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# A Study of Various Photosynthetic Pigment Contents in *Tephrosia purpurea (L) Pers*

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**Abstract**

Photosynthetic pigments are important to plants mainly for harvesting light and production of reducing powers. Chlorophyll content gives a good idea about the productivity of plants and is an index of community function. There is a close correlation between the amount of chlorophyll and the rate of photosynthesis. Plant species selected for study grows along wasteland and roadside areas of jaipur district of rajasthan . concentration of pigment was calculated using Arnom and Vernon Method. The pigment contents were higher in ***Tephrosia purpure(L) Pers*** at all the three sites.

## Introduction

Photosynthesis by foliar tissues is the fundamental metabolic process and plays a critical role in plant growth and development.No light is required for their formation. The productivity of higher plants is mediated by leaves and adaptations of plants to the environment involve leaf traits. Chlorophyll and carotenoids pigment absorb light energy and transfer it into the photosynthetic apparatus of leaves, therefore, determination of leaf pigment contents can provide a valuable tool to integrate and understand the physiological and biochemical function of leaves are controlled through light received by them.

**I**ndustrialization and Urbanization of cities especially metropolitan cities are facing fast growth in automobile number which is the major cause of dust pollution. These dust when blown carries with it large amount of pollutant into our houses and are cause of many air born diseases. Hence, covering the roadsides by vegetation is the need of hour. Keeping in view the persistent dust pollution caused by automobiles, to reduce it some field and laboratory experiments were conducted to study the pigment contents of***Tephrosia purpure(L) Pers***

A comparative study was made between sites. Three sub urban areas of Jaipur were selected as sites i.e. (Site A, Site B and Site C).

Site A- Vaishali Nagar Area Site B- Mansarovar Site C- Sanganer

## Study Material

Tephrosia purpurea (L.) Pers. Family Fabaceae sub family Papilionaceae commonly called wild Indigo in English and Bisoni, Biyani in Hindi. It occurs naturally in grassy field and along roadsides found in plains of India (Throughout), Ceylon, Mauritius, Tropical Africa and subtropical regions.

*T. purpurea(L) Pers.* is an erect much branched annual or short-lived perennial herb up to 40-80 cm tall. Leaves are pinnately compound with imparipinnately arranged leaflets. Inflorescence is axillary with reddish-purple coloured flowers..Fruit is a pilous pod, flat, linear and somewhat re-curved, apiculate with five to six seeds. Fruit is brown in colour when mature and it dehisces with twisted valves. Seed is rectangular to transversely ellipsoidal, light to dark brown to black in colour and sometimes mottled.

**Chemical Composition and Medicinal Importance**- *T. purpurea* contains glycosides, rotenoids, isoflavones, flavanones, chalcones, flavanols, tephrorins A and B and tephrosones, tephropurpurin and sterols as active compounds (Chang *et al.,* 2000). According to Sivapalan (1993) *T. purpurea* is used as interplant shade and green manure crop. It is planted with vegetables, rice, coconut, tea and banana, especially in India and Sri Lanka. When grown as a green manure on saline-sodic soils in Rajasthan (India), it is most successful in reducing soil salinity and lowering the pH. *T. purpurea* is associated with the vesicular-arbuscular mycorrhizal fungi *Glomus heterosporum* and *Sclerocystis microcarpus* in waste sites of coal mines and calcite mine spoils and is nodulated by *Rhizobium* hence improves the soil micronutrients.

Medicinally, all parts of the plant have tonic and laxative properties. It is also used as a blood purifier in the treatment of boils and pimples and is considered a cordial treatment. Pulverized roots smoked for relief from asthma and cough, and are used in treating bronchitis. A decoction of the fruit is given against intestinal worms, elephantiasis and as a nematicide for treatment against *Toxocora canis* larvae which cause a lung disease in Sri Lanka.“Yakrifit" (a polyherbal product containing *T. purpurea*) when given to the animals they recovered in three to seven days, regained appetite for food and water and their general condition had improved .

**Study Site and Methodology**

This study site is natural population of plants growing along roadsides and open land in suburban areas of Jaipur at three sites of different localities were selected for experimental study for statistical analysis of pigment content chlorophyll a, chlorophyll b and carotenoids using Arnon (1949) and Vernon (1960) . Fresh leaf sample of each selected plant was collected separately. Fifty milligram of leaf tissue was taken for each plant, then grounded and homogenized with 50 ml of 80% acetone in a mortar with pestle. The extract was centrifuged at 2000 rpm for 10 minutes. The volume was made to 10 ml with 80% acetone.

The clear supernatant solution was examined for Chlorophyll ‘a’, Chlorophyll ‘b’ and Carotenoids contents at wavelength 645 and 663nm (for Chlorophyll) and 480 and 510nm (for Carotenoids) in a Spectrophotometer (Model, Spekol, Carl Zeiss Make). The values of pigments were expressed in terms of mg/g fresh weight. The pigment concentrations were calculated with the help of following formula.

$$\text{Chlorophyll a} = \frac{12.7\text{A}663 - 2.69\text{A}\,645}{1000 \times \text{W}} \times \text{V mg / g}$$

$$\text{Chlorophyll b} = \frac{12.9A\ 645 - 4.68A\ 663}{1000 \times W} \times V\ \text{mg / g}$$

$$\text{Carotenoids} = \frac{7.6\ OD\ 480 - 1.49\ OD\ 510}{a \times 100 \times W} \times V\ \text{mg / g}$$

Here

O.D. = optical density (absorbance of light in 1 cm cell)

V = volume of extract in ml

a = length of light path in cell (cm)

W = fresh weight of leaves in gm.

**Observations and Results**

Plant species selected for study are affected by climatic conditions(stress due to high temperature, drought conditions, high irradiance level etc.) and pollution (dust, air pollution and pollution due to heavy metals) are probably causing differences in the concentration of photosynthetic pigments (chlorophyll a, b and carotenoids) when considering effects at different sites.

***Tephrosia purpure(L) Pers.***: The data of pigment contents i.e. chlorophyll a, chlorophyll b and carotenoids are recorded in Table 1. The chlorophyll a content was 1.40±0.025 at site A(highest) and 1.29±0.01 at site C(lowest) with one way ANOVA F ratio 23.2368NS. The chlorophyll b content obtained at site A was 0.60±0.28 and 0.39±0.03 at site C with one way ANOVA F ratio 1.2741*. The carotenoid content was 5.33±0.39 at site A and 4.93±0.30 at site C with one way ANOVA F ratio 1.5019*

Observations on pigment contents revealed that Chlorophyll 'a', Chlorophyll 'b' and Carotenoids content of plant species varied at different sites.Evaluated plants are from same taxonomic group exhibiting difference in growth patterns, leaf life span, texture, growth dynamics and phenological development.Arthur *et al*. (1987) have explained that variation of pigments could be related to phenological phases of plant species such as flowering and fruiting.

**Table-1: Showing Variation in Pigment Contents (mg/g fresh weight) in the Leaf of *Tephrosia purpure(L) Pers*from all the Three Sites (values are mean of three replicates).**

| Sites | Chlorophyll a (mean ± SD) | Chlorophyll b (mean ± SD) | Carotenoids (mean ± SD) |
|---|---|---|---|

| | | | |
|---|---|---|---|
| A | 1.40±0.025 | 0.60±0.28 | 5.33±0.39 |
| B | 1.33±0.023 | 0.45±0.07 | 4.93±0.24 |
| C | 1.29±0.01 | 0.39±0.03 | 4.93±0.30 |

NS=Not Significant *= Significant

**Analysis of Variance:**
**F-ratio:**
i. Chlorophyll a = 23.2368 $^{NS}$
ii. Chlorophyll b =1.2741*
iii. Carotenoids =1.5019*

**Discussion and Result**

Plantation is the best remedy for control of automobile pollution because plants act as dust trap, reduce atmospheric pollution, maintain life support system of the planet and are alpha and omega of life form and environment. Plants provide an enormous leaf area for impingement, absorption and accumulation of air pollutants to reduce the pollution level in the air environment, with a various extent for different species (Liu and Ding, 2008). The use of plants as monitors of air pollution has long been established as plants are the initial acceptors of air pollution. They act as the scavengers for many air borne particulates in the atmosphere (Joshi and Swami, 2009). Agrawal *et al.* (2006) reported that in developing cities, there is increase in automobiles, rapid economic development and higher levels of energy consumption lead to the pollution of air. Air pollution caused by automobiles has been described as the disease of India over the past few decades.

The roadside restoration by establishment of self sustained native vegetation cover in the newly constructed road helps in controlling soil erosion, dust pollution, exotic plant invasion and at the same time maintaining traffic visibility Naturally occurring roadside native plants have high potential to survive and regenerate in disturbed habitats (Prach and Pysek, 2001). Native plants are also important from a conservation point of view, as they can maintain natural plant diversity (Knops et al., 1995).

The productivity of higher plants is mediated by leaves and adaptations of plants to the environment involve leaf traits (Valladares *et al*., 2000). Chlorophyll and carotenoids pigment absorb light energy and transfer it into the photosynthetic apparatus of leaves, therefore, determination of leaf pigment contents can provide a valuable tool to integrate and understand the physiological and biochemical function of leaves(Sims and Gamon, 2000). Kramer and Kaslowski (1979) explained that leaf chlorophyll levels are controlled through light received by them. Plants during summers have to deal with soil water deficits, high temperature and high irradiance levels (Gonzalez *et al*., 2004). Furthermore, these plants have low tissue water potential because they are exposed to low temperature in winters (Gonzalez *et al*., 2000).

Reduction of chlorophylls do not result from severe photoinhibitory damage instead, it may be an adaptive response against the adverse conditions of the summer since water availability (Kyparissis *et al*., 1995 and 2000; Oliveira and Peñuelas, 2001) is the most limiting factor controlling plant growth, survival and distribution in dry climates (Kramer, 1983 and Newton and Goodin, 1989).

Result shows reliable data on chlorophyll contents of ***Tephrosia purpure(L) Pers***at different sites of Jaipur the quantitative analysis of photosynthetic pigment showed a reasonable amount of chlorophyll a and chlorophyll b contents and carotenoid content is higher in ***Tephrosia purpure(L) Pers*** on reviewing other herbaceous plants . further the chlorophyll content can be used as indicators of plant health, stress and nutritional deficiencies. Our findings may be helpful in further studies to monitor the effect of changing micro-climate of chlorophyll content in roadside plants.

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