IJRD International Journal of Research & Development Organisation

ISSN: 2455-7676

Journal of Biological Science

Effect of stone crusher dust pollution on Wheat *(Triticum sp.)* crop

Sadhana Chaurasia* and Raj Karan**

*Head, Dept.of Energy & Environment, MGCGV, Chitrakoot, Satna MP.485331, sadhanamgcgv@gmail.com

**Research Scholar, Dept. of Energy & Env. MGCGV, Chitrakoot, Satna M.P. 485331

surya.raj80@gmail.com

Abstract: *This study was aimed to know the effect of stone crushers dust pollutant Viz. PM_{10} and $PM_{2.5}$ on morphological as well as yield characteristics of wheat (Triticum sp.) plant growing at different distance from the stone crusher industry at Kabrai, Mahoba, U.P. India. The wheat plant near the industry showed deterioration in morphological characteristics. The study indicated that parameters reduction in wheat correlated directly with particulate pollutant which leads to lower yield at more polluted site. It was observed that wheat plant near the stone crushers industry having morphological reduction in growth and yield and as the distance from stone crushers industry increases growth and yield also increase. Over all study shows that control plants were healthier in term of morphological and yield parameter. It was found that wheat plant growing near the stone crusher industry was adversely affected. The areas around the stone crusher are constantly polluted by dust that spread in the atmosphere, thus causing damages to the environment and the resident's lives nearby. So it is clear that the stone crushers dust pollution is an operative ecological factor causing deterioration in the quality of our environment.*

Keywords: Air pollutant, Chlorophyll, Ascorbic acid, APTI and Yield.

INTRODUCTION

Stone crushers are small-scale industry in the unorganized sector. The ideal location for crusher is supposed to be near growing towns or cities so as to supply the demand for the stone and at the same time near the source to the stone to be crushed.

The dust produced during processing tends to float in air and spread all around the stone crusher. The fine dust could be dangerous to health of vegetation. Humidity has a strong effect on the spreading of dust. The severity of air pollution, depend on the local microclimatic conditions, the concentration of dust particles in ambient air, the size of the dust particles and their chemistry. The stone crusher dust is not only a nuisance (in terms of deposition on surfaces) and possible effects on health of surrounding vegetation, such as blocking and damaging their internal structures and abrasion of leaves and cuticles, as well as chemical effects which may affect long-term survival (Singh & Rao , 1983).

Today the cry of "Environmental Pollution" is heard from all corners of the world. Pollution has now become a distinct threat to the very existence of humankind on this earth. It is now a major challenge of our times. From centuries man has been disturbing the balance of nature for comfort, wealth and ego but now nature has started disturbing the balance of nature. Stone crusher's dust caused environmental pollution problems, and the pollutants of the stone dust produced the undesirable impact on air water and land. Dust pollution being among the various challenges. While dust pollution has always been a naturally occurring phenomenon since the beginning of time, the fast-paced economic activities have seen dust levels rise to sometimes-unacceptable levels. The effect of dust pollution is not only limited to work exposure as dust escapes into the vegetation, atmosphere where weather conditions assist in its movements. Dust deposited on the ground may cause changes to soil properties and affect plant life (Leghari and Zaidi, 2013).

On the physiological and morphological point of view, the plants from polluted sites present important changes especially regarding their color, shape, leaf length, plants size petiole length.. Leaf is the most sensitive part to be affected by air pollutants. Therefore, the leaf at its various stages of development, serves as a good indicators to air pollutants. Air pollutant can directly affect plants via leaves or indirectly via soil acidification (Steubing et al., 1989). Pollutant when

absorbed by leaves cause a reduction in the concentration of photosynthetic pigment chlorophyll which directly affects the plant productivity.

Wheat is the second most important crop of India after Rice. It's a Rabi crop. It is the staple food in north and north western India. It's a winter crop and needs low temperature. Ideal temperature for wheat cultivation is between 10-15°C at the time of sowing and 21-26°C at the time of harvesting. Wheat thrives well in less than 100 cm and more than 75 cm rainfall. The most suitable soil for cultivation of wheat is well drained fertile loamy soil and clayey soil. Plain areas are most suitable. The wheat crop is highly mechanization oriented and may need less labour.

Study area

Kabrai is a town (Nagar Panchayat) of Mahoba district Utter Pradesh in Bundelkhand region, India. Kabrai is located at South-25^0 5' 35" N & North-$25^0$38'37" N, West-79^0 30' 0" & East-80^0 27' 0". It has elevation minimum 87 m, maximum 322 m and average elevation of 157 meters MSL. Kabrai is a town where main business is stone business. There are five villages in Kabrai Panchayat namely Bhagwa, Gauhari, Marahthi, Mochipura and 12 Words. Clusters of stone crushing and sizing units are located at Kabrai along the road (National Highway-76) from Allahabad (UP) to Jhansi (UP) and NH-86 Kanpur Sagar Road. This place is famous for stone production as there are more than 400 stone caves. There is a lack of environmental governance in both the quarries and the crushers which results in considerable degradation of the environment surrounding the locations where stone crushing industry is set up. Continuous quarrying or mining operations in the form of drilling, blasting, loading and hauling including plant process operations are potentially significant sources of emission of dust. In Kabrai soil has been produced by the weathering of granites. Well known Bundelkhand varieties are Parwa, Rakar, Kabar, Mar. Clayey and loamy soil is dominant in the district.

MATERIALS AND METHOD

The study was confined around the stone crusher of Kabarai town. The study was divided into two parts

1. Ambient Quality study .2. wheat crop study

1: Ambient Quality

The purpose of this study was to investigate and explain the review of stone crusher processing and its impact on the wheat crop. The locations for AAQM study were selected within the 3 Km radius. Ambient air quality was monitored on 5 locations for one year. seasonal variation in ambient air quality was also determined to generate representative ambient air quality status in 2014.

The 5 station were selected keeping in view the prevalent wind direction and topography of the area surrounding stone crushers plant. The detail of various air quality stations are tabulated in Table-1

Table: 1. Detail of AAQ sampling locations, direction & distance with the respect of centre point of Kabrai City (Rajendra Nagar)

S. No.	Station Code	Location Name	Direction	Distance Approx. (Km.)
1.	S1	Shakti Nagar (Kanpur Sagar Road, Nh-86)	North	1.0 Km
2.	S2	Kanpur Sagar Road (NH -86)	North	2.0 Km
3.	S3	Mataundh Road Kanpur (NH -76)	East-South	1.5 Km
4.	S4	Mochipura	West-South	1.0 KM
5.	S5	Alipura (Mahoba Road) (NH-76)	West-South	3.0 Km

1. Ambient air quality study includes PM_{10} & $PM_{2.5}$.The analysis was done as per standard method prescribed by CPCB.
2. Study of morphological and bio-chemical characteristics of wheat.
   Morphological characteristic include Shoot length, Number of branches, Number of leaf/leaf let, Root length, Number of spike ,Weight of grains

Biochemical analysis include total Chlorophyll content (Arnon, 1949), Ascorbic Acid (Keller and Schwager, 1977), Leaf relative water content (Sen and Bhandari, 1978), Leaf extracts pH (Singh and Rao, 1993)

Selection of crops species- On the basis of dominance, frequency of damage and economic importance Rabi crops *Triticum sp.* (Wheat) was selected from both Polluted and

control site. Plants of wheat species were collected from each site for 100 day in 20 days interval at 0.5 and 1.0 km distance from stone crusher.

APTI is also determined by using the method prescribed by Singh & Rao, 1983. The APTI was calculated by the formula given bellow-

APTI = A (T+P) +R / 10.

Where-: A = Ascorbic acid content (mg/g). T = Total chlorophyll mg/g. P = pH of leaf extract. R = Relative water content of leaf.

Results and Discussion

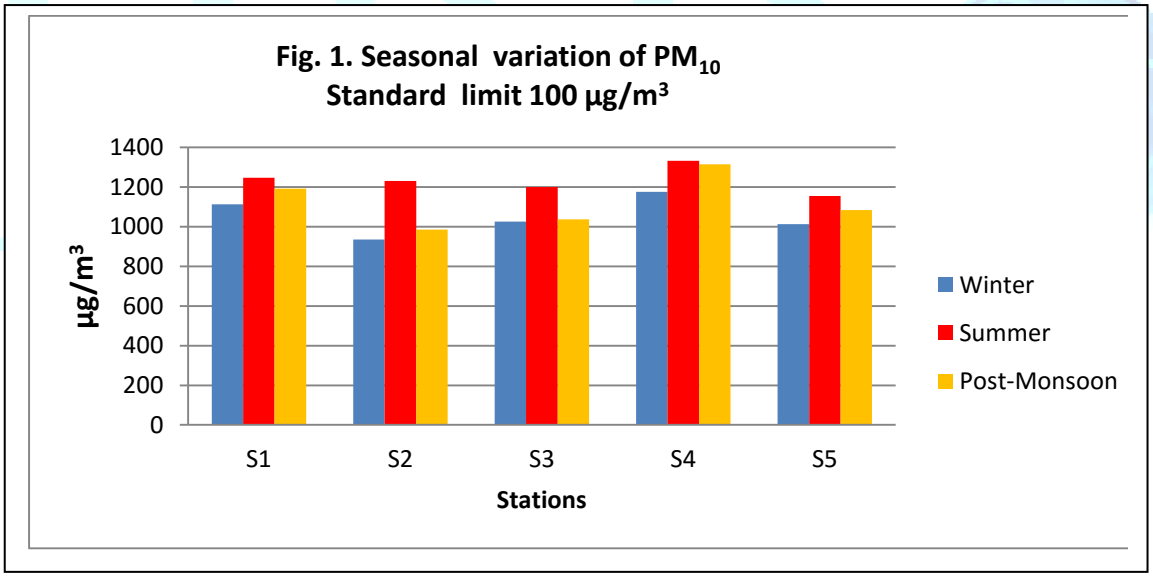
Stone crusher dust had significant affect on the growth of wheat crops. The 24 hours mean concentration of pollutants recorded during winter, summer and post-monsoon seasons has been presented in Table-2 & 3. Higher Concentration of PM_{10} was observed 1332.64±184.06 $\mu g/m^3$ during summer season at S4 while lower concentration was 517.040±59.45 $\mu g/m^3$ during winter season at S2, whereas the standard limit prescribed by CPCB for PM_{10} is 100 $\mu g/m^3$. Higher concentration of $PM_{2.5}$ was 1057.61 ±217.07 µg/m3 at S4 station in summer seasons while lower concentration was observed 517.040±59.45 $\mu g/m^3$ during winter season, whereas the standard limit prescribed by CPCB is 60 $\mu g/m^3$. The PM_{10} and $PM_{2.5}$ was found higher than the permissible limit at all sampling station in all the seasons due to stone crushing, operating, loading and processing which generate lots of dust.

Table-2: Average PM_{10} at different stations.

S. No.	Stations	Ground level concentration, 24 hourly µg/m³		
		Year 2014		
		Winter	Summer	Post-Monsoon
2.	S1	1112.69±126.37	1247.21±35.52	1191.73±130.64
3.	S2	935.75±49.05	1230.99±212.40	986.24±05.10
4.	S3	1026.63±83.76	1200.09±212.40	1037.69±59.89
6.	S4	1175.98±60.89	1332.64±184.06	1315.24±155.65
9.	S5	1013.63±64.70	1154.70±348.63	1083.36±30.50

Table-3: Average $PM_{2.5}$ at different stations.

S. No.	Stations	Ground level concentration, 24 hourly µg/m³		
		Year 2014		
		Winter	Summer	Post-Monsoon
2.	S1	601.74±53.03	1005.39±230.4	689.88±71.17
3.	S2	517.040±59.45	815.81±155.39	571.35±34.63
4.	S3	558.363±47.00	863.36±201.35	652.55±40.00
6.	S4	708.280±12.24	1057.61±217.07	729.15±44.17
9.	S5	591.410±57.49	913.67±174.75	646.08±17.68



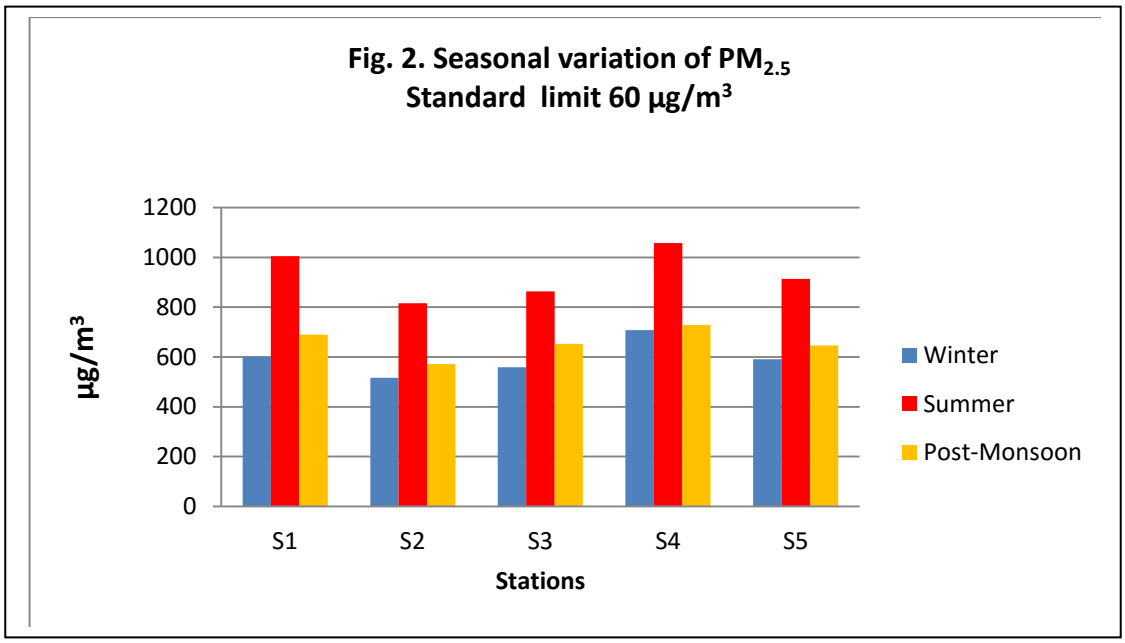


Table.4: Morphological parameters of *Triticum sp.* (Wheat) at various distance from stone crushers plants.

S.N.	Morphological Parameters	Distance from Stone crushers (Km.)	Year 2014. Age in Day				
			20	**40**	**60**	**80**	**100**
1.	**Shoot Length (cm)**	**Control**	**24.7**	**49.5**	**62.9**	**76.1**	**88.6**
		0.5	21.9	45.7	56.8	68.3	78.5
		1.0	23.5	47.0	59.8	73.6	83.8
2.	**No. of Branches**	**Control**	**6**	**8**	**11**	**12**	**13**
		0.5	4	6	8	9	10
		1.0	5	7	8	10	12
3.	**No. of Leaf**	**Control**	**41**	**49**	**67**	**71**	**76**
		0.5	37	42	59	67	70
		1.0	38	44	62	68	73
4.	**Root Length (cm)**	**Control**	**6.0**	**7.0**	**9.6**	**14.6**	**16.9**
		0.5	5.6	6.2	8.5	12.7	13.8
		1.0	5.7	6.4	8.8	13.0	14.9
5.	**No. of Spike**	**Control**	-	-	-	**12**	**12**
		0.5	-	-	-	10	10
		1.0	-	-	-	10	10
6.	**Weight of 100 dry grains**	**Control**	-	-	-	-	4.4
		0.5	-	-	-	-	3.8

	(gm)	1.0	-	-	-	-	4.1

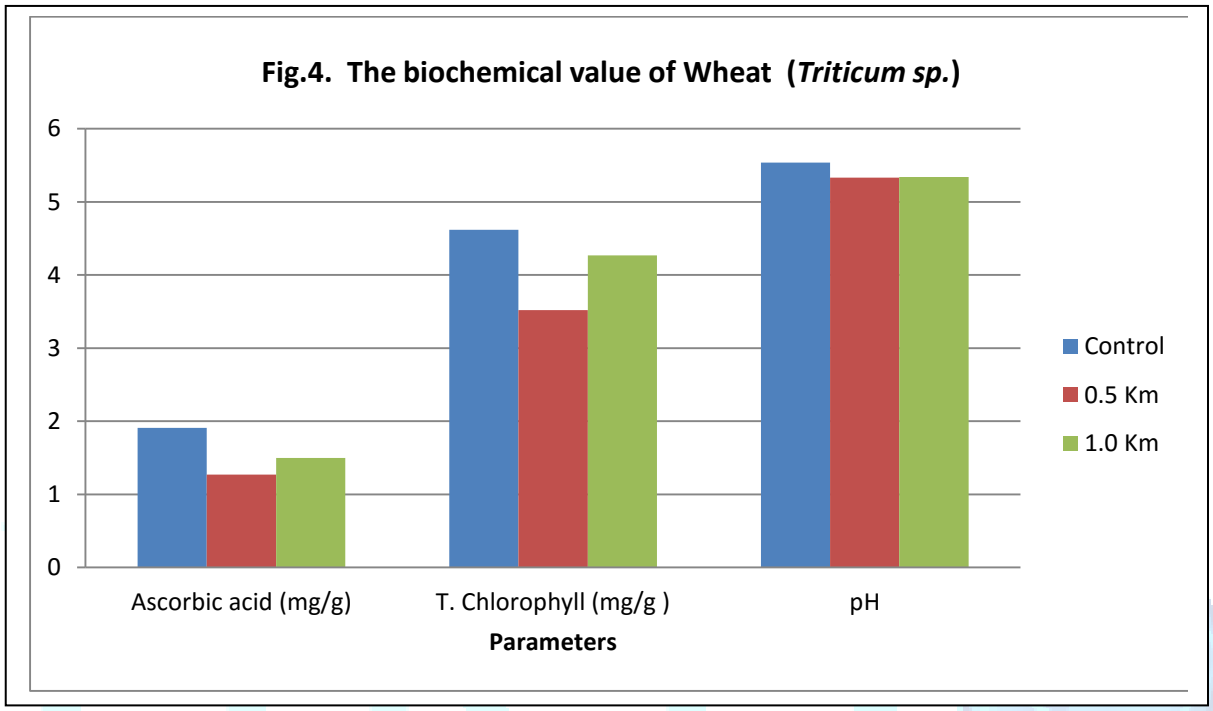
Morphological parameters studied for wheat is given in table-4. It was observed that shoot length was lowest 78.5 cm in hundred days for the plant growing at 0.5 km distance at 1.0 km the shoot length was observed 83.8 cm while maximum shoot length was observed in control site. Similarly root length was found minimum at 0.5 km distance and maximum at control site. Weight of hundred seeds was also found maximum in control site and minimum for the plant growing at the 0.5 km distance. Such reduction in seed weight is due to reduce photosynthetic potential of dusted plant as affected by decrease absorption of light. Stone crusher dust had significant affect on the growth of wheat crops. The value was increase with the increase distance. The grains of wheat plants at polluted site also remarkably affected. The reduction in height of plants, spike and grains probably due to reduction in chlorophyll content (Chaurasia et al., 2013).

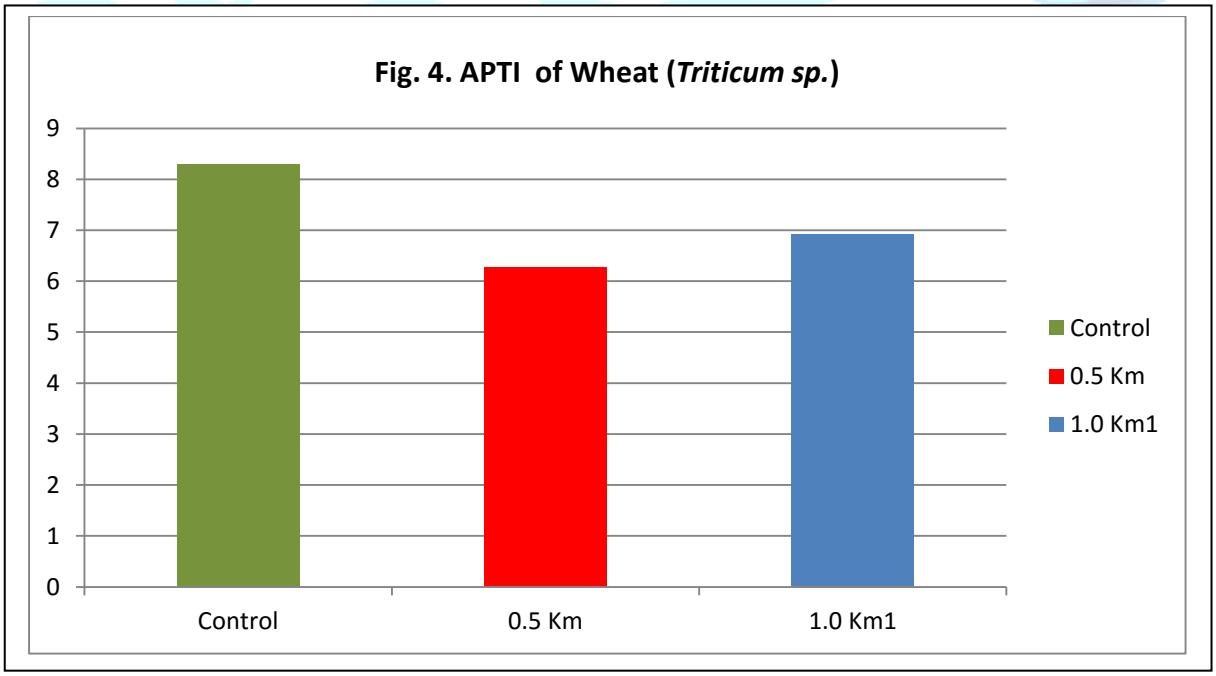
Table.5 : Biochemical constituents in wheat collected from different distance from stone crusher.

Crops species	**Station code**	**Ascorbic acid (mg/g)**	**T. Chlorophyll (mg/g fw)**	**pH**	**Relative water content (%)**	**APTI**
Wheat species	Control	1.91	4.62	5.54	63.32	8.28
	0.5	1.27	3.52	5.33	51.60	6.28
	1.0	1.50	4.27	5.34	54.78	6.92

The total chlorophyll, pH extract, relative water content and ascorbic acid of the plants sample were estimated and the results are given in (table -5). A considerable loss in total chlorophyll in the leaves of plants exposed in severe air pollution at 0.5 km distance supports the argument that the chloroplast is the primary site of attack by air pollutants which make their entrance into the tissues through the stomata and cause partial denaturation of the chloroplast and decreases pigment content in the cells of polluted leaves (Senthil et al., 2015). Similarly ascorbic acid and relative water content was also found minimum at o.5 km distance 1.27 mg/g and 51.60 % respectively. Air pollution tolerance was also concluded and given in table-5. Air pollution

tolerance index was found minimum 6.28 for the plant growing 0.5 km distance from crusher and maximum APTI 8.28 was observed in control site. All the observation indicates that stone crushers are adversely affecting the growth and yield of wheat crop.





CONCLUSION

Ambient air quality around the stone crushers was found very unhealthy as the PM_{10} and $PM_{2.5}$ were thousand times higher than the permissible limit. Morphological and biochemical characteristics of wheat at different distance from the crushers was found poor than the control site wheat crop. The data obtained at different stages of development indicate that shoot length, root length, number of branches, number of leaf number of spike, number of seeds were adversely affected by stone crushers dust pollution. The plant growing in control site were healthy than the plant growing near the stone crusher. As the distance from the stone crushers increases the plant health also improves. The yield in term of seed weight regarding control site plant may be attributed to the photo synthetics potential as against the dusted plant and assimilate supplies to support reproductive development and seed growth. Yield reduction was observed along the gradient of air pollution. A loss in total chlorophyll in the leaves of plant exposed in severe air pollution supports the argument that the chloroplast is the primary site of attack by air pollutants and decrease pigment content in the cells of polluted leaves.

References

1. Anderson P.J.(1994). The effect of dust from cement mills on the setting of fruits, Pl. Wld. 17, 57-68.
2. Arnon D.I. (1949). Coenzyme in isolated chloroplast. Polyphenol oxidase in *Beta vulgaris.* Plant Physiol. 24:1-15.
3. Chaurasia Sadhana, Karwaria Ashwani and Gupta Anand Dev (2013).Effect of cement industry pollution on chlorophyll concentration of different crops Kodinar Gujarat, India. Proceeding of the International academy of Ecology and Environmental Science, 3(4): 288-295.
4. Keller T., Schwager H. (1977). Air pollution and ascorbic acid. Europ. J. Forest Pathol. 7:338-350.
5. Laghari S.K., Zaidi M.A. (2013). Effect of air pollution on the leaf morphological of common plant species of Quetta city. Pak J. Bot. 45(S1): 447-454.

6. Sen D.N., Bhandari M.C. (1978). Ecological and water relation to two Citrullus spp. In: Althawadi, A.M. (Ed.). Indian Arid Zone. Env. Physiol. Ecol. Plants. 203-228.
7. Senthil P.K.., Sobana K., Kavitha K.and Jegadeesan M. (2015). A study on the effect of cement dust pollution on certain physical and biological parameters of *Sessamum indicum* plant, Asian Journal of Plant Science and Research 5(1):1-3
8. Singh S.K., Rao D.N. (1983). Evaluation of plants for their tolerance to air pollution. In Proc. Symp. on air pollution control held at IIT Delhi. 218-224.
9. Steubing L, Fangimier A, Both R. (1989) Effect of NO2, SO2 and O3 on population development on morphological and physiological parameters of native herb layer species in a beech forest. J. Environ. Poll. 58:281-301.