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Dust Deposition on Leaf and Its Impact on Chlorophyll Production in Calotropis Gigantea and Cassia Siamea Growing In Vicinity of Stone Crusher

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Abstract:
Blade surface of plant is continuously exposed to the Environs and is the main receptor of dust. Dust affects the photosynthesis, respiration, transpiration and allows the penetration of harmful plant gases pollutants. The present study was conducted the seasonal variation in dust settling on leaves and its impact on chlorophyll content of two tree species namely *Calotropis gigantea* and *Cassia siamea.* This research was carried out during the month of May 2021 to April 2023 on two tree species in the region of stone crusher area. Authors found that crusher dust had a consequential effect on the photosynthetic pigments such as chlorophyll 'a', chlorophyll 'b' and total chlorophyll content. Most dust fall occurred during winter followed by summer and rainy season in both plant species. The authors reported a significant negative correlation between dust load and chlorophyll content in all seasons. *Calotropis gigantea* showed more dust accumulation rates in comparison to *Cassia siamea*. Thus, plants can be used in the abatement of dust pollution as they act as natural filters.

Keywords: Air contamination, Crusher dust, Chlorophyll, Cyclical variation.

INTRODUCTION:

Howard Hesketh and Shobokshy (1985) present different sampling techniques and measuring instrumentation used in the field of dust, the data processing methods also presented websites were scanned in order to know the international status of affairs. It is felt that in the developed countries, few designs of the stone crushers are provide with dust suppression systems while in the developing countries, stone crusher industry work without any precautions and protections

Air pollution is a major problem in modern society. Even through air pollution is usually a greater problem in cities, pollutants contaminate air everywhere. The interaction between plants and pollutants were investigated by many authors: most studies on the influence of environmental pollution focus on physiological aspects (Heumann, 2002; Psaras and Christodoulakis, 1987; Velikova et al., 2000). Studies concerning the anatomy of the vegetative organs under conditions of pollution have been also carried out (Alves et al., 2008; Ahmad et al., 2005; Silva et al., 2005, 2006, Verma et al., 2006). The reaction of different species to the altered environmental conditions is strongly correlated with their structural and functional features.

The dust as a result of stone crusher activity, slowly deposits over the leaves of the vegetation affecting the productivity of horticulture plants, natural vegetation and so on. The dust deposition the leaf surface affects the plants in many ways. The dust deposition on leaves impacts the production of chlorophyll a, b, and total chlorophyll. The stomata also closed increasing heat effect there by creating an imbalance in the homeostasis of the plant. This further results in the decrease in the production of secondary metabolites like phyto-enzyme, phytohormones etc. the impacts will be much higher in the medicinal plants and plant products used in cosmetic industry.

REVIEWOF LITERATURE:

Dust from stone crusher sites and other sources of air pollution is known to harm vegetation and reduce agricultural yields; as a result, plants in industrial regions face an increased risk of extinction (Iqbal & Shafig, 2001). In addition to the dust itself, plants are harmed by harmful substances such as sulfuric acid, lead, copper, fluoride, and magnesium in the dust. This reduces plant cover, height, and the number of leaves. Stone crushing is an international problem that has worried people in developed nations as much as anybody else. Quarry dust is a big contributor to air pollution; how bad it gets depends on things like the local microclimate, the amount of dust in the air, how big the dust particles are, and what they're made of (limestone quarries, for instance, create dust that's very alkaline and reactive). In addition to being an annoyance and a potential health risk (especially for people with respiratory issues), stone crusher dust can physically harm the plants in the area, obstructing and damaging their internal structures and abrading their leaves and cuticles. Its chemical effects can also impact their long-term viability (Guach, 2001). Dust is generated by a variety of sources, including transportation, crushing activities, mining, and other industrial processes (Patil, 2001; APPCB, 2003). So says the CPCB, or Central Pollution Control Board. According to Richard et al., (2002), of all pollutants, dispersed particulate matter may have the most persistent impact on people across the world. The most common kind of pneumococciniosis is silicosis, according to Rees and Murray (2007), since silica dust is more abundant than other forms of dust in the environment. Silicosis is quite common in tiny companies and even in people who aren't directly exposed to asbestos in India, according to research from the National Institute of 10 Occupational Health. As an example of fibrogenic dust, consider silica (Gulumian, 2005).

MATERIALS AND METHODS:

Study Site: The present study on "The Effects of Stone Crusher Dust on Vegetation" carried out at Jangamaheswarapuram (Latitude 15.896622 N and Longitude 80.460434 E) Martur mandal, Bapatla district, Andhra Pradesh, India, has been conducted during May 2021 to April 2023. Two species. *Calotropis gigantea* L, *and Cassia siamea* L, were selected for the present study. The study included seasonal variations of dust accumulation on leaves, seasonal variations in production of Chlorophyll a, Chlorophyll b and total Chlorophyll content. The results of the study are presented in standard units.

Sample collection:

Leaves of *Calotropis gigantea* and *Cassia siamea* growing in study area at jangamaheswara puram were plucked carefully and kept in separate polythene bags for the study.

Dust load accumulation:

Ten leaves were taken from both tree species for the estimation of dust load and total leaf area. These leaf samples were washed in petridish containing 50 ml of distilled water with the help of brushes and

forceps. The amount of dust was calculated by taking the initial and final weight of petridish in which the leaf samples were washed. Dust load was calculated by using this formula:
Dust content (mg/cm) = W 2-W1/A.
Where, W1 = weight of petridish without dust,
W2 = weight of petridish with dust,
A = Total area of leaf in cm^2For the calculation of total leaf area,
Extraction of Chlorophyll: Chlorophyll extraction was done as per method of Arnon (1949). One gram of finely cut fresh leaves was taken and ground with 20-40 ml of 80% acetone. It was then centrifuged at 5000-10000 rpm for 5minutes. The supernatant was transferred and the procedure was repeated till the residue becomes colorless. The absorbance of solution was red at 645 nm and 663 nm against the solvent (acetone) blank.
Estimation of chlorophyll content: The estimation of concentration of chlorophyll 'a', chlorophyll 'b' and total chlorophyll were done by using equations:
Chlorophyll 'a': 12.7(A 663) – 2.69(A 645)
Chlorophyll 'b': 22.9 (A 645) – 4.68(A 663)
Total chlorophyll: 20.2 (A 645) + 8.02 (A663)

RESULTS AND DISCUSSION:

CALOTROPIS GIGANTEA L: Calotropis gigantea is a widely distributed highly tolerant species that grows in all types of terrains with the stature of shrub, Broad, hairy leaves with thick veins. The dust accumulated on the leaves varied widely during the different seasons of a year. The two year study on the accumulation of dust revealed interesting facts. The total accumulation was minimum in June during both years 2021-2022 i.e. 0.24, 0.62 mg/cm2, respectively. June, July, August showed lowest accumulations, March, April showed medium while maximum accumulation was found during winter.

Table: 1 Distribution of dust concentration over the leaves *Calotropis gigantea* during the study period

Month	Dust mg/cm^2 2021-2022	Dust mg/cm^2 2022-23
May	3.24	3.18
June	0.62	0.24
July	1.31	2.38
August	1.68	3.11
September	2.21	3.18
October	2.26	2.41
November	3.19	3.74
December	3.75	3.98
January	4.31	4.16
February	1.65	1.78
March	2.48	2.51
April	2.81	3.16
Mean		2.45917 ± 1.06284

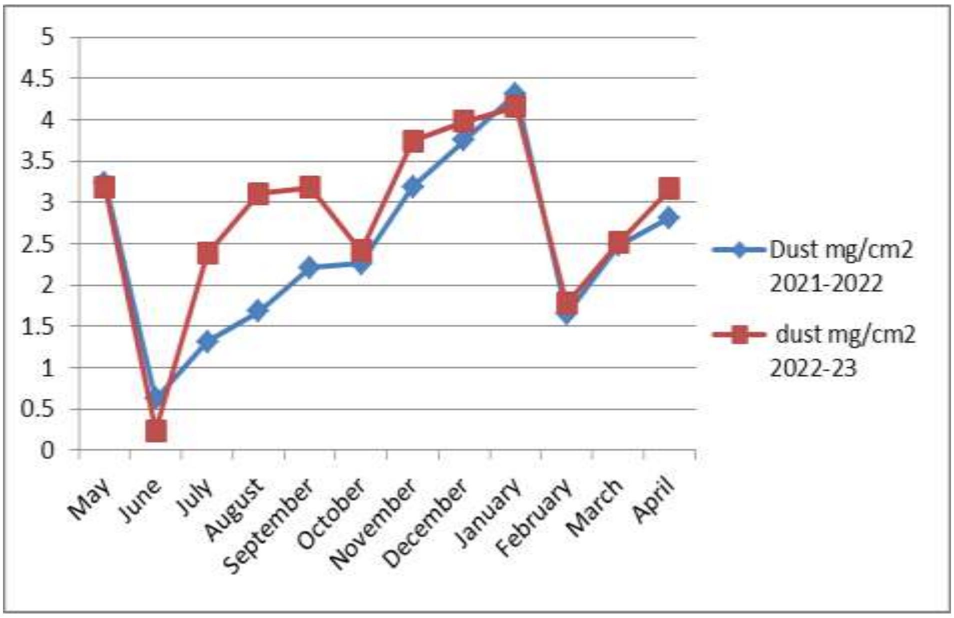


Fig: 1 Distribution of dust concentration mg/cm² over the leaves of during the study period.

Distribution of dust over the leaves during winter season during the study period on *Calotropis gigantea*

The dust accumulation in winter November, December, January and February months were considered as winter months particularly when the natural fog usually prevails the overall concentrations were higher during the first three months in this season while accumulation decreased from February when gradually the fog decreases and ambient temperatures starts increasing. The mean accumulation during both the years was more or less equal and followed the same trend (Table: 1.1; Fig: 1.1).

Month	Dust mg/cm² 2021-22	Dust mg/cm² 2022-23	Mean
November	3.19	3.74	3.465 ± 0.38890873
December	3.75	3.98	3.865 ± 0.16263456
January	4.31	4.16	4.235 ± 0.10606601
February	1.65	1.78	1.715 ± 0.09192388
Mean	3.225 ± 0.99180391	3.415 ± 0.95565422	

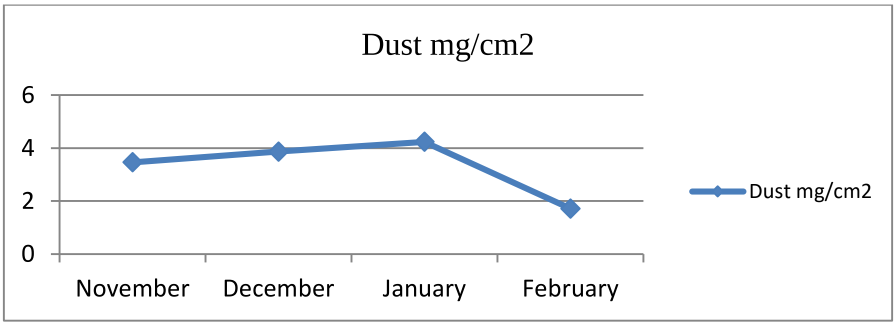


Fig: 1.1 Seasonal variation of Mean dust deposition mg/cm² over the leaves of *Calotropis gigantea* in winter

Distribution of dust over the leaves during summer season during the study period on *Calotropis gigantea*

The dust accumulation on *Calotropis gigantea* during summer season varied marginally in summer months the broad leaves of the plants enable higher accumulation density but during summer the wind velocity will also be higher the accumulation of dust also showed a positive trend of slow increase up to May and a sudden decrease in June which can be attributed to onset of south west monsoon or pre monsoon rains the mean accumulation is more or less equal in both the years viz 2.28 mg/cm^2(2021-22) and 2.27 mg/cm^2(2022-23) the same trend is followed by during each month of summer (Table: 1.2; Fig: 1.2).

Table: 1.2 Dust deposition during summer season in *Calotropis gigantea*

Month	Dust mg/cm^{2}2021-22	Dust mg/cm^{2}2022-23	Mean
March	2.48	2.51	2.495 ± 0.021213203
April	2.81	3.16	2.985 ± 0.247487373
May	3.24	3.18	3.21 ± 0.042426407
June	0.62	0.24	0.43 ± 0.268700577
Mean	2.2875 ± 1.15439378	2.2725 ± 1.390284743	

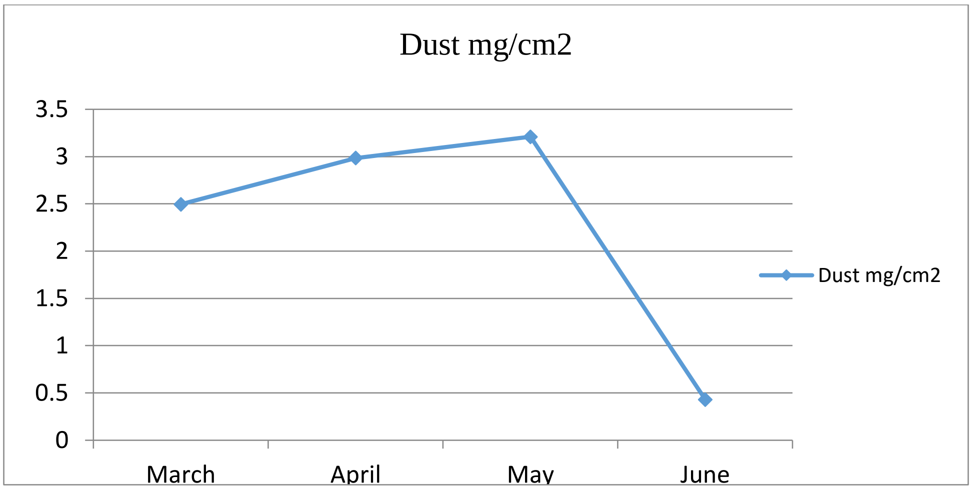


Fig: 1.2 Seasonal variation of Mean dust deposition mg/cm^2 over the leaves *Calotropis gigantea* in summer

Distribution of dust over the leaves during Rainy season during the study period on C*alotropis gigantea*

The rainy season included July, August, September and October. Most of the period falls under south west monsoon and October month can be treated as retreating and closing month making either beginning of north east or closing at south west monsoon .the accumulation of dust was slightly higher in 2022-23 compared to 2021-22 viz 2.77mg/cm^2 and 1.86 mg/cm^2, respectively. The monthly means for both the years followed an increased trend during first three month and a slight decrease in October (Table: 4.33, Fig: 4.33).

Table: 1.3 Dust deposition during Rainy season in *Calotropis gigantea*

Month	Dust mg/cm^{2}2021-22	Dust mg/cm^{2}2022-23	Mean
July	1.31	2.38	1.845 ± 0.756604256
August	1.68	3.11	2.395 ± 1.011162697
September	2.21	3.18	2.695 ± 0.685893578
October	2.26	2.41	2.335 ± 0.106066017
Mean	1.865 ± 0.453615109	2.77 ± 0.434127477	

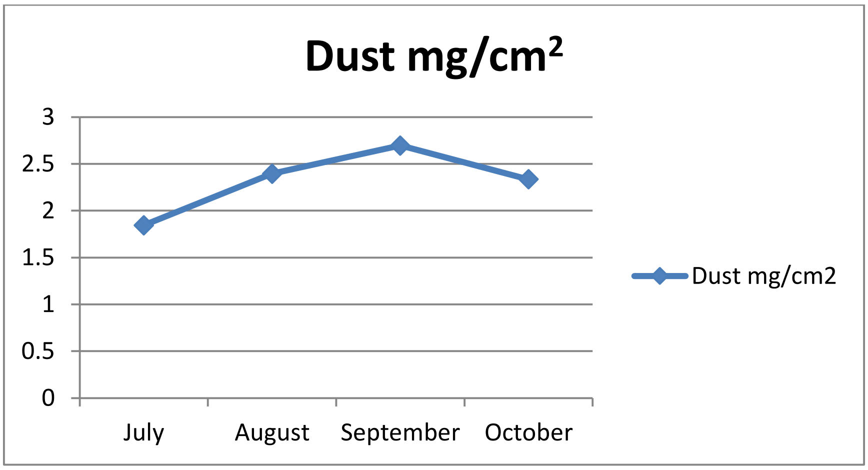


Fig: 1.3 Seasonal variation of Mean dust deposition mg/cm^{2}over the leaves of *Calotropis gigantea* in rainy

***CASSIA SIAMEA* L:**

Seemingly the values of dust accumulation are visibly low. This is because of the small size of the leaf which is described as ovate, elloptic pointed leaflets. The dust accumulated in definitely proportional when compared to other three species .hence the dust concentration ranged between a lowest of 0.06 mg/cm^2 and a height of 2.21 mg/cm^2 while the mean concentration of whole study period was 0.8583 mg/cm^2 and the standard deviation was insignificant at 0.05 levels (Table: 2; Fig: 2).

Table: 2. Distribution of dust concentration over the leaves *Cassia siamea* during the study period

Month	Dust mg/cm^2 2021-2022	Dust mg/cm^2 2022-23
May	1.16	1.32
June	0.06	0.19
July	0.21	0.29
August	0.41	0.41
September	0.52	0.57
October	1.15	1.13
November	1.23	1.34
December	1.65	1.51

January	2.21	2.07
February	0.41	0.32
March	0.51	0.42
April	0.73	0.78
Mean		0.854167± 0.638157

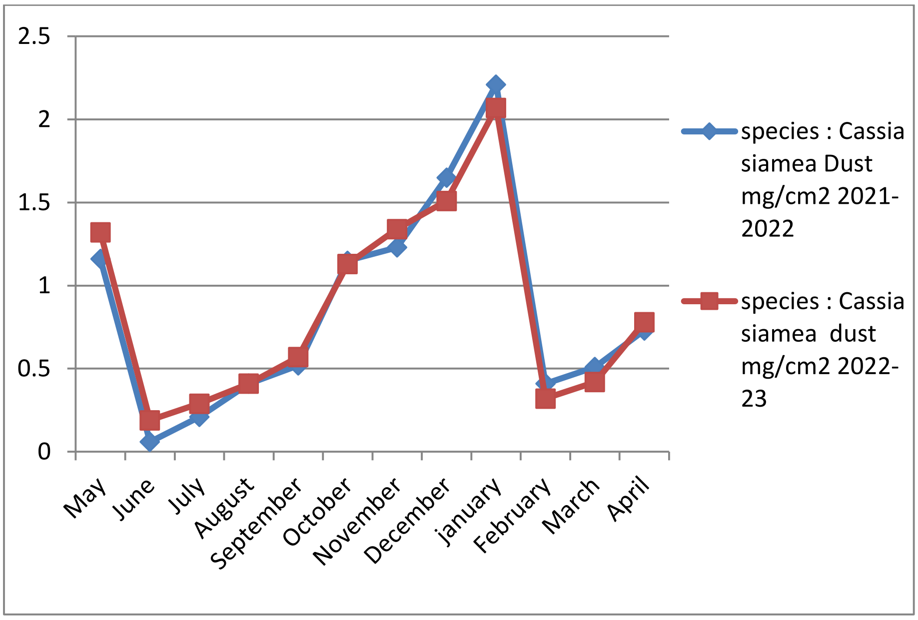


Fig: 2 Distribution of dust concentration mg/cm^2 over the leaves of during the Study period

Distribution of dust over the leaves during winter season during the study period on *Cassia siamea*

Two winter seasons were studied for dust accumulation on *Cassia siamea* during the November, December, January and February. The Dust accumulation increased with decreased of temperatures evident is from the increase during November, December, and January is the month when the lowest temperatures are recorded in Andhra Pradesh the dust concentration during season showed only a marginal difference in different months. The monthly standard deviation of the means of two years was insignificant. The February month which marked increased temperature and turbulence recorded a dust accumulation of lowest concentrations (Table: 2.1, Fig: 2.1).

Table: 2.1 Dust deposition during winter in *Cassia siamea*

Month	Dust mg/cm^2 2021-22	Dust mg/cm^2 2022-23	Mean
November	1.23	1.34	1.285 ± 0.077781746
December	1.65	1.51	1.58 ± 0.098994949
January	2.21	2.07	2.14 ± 0.098994949
February	0.41	0.32	0.365 ± 0.06363961
Mean	1.375 ± 0.758309523	1.31 ± 0.729977169	

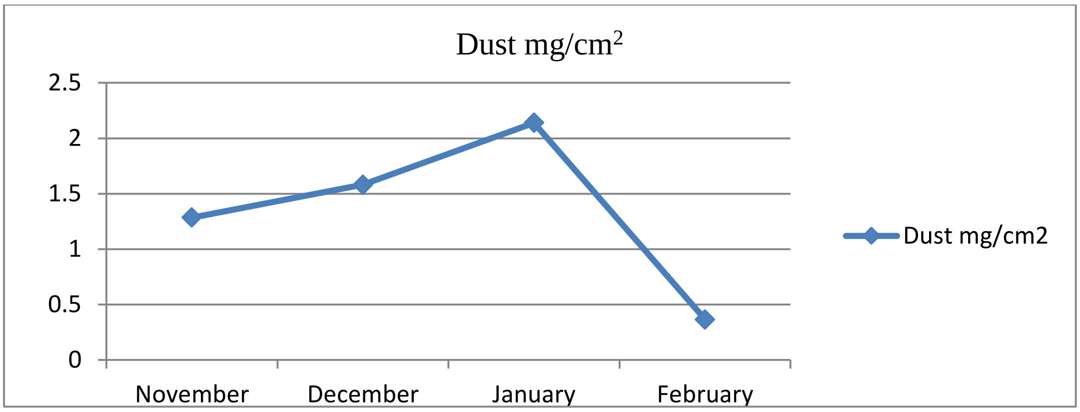


Fig: 2.1 Seasonal variation of mean dust deposition mg/cm^2 over the leaves of *Cassia siamea* in winter

Distribution of dust over the leaves during summer season during the study period on *cassia siamea*

The summer season which shows characteristic highest temperatures in the entire Andhra Pradesh in which a part of the study area also falls. The atmospheric turbulence is high during February to June and hence the dust swept away due to high wind and velocity and the accumulation is also very less. The lowest accumulation was 0.06 mg/cm^2 in June 2021-22 and highest was 1.32 mg/cm^2. The difference of dust concentration was negligible between two years in any month of the season. The dust accumulation was low due to small stature of plant, branches of leaves. (Table: 2.2; Fig: 2.2).

Table: 2.2 Dust deposition during summer in *Cassia siamea*

Month	Dust mg/cm^2 2021-22	Dust mg/cm^2 2022-23	Mean
March	0.51	0.42	0.465 ± 0.06363961
April	0.73	0.78	0.755 ± 0.03535533
May	1.16	1.32	1.24 ± 0.113137085
June	0.06	0.15	0.105 ± 0.06363961
Mean	0.615 ± 0.45800291	0.6675 ± 0.50579145	

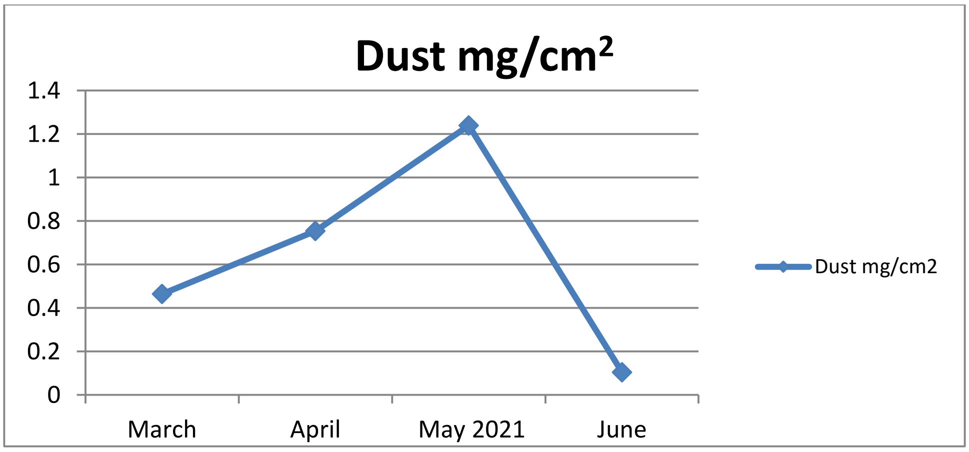


Fig: 2.2 Seasonal variation of Mean dust deposition mg/cm^{2}over the leaves of *Cassia siamea* in summer

Distribution of dust over the leaves during Rainy season during the study period on *Cassia siamea*

The dust accumulation during rainy month July, august September and October those correspond to south west monsoon season. Hence rain has wash effect monsoonal wind turbulence effect greatly reduces the dust retention on leaves .the lowest concentration recorded was 0.21 mg/cm^2 in July 2021-22 and highest was 1.15 mg/cm^2.while the means of 2021-22 and 2022-23 were 0.5725 mg/cm^2 and 0.6 mg/cm^2 respectively and the difference was negligible (Table: 2.3; Fig: 2.3).

Table: 2.3 Dust deposition during rainy season in *Cassia siamea*

Month	Dust mg/cm^2 2021-22	Dust mg/cm^{2}2022-23	Mean
July	0.21	0.29	0.25 ± 0.056568542
August	0.41	0.41	0.41 ± 0
September	0.52	0.57	0.545 ± 0.03535533
October	1.15	1.13	1.14 ± 0.014142136
Mean	0.5725 ± 0.40582221	0.6 ± 0.37148351	

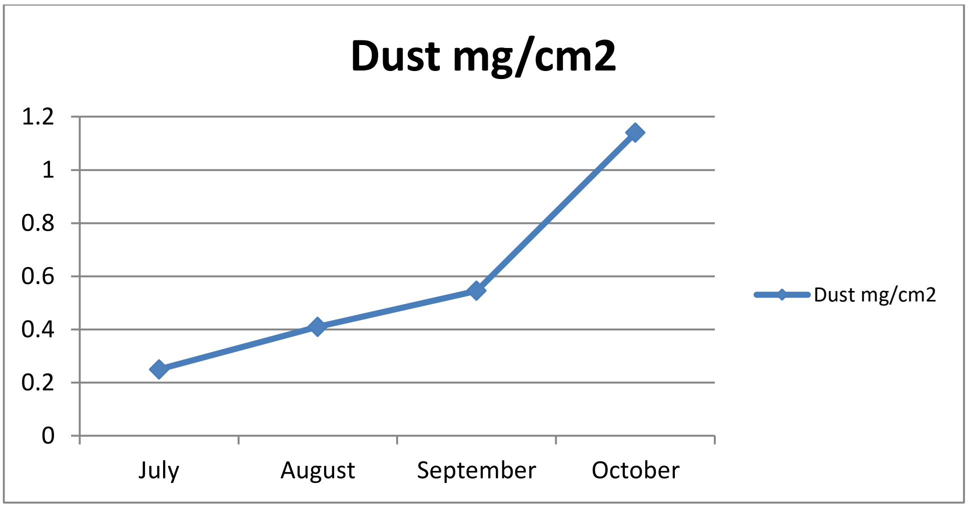


Fig: 2.3 Seasonal variation of Mean dust deposition mg/cm^{2}over the leaves of *Cassia siamea* in rainy

The impact of crushers on vegetation, human beings and on properties like houses is adverse to moderate basing on the operation time, wind velocity and direction, distance from source, and size of the particulates

The impact of dust can be acute or chronic that depends on plant parts. The change in chlorophyll content or that reflects on the phyto biochemistry or production of secondary metabolites which totally reflect on the productivity of the plant. The alternations in the productivity reflect on the decrease of economic and medicinal value of these plants. The selected plants are very useful:

***Calotropis gigantea* L**: popularly called as giant milk weed, swallow wort with great medicinal value with white / lavender flowers. The latex used in Ayurveda contains cardiac glycosides fatty acids and calcium oxalate. Roots also contain calotropine helps in transport of sodium / potassium across cell

membrane. Such a great plant through treated as a weed plant is fall of those medicinal uses. It is greatly affected by dust and the productivity is considerably reduced.
***Cassia siamea* L**: it is commonly called as kassod tree or yellow cassia. Erect perennial shrub with wide ethno botanical used widely used in Ayurveda equally as anti-allergic, anti-fungal, anti-inflammatory, wound healing. This excellent plant also affected at different levels due to dust and reduced productivity.
Estimation of chlorophyll: the chlorophyll estimation was carried out at three levels viz. chlorophyll a, chlorophyll b and total chlorophyll, for all the four plant species.

***CALOTROPISGIGANTEA*L:**

Calotropis gigantea is a wild plant with cosmopolitan distribution known for its latex thick leaves non deciduous plant. The large thick leaves are known for high dust retention .the dust deposited on the leaf surface shows many adverse impacts (Table: 4.7; Fig: 4.7).
The chlorophyll a during the period of study was lowest (9.81 mg/g) in January 2022-23 and highest was 12.65 mg/g. the seasonal variation are also distinct but the chlorophyll content varied from 10.0-12.6 mg/g and was marginal. The accumulation of dust is inversely proportional to the chlorophyll content.
The chlorophyll b varied from minimum of 3.86 mg/g to a highest of 7.21 mg/g and within a year the monthly variation is marginal. The chlorophyll a content was double or more than double in certain months compared to chlorophyll b.
The total chlorophyll was estimated in mg/g and the minimum recorded was 13.67 mg/g in January and maximum was 19.86 mg/g with in the season also the variation was comparatively high. There is a variation of at least 1.0 mg/g during the first and second year of study. Highest of all species total chlorophyll mean was recorded as 16.475 mg/g in *Calotropis gigantea*.

Table: 3 Distribution of chlorophyll a, b, and total chlorophyll content in the leaves of *Calotropis gigantea* during the study period

Month	Chl a	Chl b	Total Chl mg/g 2021-22	Chl a	Chl b	Total Chl mg/g 2022-23
May	12.35	6.99	19.34	11.96	5.26	17.22
June	12.65	7.21	19.86	11.94	6.73	18.67
July	12.04	6.18	18.22	10.91	6.21	17.12
August	12.15	6.06	18.21	11.73	6.31	18.04
September	12.18	6.09	18.27	11.91	6.21	18.12
October	11.73	4.06	15.79	10.91	4.31	15.22
November	10.08	4.11	14.19	10.6	4.20	14.8
December	11.67	4.81	16.48	9.91	4.06	13.97
January	11.77	4.07	15.84	9.81	3.86	13.67
February	11.21	3.99	15.20	10.42	4.32	14.74

March	11.32	4.67	15.99	10.64	4.31	14.95
April	11.67	5.11	16.78	10.52	4.21	14.73
Mean				11.33667 ± 0.815095	5.139167 ± 1.110581	16.47583 ± 1.803863

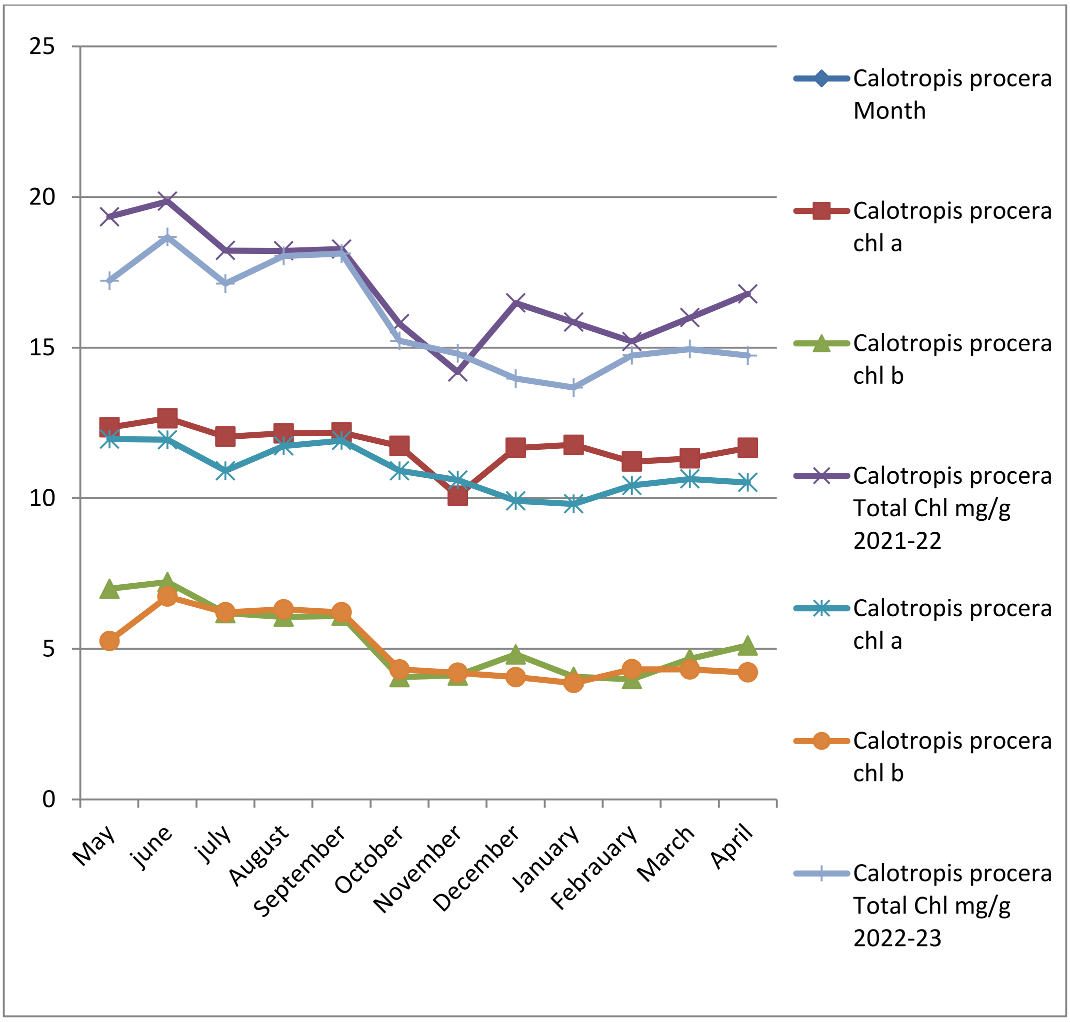


Fig: 3 Distribution of total chlorophyll content mg/g in the leaves during study period.

Distribution of chlorophyll a, chlorophyll b and total chlorophyll content in the *Calotropis gigantea* during winter season.

The total chlorophyll during winter season was higher (16.48 mg/g) in December 2021-22 whereas highest in December followed by by January, February, and November in that order during 2021-22 whereas November, February, December and January in that order in second year of study. However, overall the winter season showed higher chlorophyll content even with higher dust accumulation (Table: 3.1; Fig: 3.1).

Table: 3.1 Total chlorophyll content during winter season in *Calotropis gigantea*

Month	Total Chl mg/g 2021-22	Total Chl mg/g 2022-23	Mean
November	14.19	14.8	14.495 ± 0.43135
December	16.48	13.97	15.225 ± 1.7748
January	15.84	13.67	14.755 ± 1.5344
February	15.20	14.74	14.97 ± 0.325269
Mean	15.4275 ± 0.97657138	14.295 ± 0.56252407	

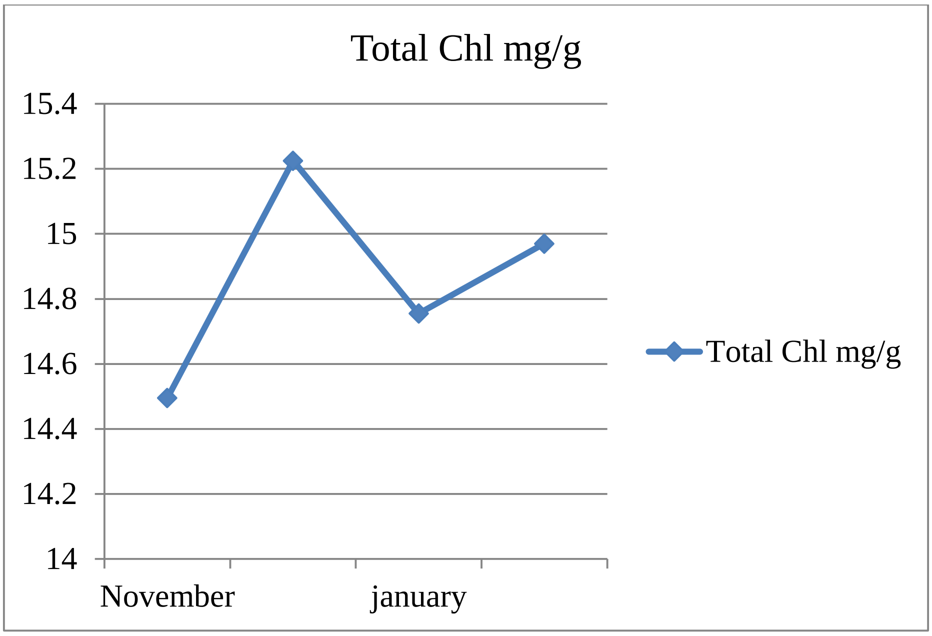


Fig: 3.1 Seasonal variation of Total Chlorophyll content (mg/g) in the leaves of *Calotropis gigantea* in winter

Distribution of chlorophyll a, chlorophyll b and total chlorophyll content in the Calotropis *gigantea* during summer season.

The total chlorophyll gradually increased in the year 2021-22 from march to June, viz 15.99, 16.78 19.34and 19.86 mg/g, respectively in that order with a mean of 17.99 whereas a lower value were recorded in the ascending order except during the month of April (i.e. lowest value 14.73 mg/g) despite turbulence, the chlorophyll contents were higher and the overall during the study period the total chlorophyll content increased from March, April, May and June in that order from 15.47 to 19.26 mg/g.(Table: 4.7.2; Fig: 4.7.2).

Table: 3.2Total chlorophyll content during summer in *Calotropis gigantea*

Month	Total Chl mg/g 2021-22	Total Chl mg/g 2022-23	Mean
March	15.99	14.95	15.47 ± 0.735391
April	16.78	14.73	15.755 ± 1.44956

May	19.34	17.22	18.28 ± 1.499066
June	19.86	18.67	19.265 ± 0.84145
Mean	17.9925 ± 1.8959	16.3925 ± 1.89001543	

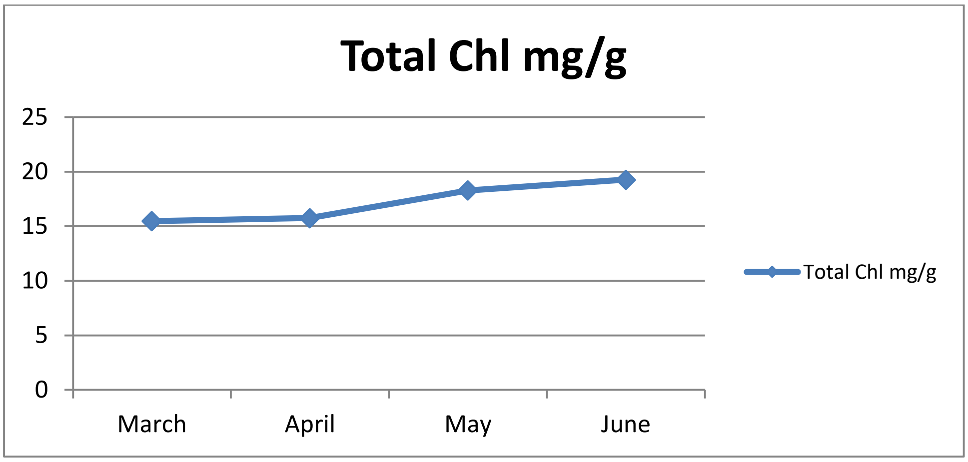


Fig: 3.2 Seasonal variation of Total Chlorophyll content (mg/g) in the leaves of *Calotropis gigantea* in summer

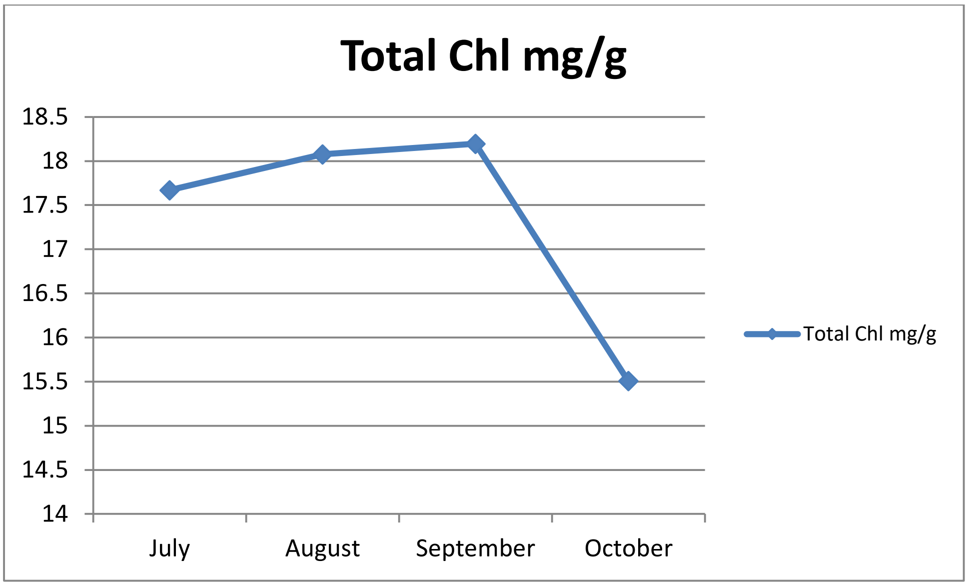
Distribution of chlorophyll a, chlorophyll b and total chlorophyll content in the Calotropis *gigantea* during rainy season.

The total chlorophyll in rainy season was higher from July to September and decreased in October with a similar trend during both the years while the total chlorophyll content was marginally less during 2022-23. The mean total chlorophyll was 17.597 and 17.125 mg/g during the study period (Table: 3.3; Fig: 3.3).

Table: 3.3 Total chlorophyll content during rainy season in *Calotropis gigante*

Month	Total Chl mg/g 2021-22	Total Chl mg/g 2022-23	Mean
July	18.22	17.12	17.67 ± 0.777817
August	18.11	18.04	18.075 ± 0.049497
September	18.27	18.12	18.195 ± 0.106066
October	15.79	15.22	15.505 ± 0.403051
Mean	17.5975 ± 1.206851966	17.125 ± 1.34861657	

Fig: 3.3 Seasonal variation of Total Chlorophyll content (mg/g) in the leaves of *Calotropis gigantea* in rainy



***CASSIASIAMEA*L:**

The chlorophyll a, chlorophyll b and the total chlorophyll were estimated monthly mg/g during the study period. The chlorophyll a content has ranged between a minimum of 2.11 mg/g in October 2021-22 and maximum of 3.063 mg/g in September 2022-23. The overall range between minimum and maximum was 2.11 and 3.063 mg/g with the difference of 0.953 mg/g. The chlorophyll b also varied narrowly with a minimum of 0.125 mg/g in December 2021-22 to 1.218 mg/g in September 2022-23 with a difference of 1.093 mg/g. there has been no significant difference during the two years of study the total chlorophyll mg/g ranged between 3.222 mg/g in October 2021-22 and the maximum value recorded was 4.281 mg/g in September 2022-23.the net difference was 1.059 mg/g (Table: 4; Fig: 4).

Table: 4 Distribution of chlorophyll a, b, and total chlorophyll content in the leaves of*Cassia siamea* during the study period.

Month	Chl a	Chl b	Total Chl mg/g 2021-22	Chl a	Chl b	Total Chl mg/g 2022-23
May	2.29	1.165	3.455	2.29	1.168	3.458
June	3.01	1.175	4.185	3.019	1.179	4.198
July	3.025	1.19	4.215	3.03	1.199	4.229
August	3.04	1.201	4.241	3.048	1.209	4.257
September	3.052	1.21	4.262	3.063	1.218	4.281
October	2.11	1.112	3.222	2.116	1.119	3.235
November	2.22	1.12	3.340	2.227	1.128	3.355
December	2.235	0.125	2.360	2.238	1.135	3.373
January	2.25	0.145	2.395	2.255	1.147	3.402

February	2.255	1.151	3.406	2.262	1.159	3.421
March	2.267	1.155	3.422	2.272	1.65	3.922
April	2.271	1.160	3.431	2.285	1.172	3.457
Mean				2.505417 ± 0.385754	1.099667 ± 0.321178	3.605083 ± 0.551557

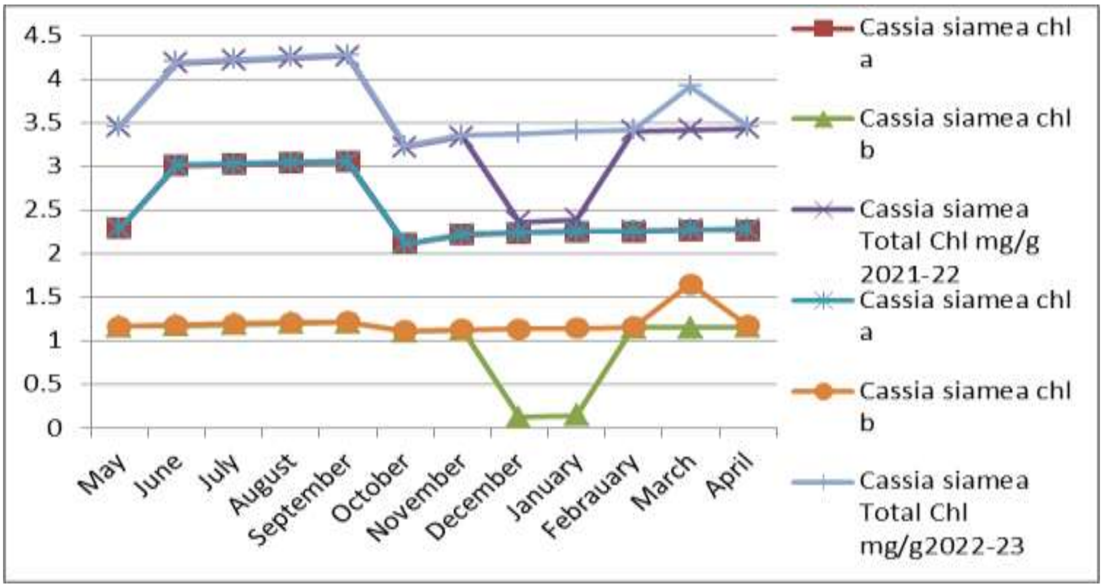


Fig: 4 Distribution of total chlorophyll content mg/g in the leaves during study period.

Distribution of chlorophyll a, chlorophyll b and total chlorophyll content in the *Cassia siamea* during winter season.

The total chlorophyll content in the cassia siamea during winter varied slightly between a minimum of 2.360 mg/g in December 2021-2022 and 3.406 mg/g in February 2022-23 while, during 2022-23 varied narrowly 3.355 and 3.421 mg/g during November and February respectively. The small leaves reflect the low quantities of total chlorophyll. February month showed almost equal quantities of total chlorophyll. This marked a change of season or closure of winters during both the years of study (Table: 4.1; Fig: 4.1).

Table: 4.1 Total chlorophyll content during winter season in *Cassia siamea*.

Month	Total Chl mg/g 2021-22	Total Chl mg/g 2022-23	Mean
November	3.340	3.355	3.348 ± 0.010607
December	2.360	3.373	2.867 ± 0.716299
January	2.395	3.402	2.8985 ± 0.712057
February	3.406	3.421	3.4135 ± 0.010607
Mean	2.875 ± 0.575560813	3.38775 ± 0.029432	

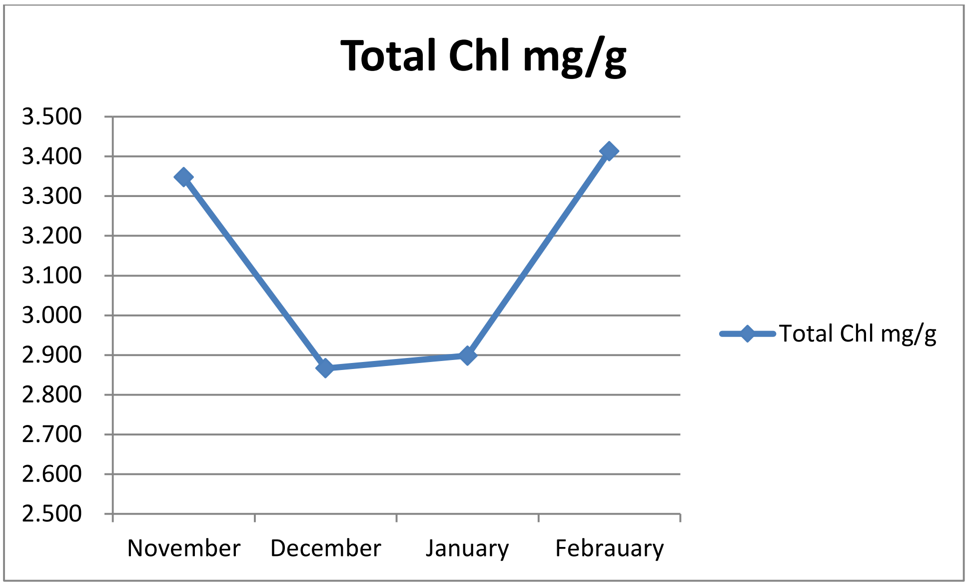


Fig: 4.1 Seasonal variation of Total Chlorophyll (mg/g) in leaves of Cassia *siamea* in winter

Distribution of chlorophyll a, chlorophyll b and total chlorophyll content in the *Cassia siamea* during summer season.

During summer season both the years of study the total chlorophyll production showed very narrow margins with the mean values of 3.623 and 3.758 mg/g during 2021-22 and 2022-23, respectively. The last month of summer June, this marks the beginning of rainy season. The total difference between the minimum values of total chlorophyll was 3.422 mg/g and the maximum value of 4.198 mg/g (Table: 4.2; Fig: 4.2).

Table: 4.2 Total chlorophyll content during summer in *Cassia siamea*

Month	Total Chl mg/g 2021-22	Total Chl mg/g 2022-23	Mean
March	3.422	3.922	3.5886 ± 0.353553
April	3.431	3.457	3.4396 ± 0.018385
May	3.455	3.458	3.456 ± 0.002121
June	4.185	4.198	4.1893 ± 0.009192
Mean	3.62325 ± 0.374758923	3.75875 ± 0.365648	

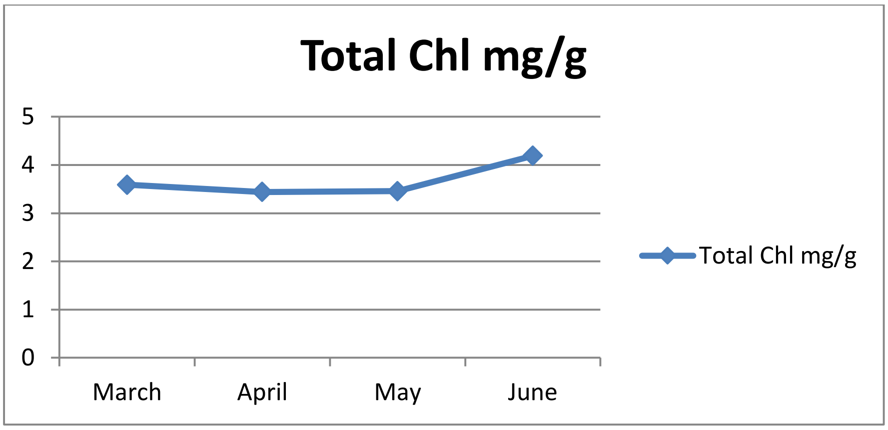


Fig: 4.2 Seasonal variation of Total Chlorophyll content (mg/g) in leaves of *Cassia siamea* in summer

Distribution of chlorophyll a, chlorophyll b and total chlorophyll content in the *Cassia siamea* during rainy season

The rainy seasons marks moderate temperatures and increased RH reflecting pleasant climate with increased total chlorophyll content production .however during the first year of study the rainy season has shown minimal increase of chlorophyll production while during second year of study there was considerable increase of production of total chlorophyll 7.97 ± 1.001 this might be due to the production of large rain fall compared to previous year (Table: 4.3; Fig: 4.3).

Table: 4.3 Total chlorophyll content during rainy season in *Cassia siamea*

Month	Total Chl mg/g 2021-22	Total Chl mg/g 2022-23	Mean
July	4.215	8.43	6.3225 ± 2.980455
August	4.241	8.482	6.3615 ± 2.99884
September	4.262	8.524	6.393 ± 3.013689
October	3.222	6.444	4.833 ± 2.278298
Mean	3.985 ± 0.509029796	7.97 ± 1.01806	

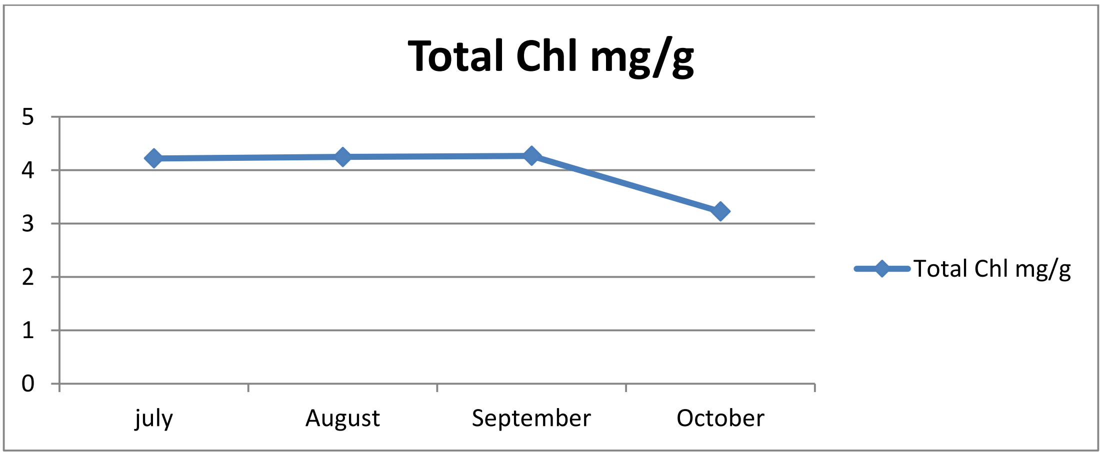


Fig:4.3 Seasonal variation of Total Chlorophyll content (mg/g) in leaves of *Cassia siamea* in rainy

SUMMERY& CONCLUSION:

The unstinted expansion of RCC culture has increased the stone crushing activity that paved the way to disturb the hillocks. Stone crushing machinery has brought in several environmental problems such as: dust rising, decrease of plant/ crop productivity, physiological imbalances in plants and animals and so on. The secondary metabolites production is intercepted by accumulation of dust on the leaves and plant parts. Plant photosynthetic ability was hampered in many ways. Many researchers have studied the effects of dust both short term and long term.

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