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STUDY OF PHOTOSYNTHETIC PIGMENTS IN PTERIDOPHYTES OF KOLHAPUR DISTRICT

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ABSTRACT

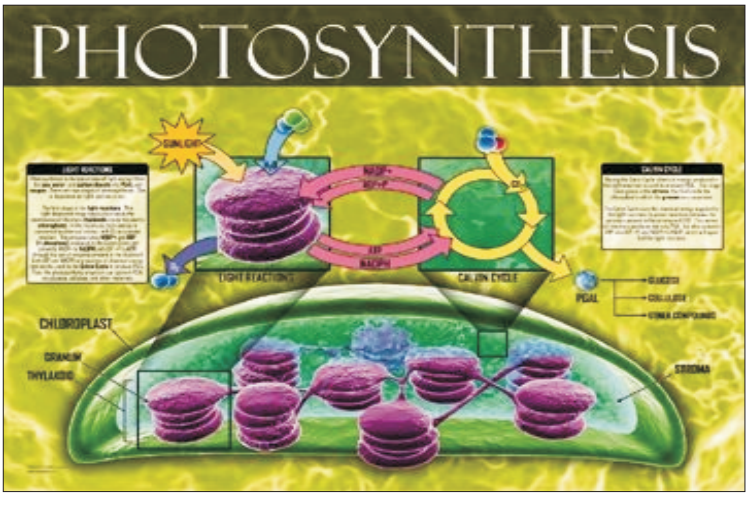
The present study mainly focuses on the estimation of photosynthetic pigments from the vegetative and reproductive stages of Pteridophytes of Kolhapur district (Maharashtra). Chlorophyll –a, chlorophyll–b, total chlorophylls and carotenoids were determined from vegetative and reproductive leaves. The Kolhapur district is situated at southwestern part of Maharashtra. The district lies between 17^{0}10'45"and 15^{0}50'20" North latitude and 74^{0}44'11" and 73^{0}43'16" East longitudes.

KEYWORDS: *Pteridophytes, Photosynthetic pigments, chlorophyll, carotenoids, Kolhapur.*

INTRODUCTION

Chlorophylls are the major light absorbing pigments in green plants. They are located within the chloroplasts. They play important role to initiate photosynthesis, a complex biochemical pathway. Chlorophyll–a is the most common type of chlorophyll. It is dark green in colour. It occurs in the core complexes of photosystems whose composition and organization are highly conserved. On the other hand chlorophyll–a and chlorophyll–b are components of peripheral antenna complexes. Both these show controlled changes in adapting to various growth conditions, enabling optimal utilization of available light. It is known that the chlorophyll– a to b ratio is higher in high-light growth conditions than in low-light growth conditions. Thus the regulation of chlorophyll–b synthesis is important for understanding the mechanisms of adaptation of plants to various light intensities. Other pigments that occur in plants are xanthophylls and carotenes.

Pteridophytes generally grow in moist and shady places but some of the forms survive in comparatively drier conditions. Extreme moist and shady plants not only survive but thrive at much lower irradiance than drier species. In contrast to the large amount of information available concerning photosynthesis, respiration and biochemical studies in flowering plants, very few studies of this sort have been made with Pteridophytes (Joseph and Wolf, 1975). We studied the effect of spore formation on the content of photosynthetic pigments; chlorophyll–a, chlorophyll–b,



total chlorophylls, chlorophyll–a to b ratio and carotenoids.

MATERIALS AND METHODS

The pteridophytes were collected from of Kolhapur District (Maharashtra). Vegetative and reproductive pteridophytic plants are randomly collected from the Western Ghats of Kolhapur district. The plant material collected were identified with the help of Rosenburgh (1908), Blatter and d'Almeida (1922), Manickam and Irudayaraj (1992), Ghosh et.al.(2004). Randomly sampled fronds were used for the experimental purpose. Chlorophylls were estimated from the 80% acetone extract by using the method of Arnon, (1949). The carotenoids were extracted by using Jenson and Jenson (1971).

RESULTS AND DISCUSSION

The values of chlorophyll-a, chlorophyll-b, total chlorophylls, chlorophyll a to b ratio and carotenoid contents analysed from the vegetative and reproductive fronds of some of the pteridophytes are depicted in Table.No.1.

It is evident from the Table 1 that concentration of chlorophyll-a and chlorophyll-b does not show any particular trend. It was observed that chlorophyll-b contents to be higher in some plant samples while in remaining it is lower than chlorophyll-a contents.

From this chlorophyll analysis the best quality in terms of highest chlorophyll contents indirectly showed the plant had most efficient photosynthetic mechanism. It is well documented that plants growing in the shade photosynthesize more efficiently at low irradiance than do the sun plants. The shade plants have large dark green chloroplast in comparison with those from sun plants. Obviously the chlorophyll contents were greater in the shade ferns when compared the sun ferns (Boyce and Mohamed, 1987).

These results may be due to chlorophyll degradation during senescence. The degradation must be associated with the funneling of chlorophyll-b into the pool of chlorophyll-a. The corresponding reduction was originally discovered and thought to be part of a chlorophyll cycle by which the two forms of chlorophylls are balanced in the photosynthetic apparatus. According to Lahani et.al. (2003) chlorophyll a/b ratio is lesser in the plants that growing under the shade than in plants that were exposed to full sunlight. It is believed that chlorophyll loss is associated to environment stress and the variation in total chlorophyll as a good indicator of stress. Chlorophyll contents and photosynthetic capacity is different in many species.

It is observed that in all the species, chlorophyll a content is more in vegetative frond than in fertile fronds except *M. membranaceum, M. punctatum and Pteris quadriaurita*, where it is slightly more in fertile fronds than vegetative fronds. Chlorophyll b in the pteridophytes studied shows that the vegetative fronds contain more amount than the fertile fronds except in *M. membranaceum*. Chlorophyll content is one of the most important physiological parameter as it determines the rate of photosynthesis. It is influenced by the environment in which the plants grow. Ramchandran et al. (1991) observed that water stress plays a great role in the functioning of many kinds of metabolic processes in a plant body for example low water deficit influences very much the pigment forming mechanism localized in the chloroplast.

It was observed that in majority of the plants chlorophyll-b dominates over chlorophyll-a in vegetative as well as fertile fronds. The dominance of chlorophyll-b over chlorophyll -a has been observed in *Adiantum lunulatum, Hypodematium crenatum, Asplenium pumilum and Pteris vittata* by Vyas and Sharma, (1988) while, in *Adiantum capillus-veneris, Adiantum lunulatum, Ophioglossum reticulatum* by Rathore and Sharma, (1991), in *Sphaerostephanus unitus, S. arbuscula and S. subtruncatus* by Britto et al., (1994), in *Pteris argyraea*, and *P. quadriaurita* by Jesudass et al., (1993), and in *Ophioglossum costatum* and *Adiantum incisum* by Sharma et al., (1995).

The increase or decrease in chlorophylls depends on the available light. There was a much greater quantity of chlorophylls and Carotenoids in the terrestrial and epiphytic species than in the climbing species. Shaikh and Dongare, (2008) showed that variation in chlorophyll and carotenoids contents varied with microclimatic conditions in *Adiantum philippense*. Because of numerous factors concerned with nutrition, light and the plants sampled were growing under a variety of conditions which can influence chlorophyll content

(Wolf, 1958). The studies by Kale, (2003) revealed that chlorophyll content in the dimorphic leaves of four homosporous ferns growing in different habitats is different. It was analyzed that total chlorophylls and carotenoids content in vegetative fronds are more in the terrestrial and epiphytic ferns. It is also considered that these variations may be due to altitudes at which plant species is occurred. Phytochemical studies on nineteen taxa of thelypteroid ferns of the Western Ghats of South India showed the relationship between the amount of pigments such as chlorophylls, carotenoids, anthocyanins and flavonoids and the habitat of the species has been studied (De Britto and Manickam 1994, Masal, et. al. 2010).

Carotenoids have two important roles in photosynthetic organisms. First, they act as accessory light-harvesting pigments, effectively extending the range of light absorbed by the photosynthetic apparatus. Secondly, they perform an essential photoprotective role by quenching triplet state chlorophyll molecules and scavenging singlet oxygen and other toxic oxygen species formed within the chloroplast. Vyas and Sharma, (1988) have shown that the variability in carotenoids from species to species is independent of ecological conditions and morphology of the plant. Vyas, (2008) found no relationship in between carotenoids and chlorophylls and in between dry to moisture loving species of pteridophytes of Rajasthan. Krinsky, (1966) has observed that during stress carotenoids show sufficient degradation. Our results support these opinions.

CONCLUSION

The different species of pteridophytes show increase or decrease in photosynthetic pigment during vegetative stage and during mature stage. The decrease in photochemicals during reproductive stage may be due to sporangium formation which may create a stress during the maturation and increase trend may be because of balanced photosynthetic apparatus.

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