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Dimensions of Pollen Deformities as Bio-Indicator of Vehicular Pollution

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Abstract: ***Pollen deformities remain as bio - indicator of vehicular pollution. Different types of deformities were observed in the pollen grains collected from polluted sites of Chapra town belonging to fifteen plant species such as abnormal shape and reduced size of pollen grains, black spot on exine, broken exine and accumulation of cytoplasmic grainules on the pollen surface. These deformities were recorded in percentage of occurrence.17 percent abnormal shaped pollen grains were observed for* Cassia fistula. *The percentage occurrence of 21% reduced sized pollen grains, 7 percent pollen grains having black spot on surface, 9% pollen having broken exine and 13% pollen grains having cytoplasmic granules on surface were observed with respect of* Cassia fistula. *Maximum pollen deformities as compared to other species were observed for this plant species. Higher percentage of deformed pollen grains were also observed for Amaranthus spinosus, Azadiracta indica* and *Parthenium hysteroforus. Minimum number of deformed pollen grains were observed among* Acacia arabica, Brassica compestris, *Dalbergia sisso, Hibiscus rosa sinensis, Mangifera indica and Mimosa sp. There were no any broken exine having pollen grains noticed among pollens of Argemone mexicana, Acacia arabica, Brassica compestris, Dalbergia sisso, Datura alba, Hibiscus rosa sinensis, Mangifera indica, and Mimosa sp. The pollen grains having cytoplasmic granules was not observed for these plant species of plants except Datura alba.***

Keywords: Pollen deformities, Bio - indicator, Vehicular pollution, Chapra town.

1. Introduction

Dangerous substances present in air leads to environmental pollution and have negative impact on different components of ecosystem including pollen grains. Use of pollen grain as bio - indicator for vehicular pollution is one efficient way to monitor the environment. Pollen grains also respond to environmental changes, thus may be used to get information about the state and quality of air. Use of pollen grains for air quality monitoring remain successful method due to cheap and simple as compared to physico - chemical methods. Pollen grains used as bioindicator for vehicular pollution provides important information regarding potential adverse effects of these pollutants on living organisms.

Bioindicators are living substances or group of organisms that show the information about pollutants present in the environment. Keeping this definition in mind, Posudin (2014) conducted study aiming to select different types of bioindicators such as microorganisms, pollen grains etc., which under environmental alterations tend to produce certain molecular signals. Identification of bioindicators is a new fields of research due to the invasions of a wide range of individual components in the environment in toxicological, chemical, and ecological terms (Merian *et al*., 2008).

Air pollutant, such as those from vehicular emissions, interact with the pollen grains of plants causing alteration of physiology, ontogeny and morphology both at the surface level and within the pollen protoplasm. Many airborne pollen grains are responsible for allergic diseases. Thus, it is decided to select this unexplored area of the environmental biology with respect to pollen grains as bioindicator about vehicular pollution in Chapra town of Bihar.

Pollen grains indicates relative levels of the concentration of pollutants present in air of any locality with accuracy. Pollen grains as bioindicators can give information related to identities, levels and geographical localisation of pollutants. The information related to bioindicator may help in drawing pollution map of any locality. Thus, methods using pollen grains for biomonitoring of air quality of any locality remain simple and can supplement the classical physico - chemical methods. The information related to vehicular pollutants can be obtained from the study of the response of pollen to air pollution.

2. Materials and Method

Pollen grains remain more sensitive, so can be used in scientific experimental research as bio - indicators for air pollution. Air pollutants causes gametocidal effect. Thus, the purpose of this research study was to estimate the impact of vehicular pollution on pollen grains of higher plants, collected from three sampling sites having different intensity of motor traffic. Pollen grains collected from sub urban area served as control, which was considered to be relatively almost free of vehicular pollution.

City area (City Centre and along highway) and Suburb area (as control) of Chapra town were selected as sampling sites in order to evaluate the effects of vehicular pollution on pollen grains of some plant species to be used as bio - indicator of air pollution. There is no industry in the study area thus the major source of atmospheric pollution is from the vehicular emissions. Before sampling in the study area, a walk-through survey of the locality was made and on the basis of small and large vehicular traffic density, the emissions were expected very high along the road side, median in the city centre and low in the sub urban area. Thus, the criteria used for selection of collection centres was the degree of pollution such as location related to degree of vehicular pollution.

Morphological analysis of pollen grains was conducted for each collection site. Pollen size was measured by micrometry method, with help of a ocular micrometer calibrated by use of stage micrometer attached with a light microscope in ten microscopic fields. The investigation was repeated thrice and the average was noted in Mm (1×10^{-6}m.).

Regularity of the collected pollen grains was observed as percentage as well - regulated and normal pollen grains. For this purpose, 10 pollen grains of each species were examined. The deformities of pollen grains collected from three sampling sites were observed with help of compound microscope. All experiments were carried out in triplicate and mean data was recorded.

3. Result and Discussion

Pollen grains of 15 plant species such as *Acacia arabica*, *Amaranthus spinosus*, *Argemone mexicana*, *Azaridacta indica*, *Brassica compestris*, *Cassia fistula*, *Chenopodium sps.*, *Dalbergio sisso*, *Datura alba*, *Hibiscus rosa sinensis*, *Indigofera cordifolia*, *Mangifera indica*, *Mimosa sps*., *Parthenium hysterophorus* and *Zea mays* were identified as the main contributing members to the aeropalinological spectrum in the air of Chapra during present study.

Table 1: Peak month of occurrence of pollen grains

Sl. No.	Name of Plant Species	Peak Month of Occurrence
1.	*Acacia arabica*	October
2.	*Amaranthus spinosus*	September
3.	*Argemone mexicana*	March
4.	*Azadiracta indica*	March
5.	*Brassica compestris*	February
6.	*Cassica fistula*	July
7.	*Chenopodium sp.*	August
8.	*Dalbersia sisso*	April
9.	*Datura alba*	September
10.	*Hibiscus rosa sinensis*	March
11.	*Indigogera cordifolia*	November
12.	*Mangifera indica*	March
13.	*Mimosa sp.*	March
14.	*Pathenium hysteroforus*	September
15.	*Zea mays*	October

The peak month of occurrence of pollen grains of 5 plant species remained March, 3 plant species as September and 2 plant species as October. The peak month of occurrence observed for pollen grains of *Brassica compestris* as February, *Dalbesgia sisso* as April, *Cassia fistula* as July, *Chenopodium sp.* as August and *Indigofera cordifolia* as November (Table - 1).

Table 2: Pollen deformities (%) found in pollen grains collected from polluted area

Sl. No.	Name of Species	Abnormal shape	Reduced size	Black spots on Exine	Broken Exine	Pollen with cytoplasmic granules on surface
1.	*Acacia arabica*	07	00	07	00	00
2.	*Amaranthus spinosus*	06	16	08	06	14
3.	*Argemone mexicana*	08	00	11	00	00
4.	*Azadiracta indica*	02	12	03	14	11
5.	*Brassica compestris*	02	05	00	00	00
6.	*Cassica fistula*	17	21	07	09	13
7.	*Chenopodium sp.*	02	09	16	06	04
8.	*Dalbersia sisso*	03	03	05	00	00
9.	*Datura alba*	01	01	09	00	02
10.	*Hibiscus rosa sinensis*	00	05	03	00	00
11.	*Indigofera cordifolia*	08	11	08	06	04
12.	*Mangifera indica*	00	02	07	00	00
13.	*Mimosa sp.*	03	00	02	00	00
14.	*Parthenium hysteroforus*	07	17	13	09	18
15.	*Zea mays*	03	04	06	02	03

During present investigative study different types of pollen deformities were observed such as abnormal shape and reduced size of pollen grains. Black spots on outer surface of exine, broken exine and appearance of cytoplasmic material on the surface of pollen grains were also observed. These deformities on the pollen grains of observed plant species are presented as percentage of occurrence in Table–2. Maximum percentage (17%) of abnormal shaped pollen grains and reduced sized pollen grains (21%) were observed for *Cassia fistula*. Occurrence of black spots on outer surface of pollen grains was frequently observed for *Chenopodium sp. (*16%). Cases of broken exine were frequently observed for *Azadiracta indica* pollen (14%). Appearance of cytoplasmic granules was observed frequently on pollen grains of *Parthenium hysteroforus*. Less deformities were observed for pollen grains of *Acacia Arabica*, *Brassica compestris, Dalbergia sisso, Hibiscus rosa sinensis, Mangifera indica* and *Mimosa sp.* Shrinkage, thinning and fragility of pollen grains were noticed as the effect of vehicular pollution. Thus it is clear that vehicular pollutants can directly affects pollen grains. Aftab and Perveen (2006) stated that morphological changes in pollen grains taking place due to air pollution is very important with regard to the problem of climate change. Structural changes taking place due to adverse effect of air pollution leads to disturbances in metabolic process taking place in pollen grains. The harmful gases even present under standard limit remain responsible for above mentioned changes during favourable meterological conditions. Ghiani *et al*. (2012) observed that pollen grains of *Ambrosia artemisiifolia* collected form raod sides showed fissure or brakes in exine. These breaks pave way for release of cytoplasmic granules from pollen grains. Rezanejad (2009) observed during his study that pollen grains of *Thuja orientalis* collected from polluted area remain more fragile and exine breaks quickly. Ribeiro *et al*. (2017) also observed modification of pollen function due to even short term atmospheric pollutants exposure. The occurrence of high frequency of broken exine and presence of cytoplasmic

granules on pollen grains may be due to toxic effects of vehicular pollution.

Rejanejad (2007) observed that airborne materials get deposited on the surface of pollen grains leading to collapse and degradation of the exine outer surface. Shrinkage and abnormalities of pollen also takes place due to air pollution. Higher level of deformed pollen grains of *Amaranthus spinosus*, *Azadiracta indica*, and *Parthenium hysteroforus* were also observed during present research work.

Air pollution especially of vehicular origin became as a major problem in cities. Gaseous and particulate matter of vehicular origin remain harmful to the structure and physiology of pollen grains leading to harmful impact on human health also. Apertures of pollen grains closes and hyper sculpturing of the exine takes place due to adverse effect of pollutants. Pollutant's particulate matter attaches on pollen surface. Thus collapse and degradation of the surface of exine takes place; and cytoplasmic granules of pollen grains releases in air. These cytoplasmic granules of pollen origin remain loaded with allergens. Thus NO2 and O3 present in vehicular emissions remain responsible for prevalence of allergic diseases via exposed pollen grains. Chehregani *et al*. (2004) also indicated that air pollutant interact with pollen grains and remain responsible for modification of its allergen content and release. Pollen grains present in polluted air releases cytoplasmic granules when come in contact of water during rainy season. Thus vehicular emissions increase the release of pollen cytoplasmic granules significantly.

Behrendt *et al*. (1997) on the basis of the results of their study confirmed that exposure of environmental pollutants modifies the process of release of pollen allergens. Taylor et al. (2002) also confirmed this fact that pollen grains releases pollen cytoplasmic granules when come in contact of water and pollutants present in air excelates this process. The presence of cytoplasmic granules on pollen grains obtained during present research study also corresponds with the findings of Taylor *et al. (*2002).

4. Conclusion

Thus, on the basis of the results obtained during this research study and other similar findings by other workers it became evident that Vehicular pollutants remain responsible for pollen deformities and may be used as bio - indicator of Vehicular pollution.

References

[1] Aftab R. and Perveen A., 2006, A palynological study of some cultivated trees from Karachi, *Pak. J. Bot.,* 38 (1): 15 - 28.
[2] Behrendt H., Becker W. M., Friedrics K. H. and Ring J., 1997, Air pollution and Allergy, *International Archives of Allergy Immunology*, 113: 69 - 74.
[3] Chehregani A., Majd A., Moin M., Gholami M., Shariatzadeh M. and Mohsenzade F., 2004, Effect of air pollution on some cytogenetic characteristics, structure, viability and proteins of *Zinnia elegans* pollen grains, *Pak. J. Bio. Sci.,* 7 (1): 118 - 122.
[4] Ghiani A., Aina R., Asero R., Bellotto E. and Citterio S., 2012, Ragwed pollen collected along high - traffic roads shows a higher allergenicity than pollen sampled in vegetated areas, *Allergy*, 67 (7): 887 - 894.
[5] Merian E., Anke M., Ihnat M. and stoepler M., 2008, *Elements and their compounds in the environment,* Viley - VCH Verlag, P. - 128 - 138.
[6] Posudin Y., 2014, *Bioindication in methods of measuring environmental parameters*, John Wiley and Sons, USA, P. - 145 - 146.
[7] Renanejad F., 2007, The effect of air pollution on microsporogenesis, pollen development and soluble pollen proteins in *Spartium juncenum* L., (fabaceae), *Turk. J. Bot.*, 31: 183 - 191.
[8] Renanejad F.2009, Air pollution effects on structure, proteins and flavonoide in pollen grains of *Thuja orientalis* L. (Cupressaceae), *Grana*, 48: 205 - 2013.
[9] Ribiro H., Costa C., Abreu I. and Esteves de Silva J. C. G., 2017, Effect of O_3 and NO_2 atmospheric pollutants on *Platanus acerifolia* pollen immunochemical and spectroscopic analysis, *Sci. Total Environ.*, 599: 291 - 297.
[10] Taylor P. E., Flagan R. C., Valenta R. and Glovsky M. M., 2003, Release of allergens as respirable aerosols: A link between grass pollen and asthama, *J. Allergy clin. Immunol.*, 109: 51 - 56.