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Seasonal Variation in Chlorophyll Content of Some Selected Plant Species of Yousmarg Grassland Ecosystem

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ABSTRACT

Chlorophyll, a green color pigment, serves as an indicator of photosynthetic activity, growth, development, production as well as biochemical aspects of plant species thus providing valuable information about the physiological status of plants. Chlorophyll has the tendency to decline more rapidly when plants are under stress or during leaf senescence. It is in this backdrop that the present study was conducted with an aim to determine the effect of seasons on the chlorophyll content of plant species including Lotus corniculatus, Malva neglecta, Plantago lanceolata, Plantago major and Poa annua. The results revealed that all the plant species depicted higher amount of chlorophyll a, chlorophyll b and total chlorophyll in summer season with highest values observed for Malva neglecta and lowest values for Poa annua except chlorophyll b which showed minimum value in Lotus corniculatus.

Keywords: Chlorophyll a, Chlorophyll b, Pigment, Photosynthesis, Plants, Development

INTRODUCTION

Chlorophyll, a green color pigment, in plants is of utmost importance in the process of photosynthesis which is a very important process in the overall plant performance and contributes substantially in their growth and development [1-3]. Being a principal photoreceptor in the process of photosynthesis, it absorbs sunlight energy in the form of electromagnetic radiations especially blue and red wavelengths of the spectrum to synthesize carbohydrates and oxygen from CO_2 and water [4,5]. Two types of chlorophyll viz chlorophyll a and b are present in plants which act as photoreceptors in the process of photosynthesis [2]. Structurally, chlorophyll molecule consists of a tetra-pyrrole ring having magnesium ion in the centre and a long phytol chain which is hydrophobic. The difference between chlorophyll a and chlorophyll b is the presence of a methyl moiety in the former replaced by a formyl group in the later. The ratio of chlorophyll a to chlorophyll b in higher plants is approximately 3:1 [6]. Chlorophyll serves as an indicator of photosynthetic activity, growth, development, production as well as biochemical aspects of plant species thus providing valuable information about the physiological status of plants [7,8]. The amount of chlorophyll varies with change in season as growing conditions like temperature, precipitation and sunlight also change. It has been observed that maximum amount of chlorophyll is recorded in summer season followed by spring season and least amount is registered in autumn season because of low temperature and short-day conditions in this season.

MATERIALS AND METHODS

The present study was conducted in Yousmarg grassland ecosystem a famous tourist spot located between the geographical co-ordinates of 33°49′42′ N and 74°39′59′ E and at an elevation of 2712 m above mean sea level (a.m.s.l) in Budgam District of the state of Jammu and Kashmir. The forests of Yousmarg are bounded by lush green grasslands, rivers and the backdrop of snow-capped mountains making it a fascinating tourist spot. Yousmarg mesmerizes tourists with its picturesque meadows, a sparkling reservoir and mountains comparable to European Alps. It has some of the highest peaks in Pir-Panjal range like Tatakoti (4725 m), Romesh Thong (5000 m) and Sunset Peak (4746 m). The Yousmarg forest area bounded by grasslands at its base has rich flora and fauna. The forest area is dominated by tree species like *Abies pindrow, Picea smithiana* and *Pinus wallichiana.* Herbaceous plant species in the forest area include

Cynodon dactylon, *Trifolium* spp., *Plantago* spp., *Rumex* sp., wild strawberry etc. The meadow area is dominated by herbaceous plant species like *C. dactylon*, *Trifolium* spp., *Plantago* spp., *Poa* sp., *Potentilla* sp., *Rananculus* sp., etc. The study was conducted during summer, autumn and spring seasons in the year 2014-2015 excluding the winter season due to heavy snowfall in the area. The plant species studied include *Lotus corniculatus, Malva neglecta, Plantago lanceolata, Plantago major* and *Poa annua.* Plants were collected from the selected site in healthy and lush green condition. The harvested plants were transported to the laboratory immediately in air tight polyethylene bags. Leaves and shoots of these fresh plants were incised and washed thoroughly. The material was drained of excess moisture before carrying out the required procedure for the determination of chlorophyll.

Extraction and estimation of chlorophyll

Chlorophyll content (Chlorophyll a, Chlorophyll b and Total Chlorophyll) was determined Spectrophoto-metrically from fresh leaf samples by preparing their acetone extracts by the methods of [9,10]. The extracts of the plants was prepared with 80% acetone by macerating 1 g of fresh weight of the plant leaves using a mortar and pestle. The decanted suspension was centrifuged for 3 min at 1320 rpm. After centrifugation, the upper green clear solution was decanted from the colourless residue and the volume was made upto 10 ml with 80% acetone in 10 ml test tubes. The solution was then subjected to centrifugation at 10,000 rpm for 10 min. The absorbance of the solution was determined using a spectrophotometer at wavelengths of 665 and 649 nm, respectively. The samples were taken in triplicates and the results expressed as µg/ml were calculated by the following formulae:

Chlorophyll 'a' (µg/ml) = $11.63 \times A_{665} - 2.39 \times A_{649}$

Chlorophyll 'b' (µg/ml) = $20.11 \times A_{649}) - 5.18 \times A_{665}$

Total Chlorophyll (µg/ml) = $6.45 \times A_{665} + 17.72 \times A_{649}$

RESULTS AND DISCUSSION

In photosynthetic organisms, functionally pigments are of great importance. Apart from harvesting light energy for the process of reduction of carbon, some pigments possess the properties of stress relievers [11]. Chlorophyll a (Chl. a), Chlorophyll b (Chl. b) and total chlorophyll (T. Chl.) of all the plant species was determined on seasonal basis depicting significant differences between the plants species as well as among different seasons (Table 1). Chlorophyll a content of plant species, determined on seasonal basis, showed considerable variations among different plant species recording highest value of 43.80 ± 1.26 µg/ml in *Malva neglecta* and lowest value of 18.18 ± 0.38 µg/ml in *Poa annua*. Chlorophyll b depicted maximum value of 4.72 ± 0.10 µg/ml for *Malva neglecta* and lowest value of 1.09 ± 0.03 µg/ml for *Lotus corniculatus*. Similarly, Total Chlorophyll registered peak value of 48.53 ± 1.35 µg/ml for *Malva neglecta* as against the minimum value of 19.28 ± 0.46 µg/ml for *Poa annua*. Among the plant species studied, *Malva neglecta* maintained an overall increased value of these pigments throughout the study period while as lowest values were recorded for *Lotus corniculatus*. All the plant species registered highest values of Chl. a, Chl. b and T. Chl. (Figure 1) in summer season which may be attributed to the availability of better growing conditions in this season. This view is supported by [5,12,13] who also reported highest value of chlorophyll in this period. This may be attributed to the fact that chlorophyll concentration in leaves decreases in response to low temperature and short-day conditions as are found in the present study area and increases with increase in temperature [14-16].

Table 1: Seasonal variation in chlorophyll a, chlorophyll b and total chlorophyll content (µg ml^{-1}) of plants

Plant species	Season	Summer-14	Autumn-14	Spring-15
Lotus corniculatus	Chl. a	29.90 ± 3.57	23.75 ± 1.37	21.48 ± 0.49
	Chl. b	2.14 ± 0.59	1.77 ± 0.08	1.09 ± 0.03
	Total Chl.	32.04 ± 4.15	25.52 ± 1.45	22.57 ± 0.47
Malva neglecta	Chl. a	43.80 ± 1.26	33.93 ± 0.65	41.95 ± 1.39
	Chl. b	4.72 ± 0.10	1.99 ± 0.12	4.18 ± 0.54
	Total Chl.	48.53 ± 1.35	35.93 ± 0.74	46.13 ± 1.93
Plantago lanceolata	Chl. a	42.20 ± 1.58	28.89 ± 0.24	39.00 ± 1.55
	Chl. b	3.91 ± 0.13	1.40 ± 0.02	1.48 ± 0.05
	Total Chl.	46.11 ± 1.58	30.29 ± 0.25	40.48 ± 1.59
Plantago major	Chl. a	42.02 ± 1.60	33.75 ± 0.91	40.74 ± 1.30
	Chl. b	4.22 ± 0.27	2.29 ± 0.07	3.95 ± 0.13
	Total Chl.	46.24 ± 1.87	36.04 ± 0.97	44.68 ± 1.40
Poa annua	Chl. a	40.97 ± 0.81	18.18 ± 0.38	39.64 ± 0.88
	Chl. b	3.26 ± 0.43	1.11 ± 0.08	1.55 ± 0.08
	Total Chl.	44.23 ± 1.14	19.28 ± 0.46	41.20 ± 0.94

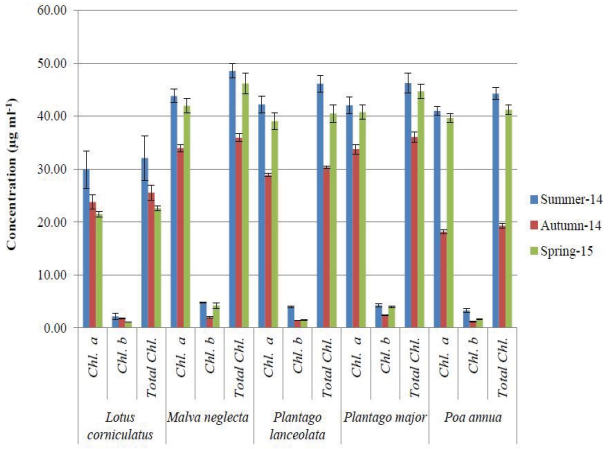

Figure 1: Seasonal variation in chlorophyll a, chlorophyll b and total chlorophyll content (µg ml^{-1}) of plants

CONCLUSION

The present study was conducted with an aim to determine the effect of seasons on the chlorophyll content of plant species including *Lotus corniculatus, Malva neglecta, Plantago lanceolata, Plantago major* and *Poa annua.* Since, chlorophyll content is the best indicator of photosynthesis activity, stress conditions; measure of the crop response to nitrogen application and many other plant biochemical aspects, variations in pigment content may provide valuable information about the physiological status of plants [7,17-20]. The results revealed that all the plant species depicted higher amount of chlorophyll a, chlorophyll b and total chlorophyll in summer season with highest values observed for *Malva neglecta* and lowest values for *Poa annua* except chlorophyll b which showed minimum value in *Lotus corniculatus*.

REFERENCES

[1] Ashraf M, Harris PJC. Photosynthesis under stressful environments: An overview. *Photosynthetica*, **2013**, 51: 163-190.

[2] Khaleghi E, Arzani K, Moallemi N, Barzegar M. Evaluation of chlorophyll content and chlorophyll fluorescence parameters and relationships between chlorophyll a, b and chlorophyll content index under water stress in *Olea europaea* cv. Dezful. *World Acad Sci Eng Technol,* **2012**, 68: 1154-1157.

[3] Li Q, Liu X, Yue M, Zhang XF, Zhang RC. Effects of physiological integration on photosynthetic efficiency of *Trifolium repens* in response to heterogeneous UV-B radiation. *Photosynthetica*, **2011**, 49: 539-545.

[4] Mall LP, Billore SK, Misra CM. A study on the community chlorophyll content with reference to height and dry weight. *Trop Ecol*, **1973**, 14: 81-83.

[5] Mishra SS, Mishra KN, Mahananda MR. Chlorophyll content studies from inception of leaf buds to leaf-fall stages of teak (*Tectona grandis*) of Kapilash Forest Division, Dhenkanal, Odisha. *J Glob Biosci,* **2013**, 2: 26-30.

[6] Rajalakshmi K, Banu N. Extraction and estimation of chlorophyll from medicinal plants. *Int J Sci Res,* **2015**, 4: 209-212.

[7] Sims DA, Gamon JA. Relationships between leaf pigment content and spectral reflectance across a wide range of species, leaf structures and developmental stages. *Remote Sens Environ,* **2002**, 81: 337-354.

[8] Steele M, Gitelson AA, Rundquist D. Non-destructive estimation of leaf chlorophyll content in grapes. *Am J Enol Vitic,* **2008**, 59: 299-305.

[9] Strain HH, Cope BT, Svec WA. Analytical procedures for the isolation, identification, estimation and investigation of the chlorophylls. *Methods Enzymol,* **1971**, 23: 452–476.

[10] Lichtentaler HK, Wellburn AR. Determinations of total carotenoids and chlorophylls a and b of leaf extracts in different solvents. *Bioch Soc Trans,* **1983**, 603: 591-592.

[11] Angela G, Usha Shri P. A study on variation in pigment content in plants under air pollution stress. *International Conference on Recent Innovations in Sciences, management and Technology,* **2016**, 483-487.

[12] Devmalkar VS, Murumkar CV, Salunkhe SM, Chavan SJ. Studies on pigment chlorophyll isolation and estimation of different bryophytes for their biochemical properties. *J Nat Prod Plant Resour*, **2014**, 4: 56-61.

[13] Kershaw KA, Webber MR. Seasonal changes in the chlorophyll content and quantum efficiency of the moss *Brachythecium rutabulum*. *J Bryol,* **1986**, 14: 151-158.

[14] Ottander C, Campbell D, Öquist G. Seasonal changes in photosystem II organization and pigment composition in *Pinus sylvestris*. *Planta,* **1995**, 197: 176-183.

[15] Vogg G, Heim R, Hansen J, Schafer C, Beck E. Frost hardening and photosynthetic performance of Scots pine (*Pinus sylvestris* L.) needles. I. Seasonal changes in the photosynthetic apparatus and its function. *Planta*, **1998**, 204: 193-200.

[16] Weng JH, Liao TS, Sun KH, Chung JC, Lin CP, et al. Seasonal variations in photosynthesis of *Picea morrisonicola* growing in the subalpine region of subtropical Taiwan. *Tree Physiol*, **25**, 973-979.

[17] Jacquemoud S. Inversion of the Prospect-Sail canopy reflectance model from AVIRIS equivalent spectra: theoretical study. *Remote Sens Environ*, **1993**, 44: 281-282.

[18] Baret F, Vanderbilt VC, Steven MD, Jacquemoud S. Use of spectral anology to evaluate canopy reflectance sensitivity to leaf optical properties. *Remote Sens Environ*, **1994**, 48: 253-260.

[19] Kupiec JA, Curran PJ. Decoupling effect of the canopy and foliar biochemicals in AVIRIS spectra. *Int J Remote Sens,* **1995**, 16: 1731-1739.

[20] Sari M, Sonmez NK, Karaca M. Relationship between chlorophyll content and canopy reflectance in Washington navel orange trees (*Citrus sinensis* (L.) Osbeck). *Pak J Bot*, **2005**, 37: 1093-1102.