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COMPARING STUDY OF MARBLE DUST FALL AND EXAMINE CHLOROPHYLL CONTENT IN VARIOUS SEASONS ON VEGETATION OF DANTA TALUKA

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ABSTRACT:

The paper describes the effect of marble dust on plants in and around areas Danta, Dist Banaskantha. Trees species growing in and around areas of Danta were selected and various morphological characteristics were studied such as Measurement of Dust fall (mg/cm^2), Average Dust capturing efficiency and Chlorophyll content and their comparative account in various seasons. In the study the effects of marble dust on selected tree species was observed.

KEY WORD: *Dust fall, Average dust, Plant species.*

INTRODUCTION:

In the context of environmental pollution abatement, greenbelt has been defined as mass plantation of pollutant-tolerant trees for mitigating the air pollution by filtering, intercepting and absorbing pollutants in a sustainable manner (Gareth et al., 1992; Andy, 1991; Ruth and William, 1994; Sharma and Roy, 1997). Particulate Matter produced during the marble crushing is usually of relatively large size. The chemical composition of the dust tends to be homogenous mixture of oxides of calcium, potassium, aluminum, silica and sodium, which settles into a head mass when it comes in contact with water (Raina et al., 2008). In short, dust pollution affects not only human health but also ecological health of a region (Okita et al., 1996; Pandey et al., 2002, 2004; Srivastava, 2004; Srivasatava et al., 2005). Stone crusher dust, is extremely harmful to human health as well as surrounding vegetation. The dust impairs visibility the particulate

dust falling on leaves may cause foliar injuries, reduction in yield, change in photosynthesis and transpiration etc. (Raina et al. , 2008). Several studies conducted under field condition have revealed that when these particulate matters are deposited on vegetation, the plant growth is adversely effected (Chatter 1991;Rao).Monitoring of the effect of dust particles on vegetation is very important Dust emission occurs from many operations in the marble industries viz., cutting, buffing, polishing, tile making, loading and transportation therefore it was necessary to study the effect of dust on vegetation around mining areas of Danta taluka and various sites like Jarivav, Chikhla, Jetwas, Kumbhariya, koteshwar.

MATERIALS AND METHOD:

Fresh leaves of plants *Butea monosperma*, *Mucuna pruruiens*, *Boswellia serrata, Azadirachta indica, sterculia urens, Tinospora cardifolia* were collected in various season at different six sites Jarivav, Chikhla, Jetwas, Kumbhariya, koteshwar and control(Agriculrure botanical garden) of Danta taluka.

A: Measurement of dust falls on the leaves

From each plant, ten matured leaves were collected in the separate polythene bags during winter, summer and rainy from November 2009 to October 2010. Leaves were collected at the height of three to four meters from all the sites. For dust fall measurement, the method of Dry technique described by Das and Pattanayak (1997) was followed. In this technique first the intact leaf was weighted (in mg) then dust particulates from leaf surfaces were gently collected with the help of camel hair brushes and the weight of leaf was measured again. The amount of dust - deposition in mg/cm2 was calculated as:-

$$\text{Dust content } (mg/cm^2) = \frac{\text{Weight of intact leaf- initial weight of leafs}}{\text{Total surface area of leaf } (cm^2)}$$

B: Measurement of chlorophyll pigments

The chlorophyll pigments in the leaves were estimated following the method of Arnon (1949). The fully expanded leaves from all the sites were collected in the poly-thene bags and transported to the laboratory. The leaves were washed out thoroughly with distilled water. Three replicates were used for each plant. 51Weighted fresh leaf material was homogenized and extracted thrice in chilled 80% acetone (v/v). The volume of the acetone extract was made up to a known one and the optical density was read at 645nm and 663nm wavelengths

on a spectrophotometer. The concentration of the chlorophyll pigments was calculated using the following formula and the results are expressed in mg/g fresh weight.

Chlorophyll a = [(12.7 X OD at 663) - (2.69 X OD at 645)] X dilution factor
Chlorophyll b = [(22.9 X OD at 645) - (4.68 X OD at 663)] X dilution factor
Total chlorophyll = [(20.2 X OD at 645) - (8.02 X OD at 663)] X dilution.

RESULT AND DISCUSSION:

Dust fall:

Fig1.1 *B. monosprma*

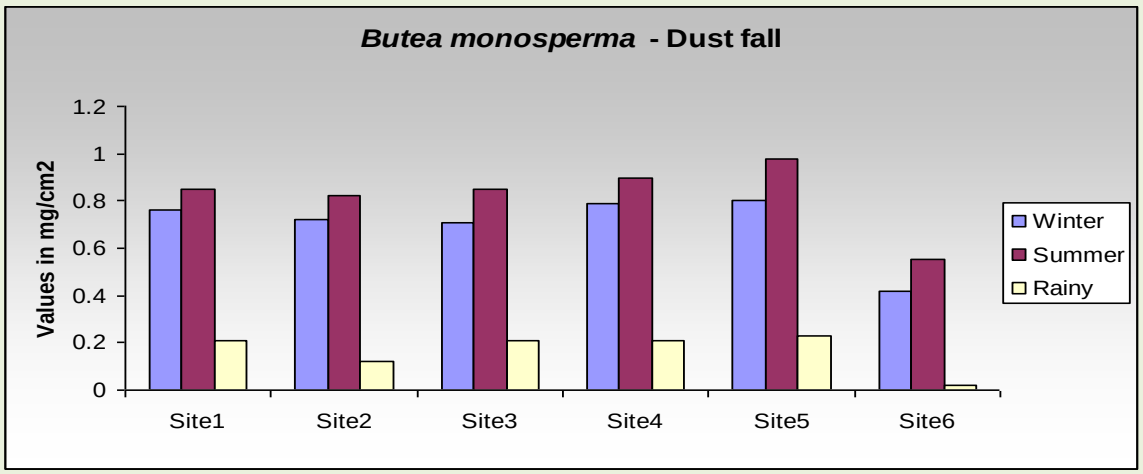


Fig 1.2 *M.pruriens*

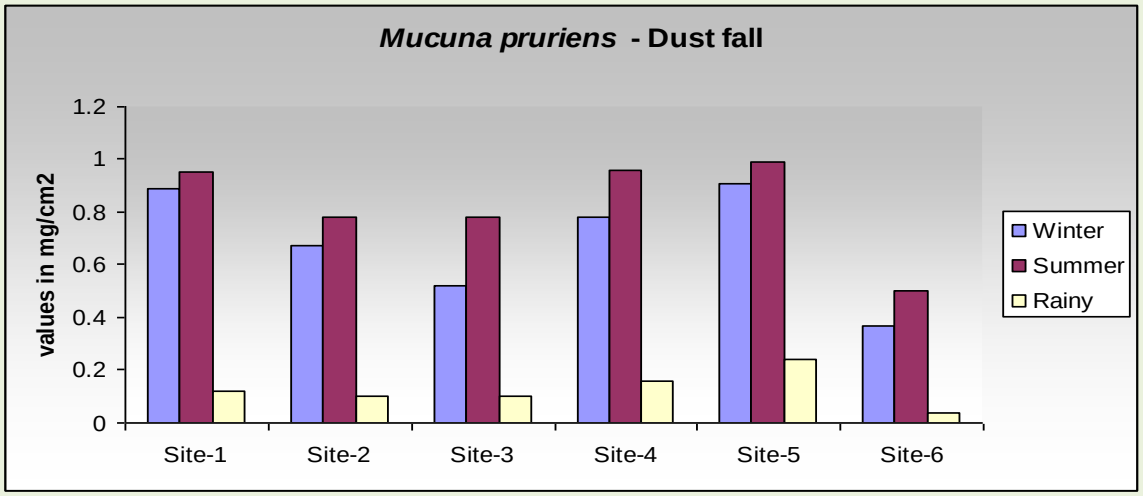


Fig: 1.3 *B.serrata*

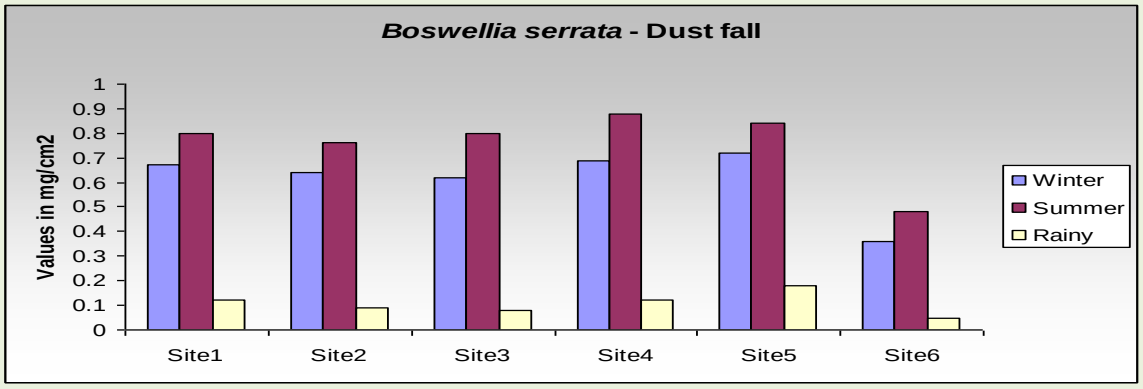


Fig: 1.4 *A.indica*

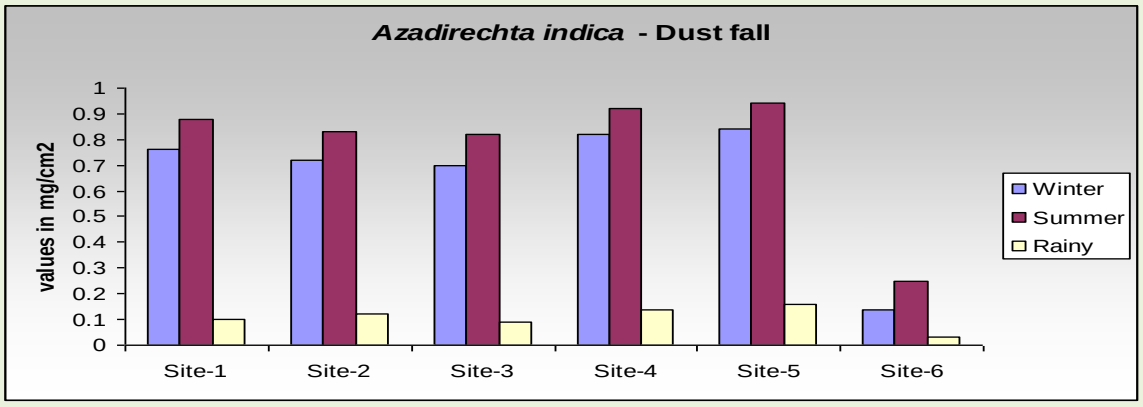


Fig 1.5 *S.urens*

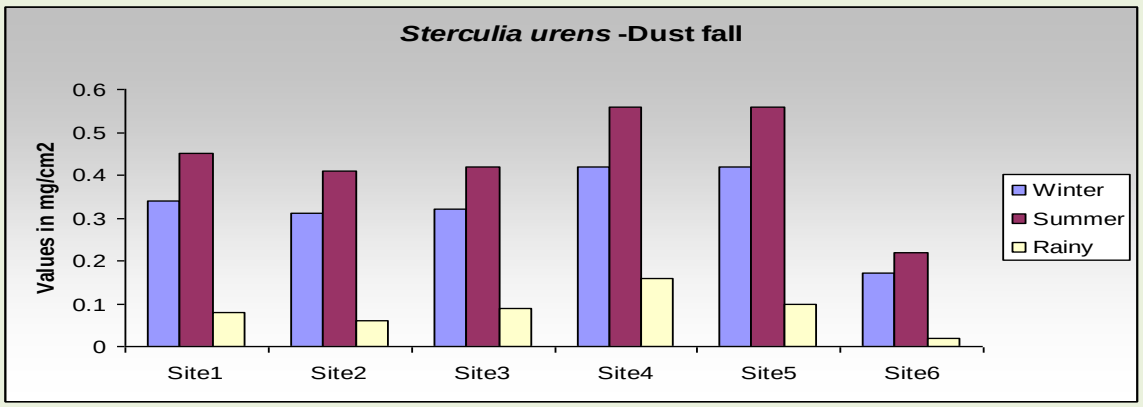
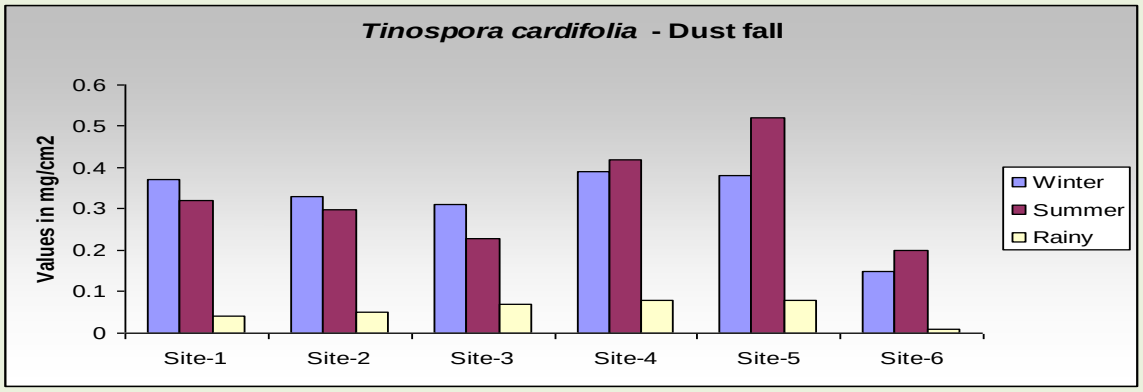
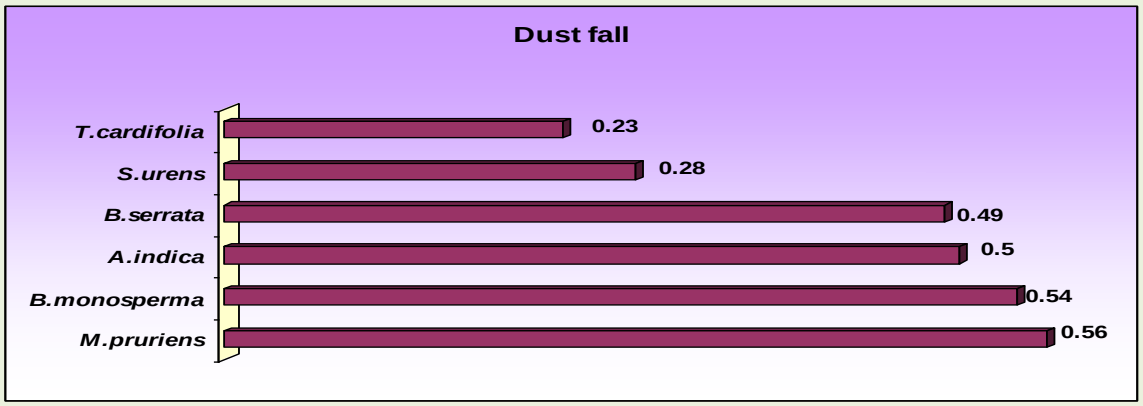


Fig 1.6 *T.cardifolia*

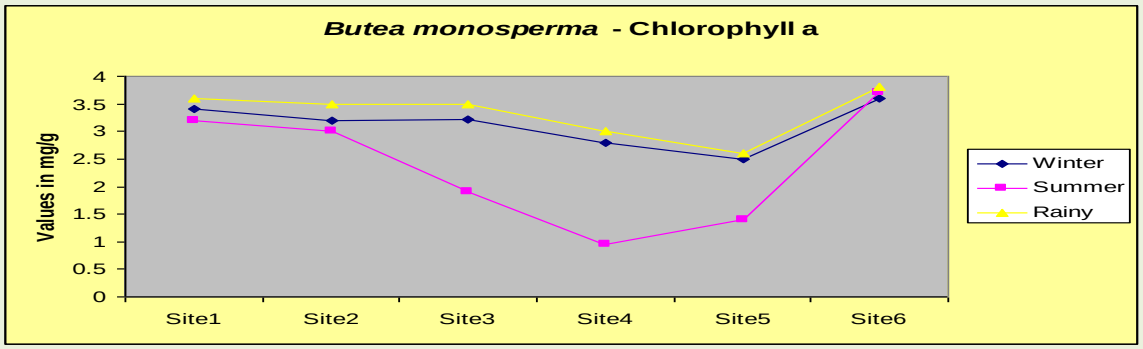


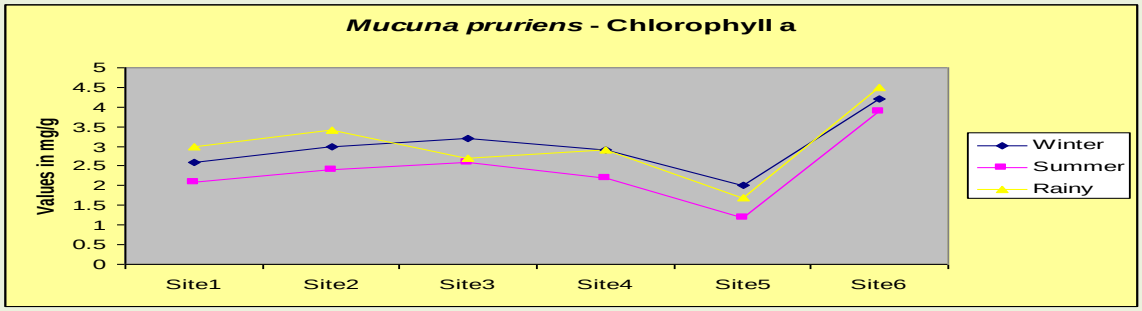
Site1 Jarivav , Site2 Chikhla, Site3 Jetwas, Site4 Kumbhariya, Site5 Koteshwar, Site6 Control

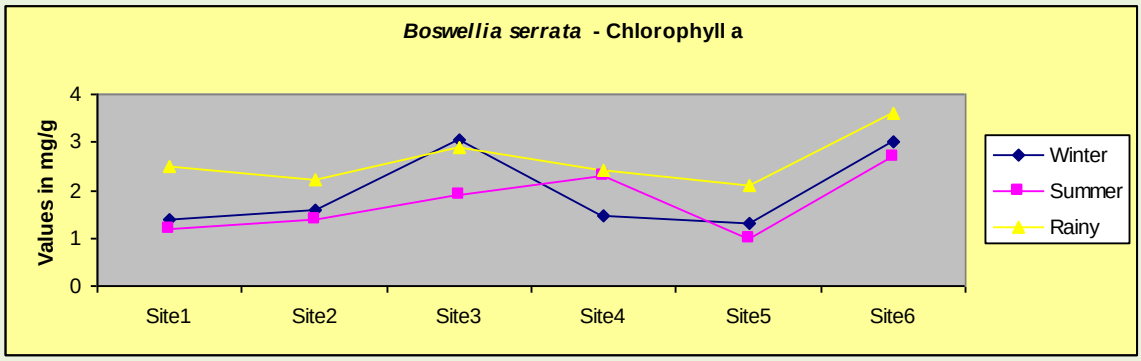
Fig 1.7 Average dust capturing capacity in mg/cm^2

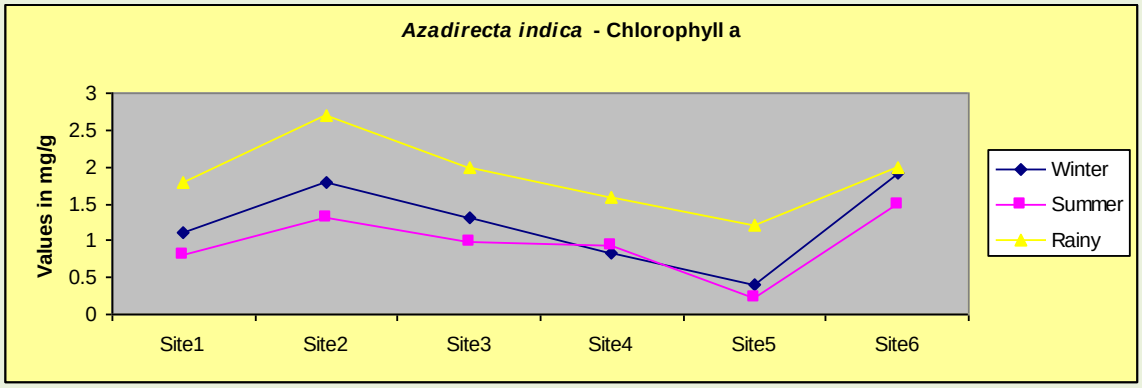


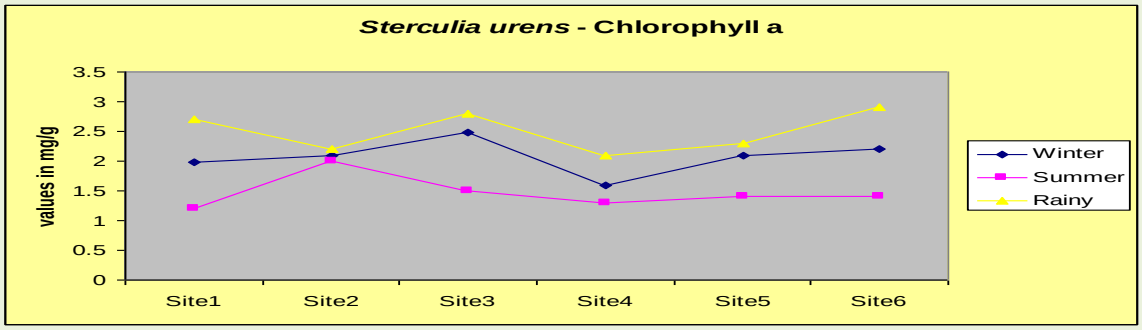
2) Chlorophyll content: Chlorophyll a:

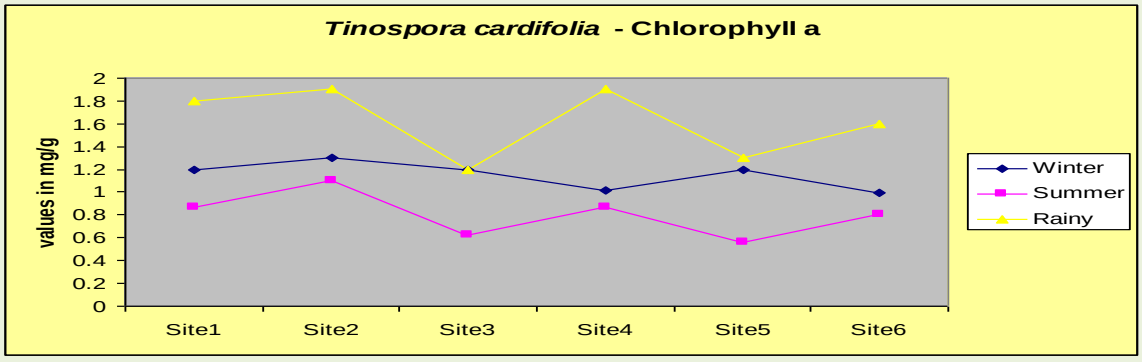



Mucuna pruriens - Chlorophyll a
Values in mg/g
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Site1
Site2
Site3
Site4
Site5
Site6
Winter
Summer
Rainy

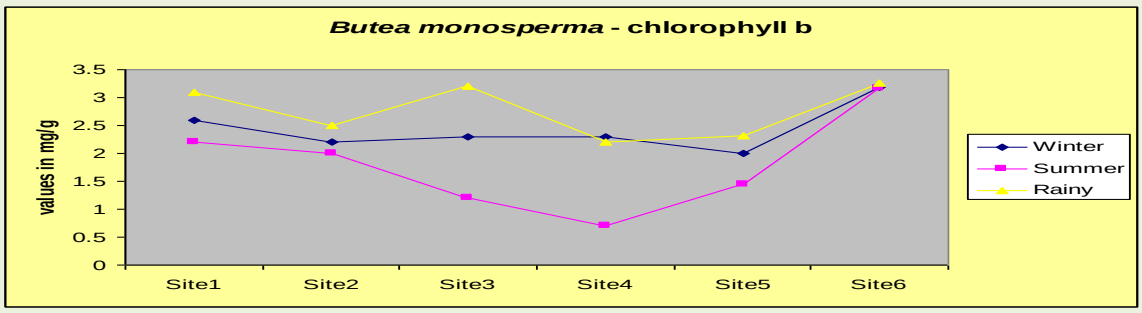

Boswellia serrata - Chlorophyll a
Values in mg/g
4
3
2
1
0
Site1
Site2
Site3
Site4
Site5
Site6
Winter
Summer
Rainy

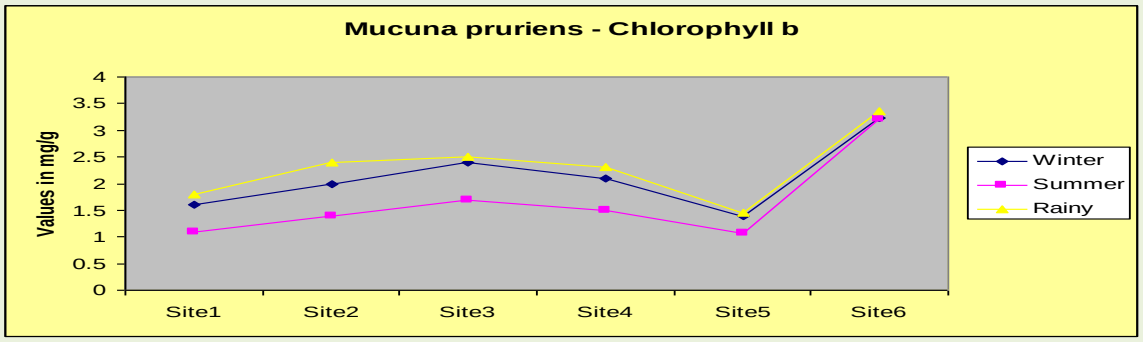

Azadirecta indica - Chlorophyll a
Values in mg/g
3
2.5
2
1.5
1
0.5
0
Site1
Site2
Site3
Site4
Site5
Site6
Winter
Summer
Rainy

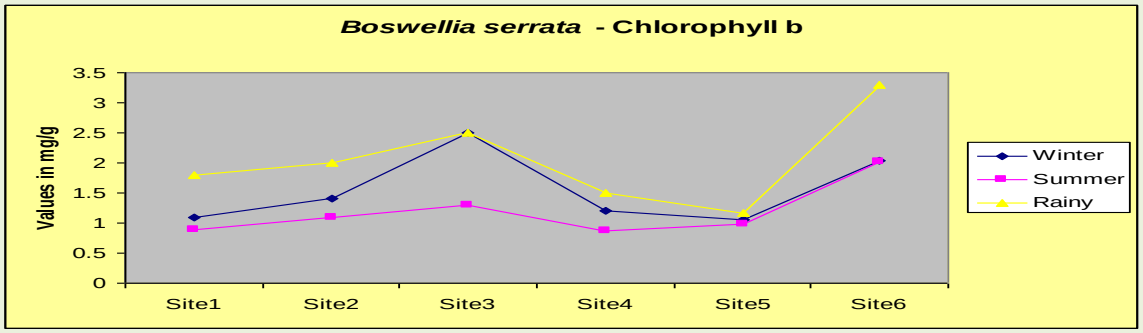

Sterculia urens - Chlorophyll a
values in mg/g
3.5
3
2.5
2
1.5
1
0.5
0
Site1
Site2
Site3
Site4
Site5
Site6
Winter
Summer
Rainy

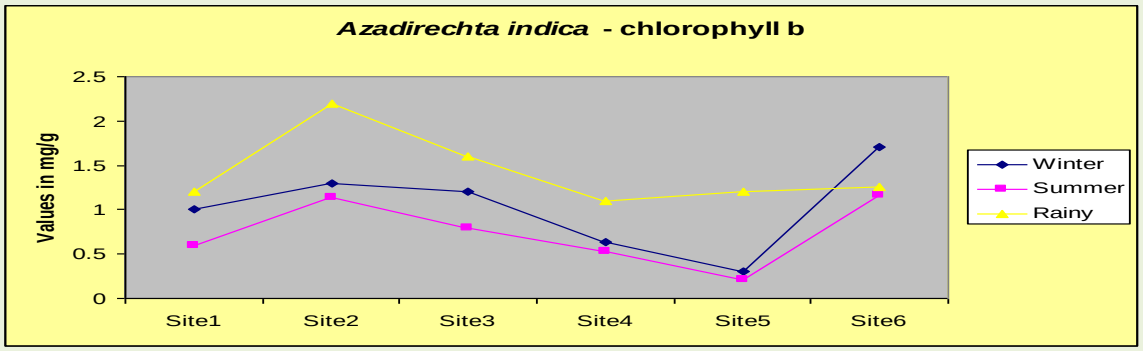

Tinospora cardifolia - Chlorophyll a
values in mg/g
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Site1
Site2
Site3
Site4
Site5
Site6
Winter
Summer
Rainy

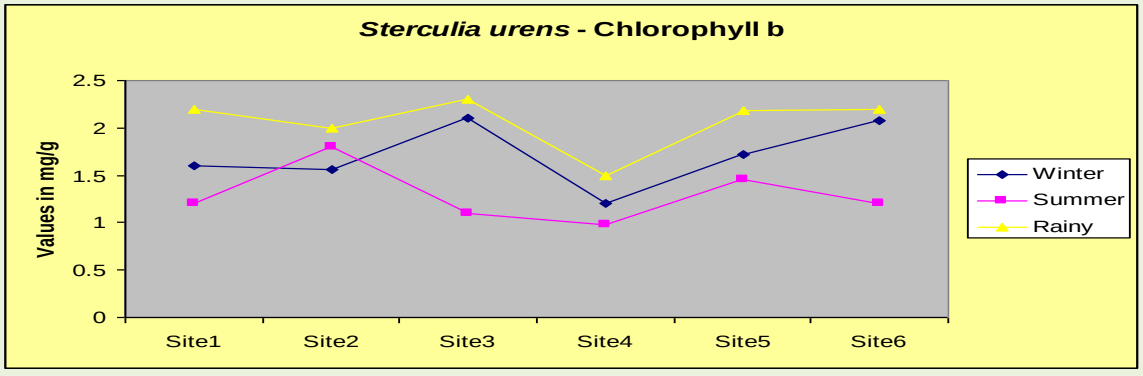
2.2) chlorophyll b

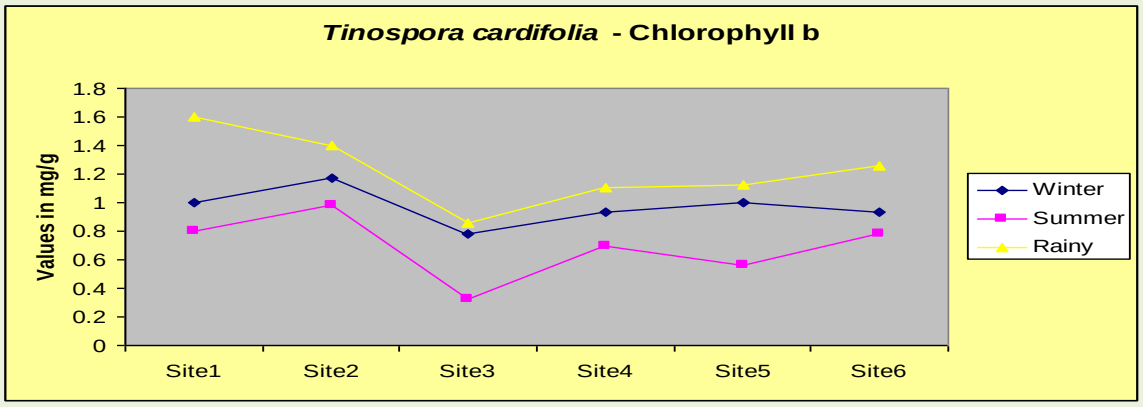




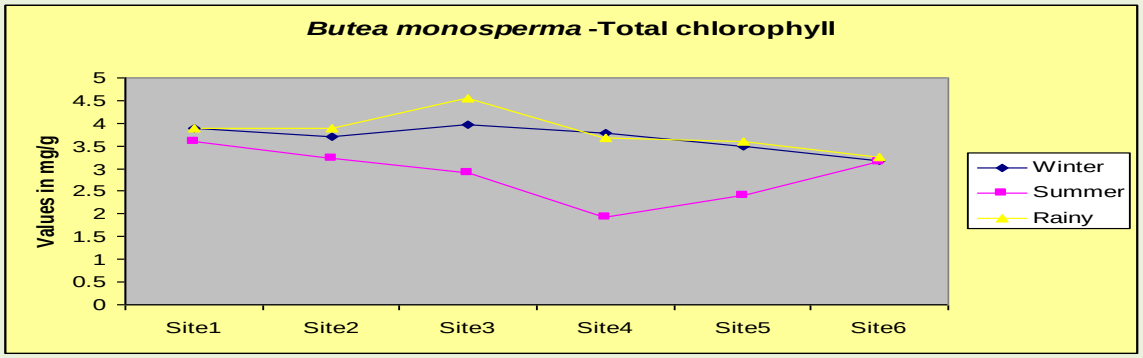


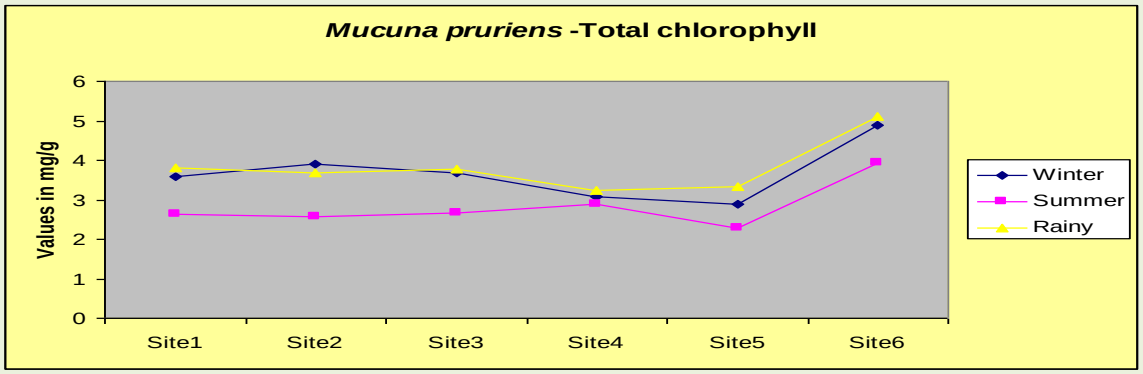


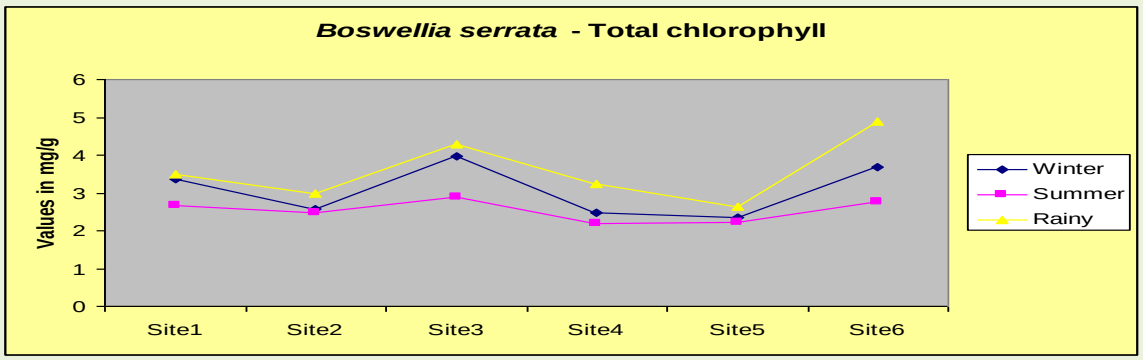


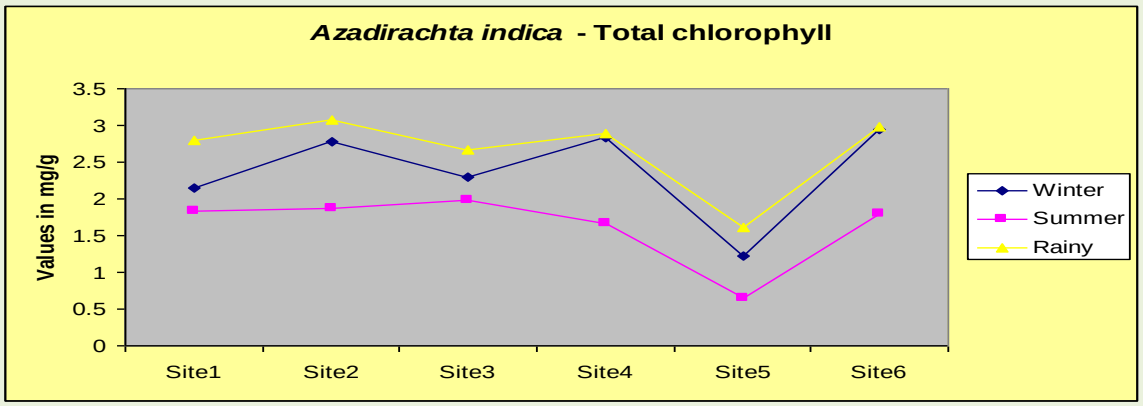


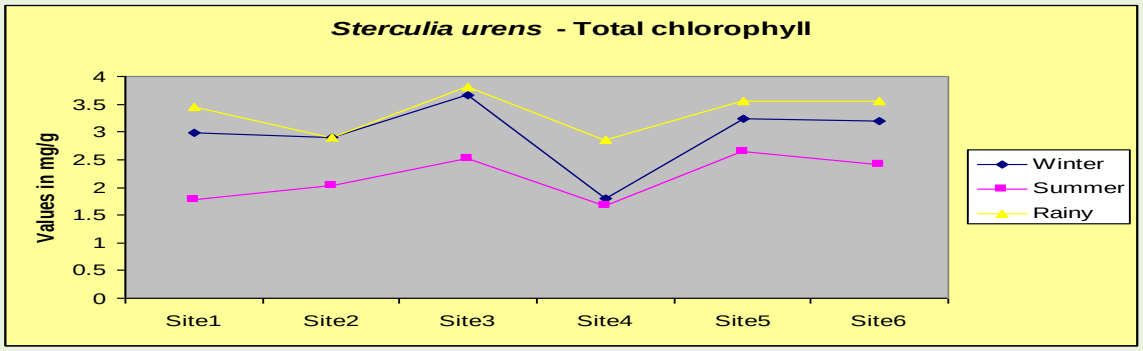
2.3) Total chlorophyll

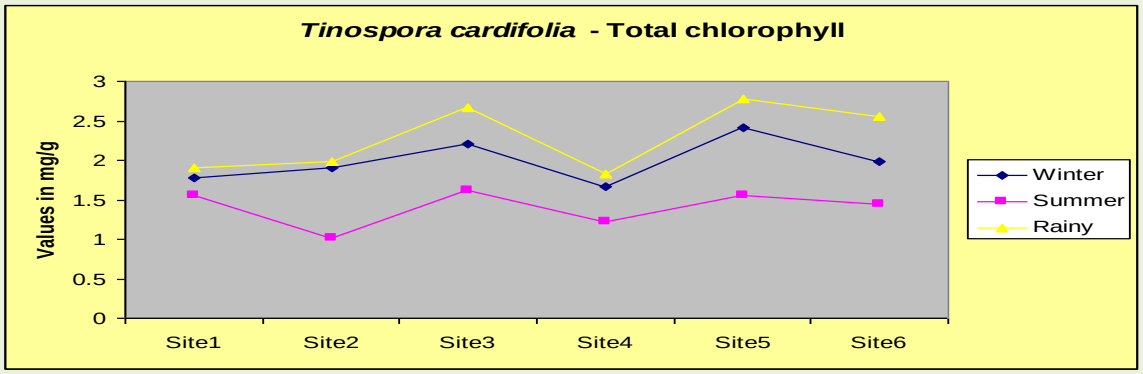












Dust fall:

According to Bernatzky (1974) urban air usually contains significant amounts of dust. Different reasons were given by different researchers for the dust holding capacity of plants. Dust interception and retention depends upon leaf orientation, age, roughness and wet ability of the leaf surface (Neinhuis and Barthlott 1998; Beckett et al. 2000). It also depends on the strength and constancy of wind, the porosity of the vegetation with respect to air movement and the amount and intensity of rain according to Raupach et al. (2001). The deposition of gaseous pollutants and particulate matter and their interception are greater in woodlands than in shorter vegetation (Fowler et al., 1989; Bunzl et al., 1989). It has been established that leaves and exposed parts of a plant generally act as persistent absorbers in a polluted environment (Samal and Santra, 2002).

Removal of pollutants by plants from air is by three means, namely absorption by the leaves, deposition of particulates and aerosols over leaf surfaces, and fallout of particulates on the

leeward side of the vegetation because of the slowing of the air movement (Tewari, 1994; Rawat and Banerjee, 1996). Leaf petioles are more efficient particulate impactors than either twigs (stems) or leaf lamina(Ingold,1971).With all these morphological characterisposition/location of tree also plays an important role. If the tree is nearer road chance of getting more dust increases M.pruriens showed maximum dust trapping efficiency among all the plants which may be due to its habitat and morphological characters. It is an evergreen plant with big and horizontally arranged leaves. It has rough leaf surface due to the presence of hairs, vein is thick, large and many on the lower surface all these characters help dust to adhere more on leaves. Ahmed and Yunus, (1981) reported that larger and more vein lets are the main characters of a leaf which help for dust collection. Once the dust particles settled down there are less chance to rid of as it has small petiole, which reduces the movement of leaf. Anatomical features of leaves also play an important role of high dust capturing capacity. *M.pruriens* is having hairy presence which helps in condensation of water vapors taking place during transpiration process. This helps in maintaining moisture condition on leaf surface and increases the capturing of dust by these plants.

Chlorophyll content:

The photosynthetic pigments are the most liable to be damaged by auto-pollution. Chlorophyll is said to be an index of productivity, hence any alteration in chlorophyll concentration may change the morphological, physiological and biochemical behavior of the plant. From the analysis of the results of chlorophyll pigments, a considerable reduction was found at all the polluted sites compared to the control site during the entire study period. Maximum concentration of chlorophyll pigments was found at site-6 (control) in all the plants except in Tinospora cardifolia in which chlorophyll a was found maximum at site-1 (Jarivav).The highest reduction was observer at site - 4 &5 (Kumbhariya & Koteshwar) which may be due to its an industrial region with high traffic intensity also as mentioned in chapter - 1 that maximum air pollutants comes from the industry. No significant difference was found site-6(control) as it is a low polluted site.

Bhatnagar et al., (1985) concluded that less chlorophyll in leaves of plants growing in polluted area was due to toxic effect of industrial dust and other gaseous pollutants on leaf.Thereduction in chlorophyll concentration in the polluted leaves could be due to chloroplast damage (Pandey et al., 1991), inhibition of chlorophyll biosynthesis (Esmat 1993) or enhanced chlorophyll degradation. Prusty et al., (2005) had also described that photosynthetic pigments are the most likely to be damaged by air pollution. Chlorophyll a is

assumed to be degraded to phaeophytin, whereas chlorophyll b molecule loses its phytol group (Rao and Le Blanc 1966).

Less chlorophyll contents in the leaves of all the plants growing at the cross-roads of polluted region may be due to long term exposure of these plants to pollutants like SO2, NO2, and SPM. The synergistic effects of these pollutants caused foliar injury i.e. chlorosis and necrosis, which degrade the chlorophyll pigments. The same view has been reported by Rao and LeBlack (1966), Puckett et al., (1973) and Mahlotra(1976). The shading effects due to deposition of suspended particulate matter on the leaf surface might be responsible for this decrease in the concentration of chlorophyll in polluted area.

It might clog the stomata thus interfering with the gaseous exchange, which leads to increase in leaf temperature which may consequently retard chlorophyll synthesis. Dusted or encrusted leaf surface is responsible for reduced photosynthesis and thereby causing reduction in chlorophyll content (Joshi and Swami, 2009).

Air pollution-induced degradation in photosynthetic pigments was also observed by a number of workers (Bansal 1988; Singh et al., 1990; Sandelius et al., 1995). Chlorophyll pigments exist in highly organized state, and under air pollution stress they may undergo several photochemical reactions such as oxidation, reduction, pheophytinisation and reversible bleaching (Puckett et al., 1973). Photosynthetic pigment is very sensitive to the pollutants like SO2. Comparatively, polluted area has high SO2 concentration which may affect the chlorophyll pigments. SO2 enters in the mesophyll tissues and reacts with water to produce the sulphite ion which has strong phytotoxic properties, Taylor (1973). As nitrogen dioxide is soluble in water, oxides of nitrogen come in contact with water, both nitrous and nitric acids are formed, Jolly (1964). These toxic reactions may also be responsible to alter the concentration of photosynthetic pigments. Prasad (1980) reported a decrease of chlorophyll contents due to the effects of SO2, and NO2.

Reduction in the total chlorophyll content may be attributed to the heavy vehicular traffic (especially due to diesel driven four wheelers) that are responsible for the release of huge quantities SOx in particular and other pollutants as diesel contains four times more sulphur than petrol. This reduction may be due to the SO2 induced activity resulting in the removal of Mg++ ions, which converts it into Phaeophytin. It modifies the light spectrum characteristics as reported by Malhotra (1977). While as another study by Zeigler (1977) suggested that the reduction in the chlorophyll content is caused by toxic ions formed by the dissolution of SO2 in water inside the leaf tissue, which preferentially incorporates into the thylakoid membrane.

Reduction in the chlorophyll content of plants exposed to air pollution enriched by SO2 has also been reported by many workers (Pawar and Dubey, 1982; 97 Boralkar and Shinde, 1983;Darrall and Jager, 1984; Ayer and Bedi, 1986; Kumawat and Dubey, 1988; Panigrahi et al., 1992: Pandey and Rao, 1977; Varshney and Varshney, 1979; Singh and Rao, 1980a; Agrawal, 1982 and Agrawal et al., 1982, 1983a).

Photosynthetic pigments are fairly sensitive to air pollutants and their sensitivity may determine the responses of plants to pollutants. According to Katiyar and Dubey (2001) chlorophyll content of plants varies from species to species, age of the leaf and also with the pollution level as well as with other biotic and a biotic conditions.

In the present study also different amount of chlorophyll content was observe in different plant species present at the same site. It has been found that maximum total chlorophyll was obtained in *Mucuna pruriens* (5.10mg/g) and minimum in *Tinospora cardifolia* (1.02mg/g).Chlorophyll a was maximum in *Mucuna pruriens* (4.5mg/g) and minimum in *Tinospora cardifolia*, while chlorophyll b in *Mucuna pruriens* (3.36mg/g) and minimum in *Azadiracta indica* (0.53mg/g).

It may be because of the age of the leaf, period of senescence, sensitivity of the plant species, biotic and abiotic condition and position of plant at the cross - roads. Mir et al.,2008 suggest that high levels of automobile pollution decreases chlorophyll content in higher plants near roadsides.

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