evaporation and decrease moisture, which would negatively affect germination (IPCC 2007). The influence of light on seed germination is the most important among various factors (Wei et al., 2017). Light does not directly participate in the germination of seeds, but the signal stimulation to break seed dormancy (Du et al., 1994). Different light conditions have different effects on seed germination (Guo et al., 2017, Yue et al., 2015). Therefore, it is of great significance to study the germination and growth of seeds under different light and temperature conditions (Qu et al., 2018, Cui et al., 201)

The current study is concerned with the process of germination of medicinally important plants of Damoh district, Madhya Pradesh, India and in particular with the effect of temperature and light on the germination process.

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Plants have been used for medicinal purposes long before prehistoric period. Ancient Unani manuscripts Egyptian papyrus and Chinese writings described the use of herbs. Evidence exists that Unani Hakims, Indian Vaids and European and Mediterranean cultures were using herbs for over 4000 years as medicine. Indigenous cultures such as Rome, Egypt, Iran, Africa and America used herbs in their healing rituals, while other developed traditional medical systems such as Unani, Ayurveda and Chinese Medicine in which herbal therapies were used systematically. Traditional systems of medicine continue to be widely practised on many accounts. Population rises, inadequate supply of drugs, prohibitive cost of treatments, side effects of several synthetic drugs and development of resistance to currently used drugs for infectious diseases have led to increased emphasis on the use of plant materials as a source of medicines for a wide variety of human ailments.

Among ancient civilisations, India has been known to be rich repository of medicinal plants. The forest in India is the principal repository of large number of medicinal and aromatic plants, which are largely collected as raw materials for manufacture of drugs and perfumery products. About 8,000 herbal remedies have been codified in AYUSH systems in INDIA. Ayurveda, Unani, Siddha and Folk (tribal) medicines are the major systems of indigenous medicines. Among these systems, Ayurveda and Unani Medicine are most developed and widely practised in India.

Recently, WHO (World Health Organization) estimated that 80 percent of people worldwide rely on herbal medicines for some aspect of their primary health care needs. According to WHO, around 21,000 plant species have the potential for being used as medicinal plants. As per data available over three-quarters of the world population relies mainly on plants and plant extracts for their health care needs. More than 30% of the entire plant species, at one time or other were used for medicinal purposes. It has been estimated, that in developed countries such as United States, plant drugs constitute as much as 25% of the total drugs, while in fast developing countries such as India and China, the contribution is as much as 80%. Thus, the economic importance of medicinal plants is much more to countries such as India than to rest of the world. These countries provide two third of the plants used in modern system of medicine and the health care system of rural population depend on indigenous systems of medicine.

Treatment with medicinal plants is considered very safe as there is no or minimal side effects. These remedies are in sync with nature, which is the biggest advantage. The golden fact is that, use of herbal treatments is independent of any age groups and the sexes. The ancient scholars only believed that herbs are only solutions to cure a number of health-related problems and diseases. They conducted thorough study about the same, experimented to arrive at accurate conclusions about the efficacy of different herbs that have medicinal value. Most of the drugs, thus formulated, are free of side effects or reactions. This is the reason why herbal treatment is growing in popularity across the globe. These herbs that have medicinal quality provide rational means for the treatment of many internal diseases, which are otherwise considered difficult to cure.

Medicinal plants such as Aloe, Tulsi, Neem, Turmeric and Ginger cure several common ailments. These are considered as home remedies in many parts of the country. It is known fact that lots of consumers are using Basil (Tulsi) for making medicines, black tea, in pooja and other activities in their day-to-day life. In several parts of the world many herbs are used to honour their kings showing it as a symbol of luck. Now, after finding the role of herbs in medicine, lots of consumers started the plantation of tulsi and other medicinal plants in their home gardens. Medicinal plants are considered as a rich resource of ingredients which can be used in drug development either pharmacopoeial, non- pharmacopoeial or synthetic drugs. A part from that, these plants play a critical role in the development of human cultures around the whole world. Moreover, some plants are considered as important source of nutrition and as a result of that they are recommended for their therapeutic values. Some of these plants include ginger, green tea, walnuts, aloe, pepper and turmeric etc. Some plants and their derivatives are considered as important source for active ingredients which are used in aspirin and toothpaste etc.

Apart from the medicinal uses, herbs are also used in natural dye, pest control, food, perfume, tea and so on. In many countries different kinds of medicinal plants/ herbs are used to keep ants, flies, mice and flee away from homes and offices. Now a days medicinal herbs are important sources for pharmaceutical manufacturing. Recipes for the treatment of common ailments such as diarrhoea, constipation, hypertension, low sperm count, dysentery and weak penile erection, piles, coated tongue, menstrual disorders, bronchial asthma, leucorrhoea and fevers are given by the traditional medicine practitioners very effectively. Over the past two decades, there has been a tremendous increase in the use of herbal medicine; however, there is still a significant lack of research data in this field. Therefore since 1999, WHO has published three volumes of the WHO monographs on selected medicinal plants.

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Materials and methods- Seed collection and storage

Seeds of Asparagus racemosus and Andographis paniculata were collected from different sites of Damoh district (India). Seeds were surface-sterilized in a warm water bath at 50°C for 20 min to reduce the risk of fungal growth. Thereafter, seeds were chilled in cold distilled water, evenly spread on a piece of germination paper and dried overnight at 20°C (Floyd, 2005) and stored in sealed desiccator and partial vacuum was created using rotator vacuum pump (Gevivek Compressor ¼ HP at 28" HG).

Temperature

To determine the germination behavior of fresh seeds at different temperatures were studied by fixing the temperature of seed germinator at following constant temperature 20, 25, 30, 35 and 40°C.

Light

The effect of different light conditions on seedling growth was conducted and observed in botanical garden of the Ojaswani Institute par Excellence, Damoh. Healthy seeds were sown on earthen pots.

Three light condition-

1) Full sunlight or open
2) Semi shady or under tree canopy
3) Shady or diffused sunlight were considered for the experiment. Regular watering was done to these sets to provide sufficient moisture level.

Results and discussion

During present studies it has been noted that at higher and lower temperatures i.e.,45°C and 10°C respectively the seed germination remained nil, it might be due to hindrance of metabolic activities at these extremes of temperature whereas 30°C to 35°C temperature was found to be most adequate temperature for the seeds to germinate. Asparagus racemosus showed beginning of seed germination within 3 days which was completed in 6 days at 35°C of temperature whereas the germination rate was 43.38% (table 1, fig.1). In the same way Andographis paniculata showed beginning of seed germination within 2 days which was completed in 5 days at 35°C of temperature whereas the germination rate was 54.59% (table1, fig.2). Our experiment focused on temperature as a primary control of germination because it is having been proven that temperature is the most important variable (Milbau et al. 2009). Tiwari (1994) have observed similar relation of temperature with germination of Asparagus racemosus seeds except that the most favorable temperature for this species was 30°C germination percentage was less at 20°C and was nil at 10°C and 45°C in both medicinal plants.

Table 1 Effect of temperature on seed germination of different medicinal plants

Plants name	Temperature (◦C)	Germination		Germination %
		Beginning of germination(days)	Completion of germination(days)	
Asparagus racemosus	20	6	9	41.34
	25	5	8	42.52
	30	4	7	44.32
	35	3	6	43.38
	40	5	8	54.24
Andographis paniculata	20	5	9	25.8
	25	4	7	35.3
	30	2	5	54.59
	35	3	6	50.5
	40	5	8	40.3

The seed of Asparagus racemosus and Andographis paniculata demonstrated positive photosensitivity (table 2), suggesting that seed germination of these two plants is a photo chrome-mediated response (Kettenring et al., 2006). The effect of light conditions on seedling growth indicates that maximum root, shoot length was observed in full sunlight conditions. The absolute light condition may have an injurious effect on the growth of seedlings due to increased temperature and decreased moisture in soil. Environmentally induced photosensitivity of seed is usually interpreted as an adaptation that ensures that seed germinates in places where there is a high probability of seedling establishment (Mpati, 2006). The present study are in with the seedlings of Quercus rubra L. grew in 30% f full sunlight, except the dry weight was comparatively lower than that of absolute. The observation of poor growth of seedlings

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under shady conditions (below 20% light) may be attributed indirectly to inadequate nutrition. This finding is in agreement with Robert (1971), who concluded that heavy shade leads to higher concentration of nutrients in the foliage.

Table 2 Effect of light on seed germination of different medicinal plants

Plants name	Various measurements of seedlings (cm.)	Light conditions								
		Semi shady (under canopy)			Full sunlight (Open)			Shady (Diffused light)		
		Min	Max	A.V. +S.E.	Min	Max	A.V. +S.E.	Min	Max	A.V. +S.E.
Asparagus racemosus	No. of leaves	8.00	14.00	11.00±1.04	9.00	16.00	12.5±1.090	8.00	13.00	10.5±1.02
	Root length	4.10	5.00	4.55±0.65	4.30	4.70	4.50±0.65	3.10	3.50	3.3±0.1
	Shoot length	6.90	7.00	6.95±0.84	7.20	7.80	7.50±0.87	6.20	6.80	6.5±0.81
	Plant length	11.00	12.00	11.5±1.06	11.50	12.50	12.00±1.07	9.30	10.30	9.8±0.99
Andographis paniculata	No. of leaves	6.00	11.00	8.5±0.91	7.00	13.00	10.00±1.00	5.00	10.00	7.5±0.87
	Root length	2.20	3.10	2.65±0.25	2.70	3.00	2.85±0.45	1.40	1.60	1.5±0.15
	Shoot length	2.00	2.60	2.3±0.02	2.30	2.0	2.50v0.03	0.90	1.20	1.05±0.15
	Plant length	4.20	5.70	4.95v0.08	5.00	5.70	5.35±0.09	2.30	2.80	2.55±0.23

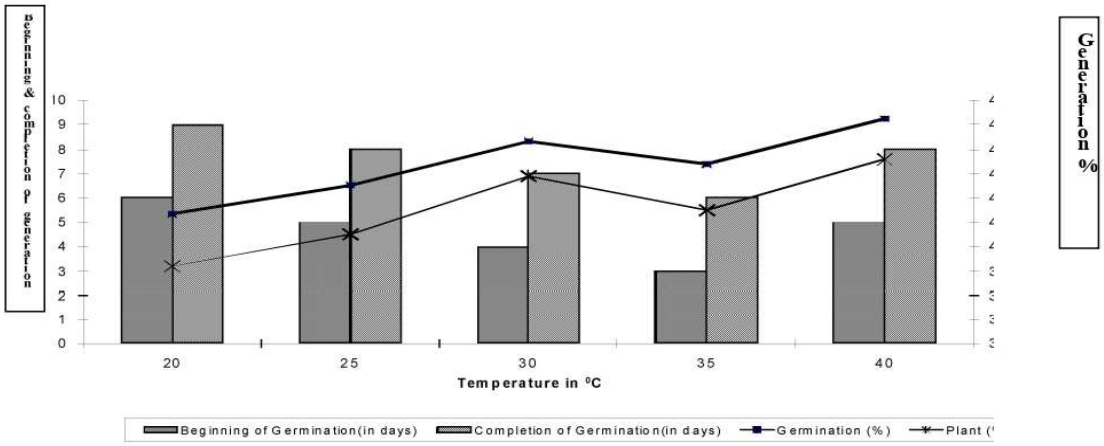

Fig 1: Effect of temperature on seed germination and plant percentage in *A. racemous*

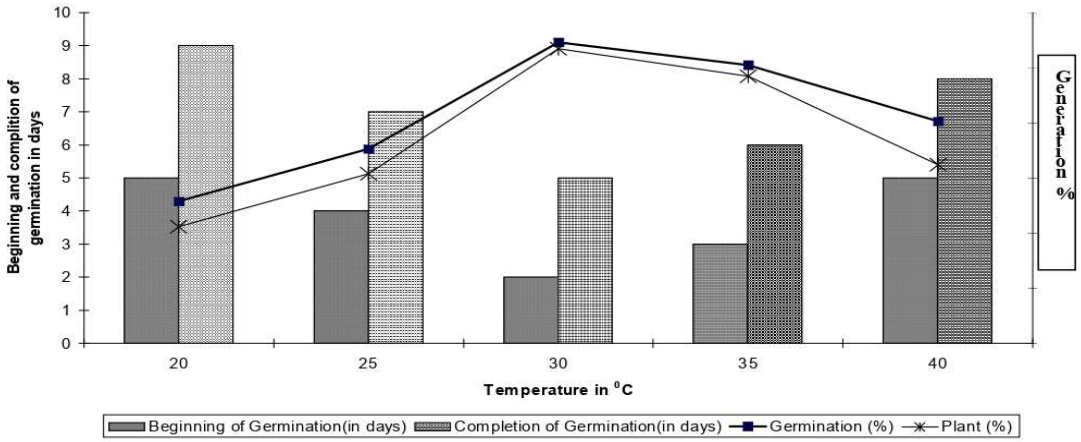

Fig 2: Effect of temperature on seed germination and plant percentage in A. paniculate

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Conclusion

In this study, the experiments were conducted under controlled environmental conditions of constant temperatures, whereas under natural conditions temperature is subject to diurnal fluctuations. Clearly, then, the seed germination and early seedling growth stages of the life cycle of Asparagus racemosus and Andographis paniculata parts of the adaptive strategy of this species that allows it to inhabit harsh conditions. Future studies should focus on the interactive effects of responsible factors to refine the results obtained in this study.

In the future more studies should focus on the interactive effects of responsible factors to refine the results obtained in this study. This is because not all regions will see the same increase in temperature and light conditions with climate change. Therefore, it is imperative to know which regions need to plan for a large-scale change in species distribution. It is important that we have accurate regional temperature models for these studies. In addition to temperature models, precipitation models must be designed so scientists can better simulate a changing climate for plants.

As our lifestyle is now getting techno-savvy, we are moving away from nature. While we cannot escape from nature because we are part of nature. As herbs are natural products, they are free from side effects, they are comparatively safe, eco-friendly and locally available. Traditionally there are lot of herbs used for the ailments related to different seasons. There is a need to promote them to save the human lives.

These herbal products are today are the symbol of safety in contrast to the synthetic drugs, that are regarded as unsafe to human being and environment. Although herbs had been priced for their medicinal, flavouring and aromatic qualities for centuries, the synthetic products of the modern age surpassed their importance, for a while. However, the blind dependence on synthetics is over and people are returning to the naturals with hope of safety and security. It's time to promote them globally.

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