International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Fertility and Viability Level of Pollen Grains Collected from Different Areas of Chapra Town (Bihar)

Naira Nayab[1], Dr. Anzer Alam[2]

[1]Research Scholar, Department of Botany, Jai Prakash University, Chapra, Bihar, India

[2]Professor of Botany & Principal, Ganga Singh College, Chapra, Jai Prakash University, Chapra, Bihar, India

Abstract: ***The effect of Vehicular pollution on fertility and viability level of 15 plant species collected from three locations of Chapra town were examined. Maximum reduction in percentage of pollen fertility (56.3 – 58.5%) was observed for pollen grains of Parthenium hysteroforus collected from polluted areas as compared to control (80%). More percentage of pollen sterility was observed in pollen grains collected from city centre area than highway area in most of the plant species observed during present research work. Reduction in percentage of pollen germination was observed in pollen grains collected from two polluted sites as compared to comparatively unpolluted suburb area (control).***

Keywords: Pollen fertility, pollen sterility, pollen viability, Chapra town

1. Introduction

As a bioindicators, pollen grains provide important information on the potential adverse effects of vehicular pollutants on living organisms. The vehicular pollutants present in atmosphere have a direct impact of the physiology of pollen grains. Garrec (2006) examined the possibilities of the use of pollen grains to evaluate air pollution. They observed different imensions of pollen grains of some plant species during his study. He pointed out that pollen grains provide essential informations on biological impact of pollutants, hence pollen grains may be used as bioindicator of air pollution. He concluded his study as use of pollen grains as bioindicators of the presence of pollutants in air could be a good material due to the peculiar characteristics of the pollen grains. Malayeri *et al*. (2012) studied the characterization of pollen grains of leguminous species to known the impact of air pollutants on pollens. Their study remained aimed to determine the importance of pollen grains as a bioindicator of the atmospheric pollution. They conducted a comparative study of the pollen grains of six legume species collected from polluted and non - polluted (control) localities.

Priscila *et al*. (2022) stated that atmospheric pollutants can induce changes in the germinability and viability of the pollen grains. They observed during their research study that the pollen grains obtained from places more exposed to air pollution show low viability. But the pollen grains obtained from peri urban areas showed higher rate of viability due to less effect of pollutants. Difference in rate of viability among pollen grains of different species of plants was also observed by them. They concluded their study as modification in the morphological and chemical composition of the wall of pollen grains as affected by pollutants remain as a cause for reduction of the viability rate of pollen grains. Thus, these features of pollen grains may be said as bioindicator for the progressive degradation of plant species growing in urban environmental conditions under stress of air pollution and especially of vehicular pollution.

Thus, pollen grains may be used as bioindicators of vehicular pollution in air of any locality and provide significant informations. Changes in viability and germinability of the pollen grains of certain species of plants frequently occurs in cities due to the high rate of air pollution. Pollutants present in air can alter the biological functions of the pollen grains leading to alteration of the quality of pollen grains. Thus, it is clear that vehicular pollutants can impose important restrictions and cause stress differentially on pollen grains of different plant species and according to the sampling sites. In urban environment, pollen grains can suffer badly.

In Chapra town, every year there is growing number of automobiles to ease transportation facilities. In the study area traffic is the major source of air pollution. Transport vehicles emissions consists lead, zinc, cadmium, copper, cromium, nickel, cobalt, manganese etc. as dangerous pollutants. These vehicles also emit dangerous gases such as oxides of nitrogen, carbon and sulfur. Theseparticulate and gaseous pollutants have a negative impact on pollen grains. Thus, production or presence of the reduced number of fertile pollen grains can be used as bioindicator to measure the level of air pollution in the study area.

There is no major industry in the Chapra town and the major source of air pollution is from vehicular emissions. Automobile exhaust have adverse effects on pollen grains. The pollen grains have capacity as bioindictors of environmental pollution. Therefore, palynological study can be used as indicators of vehicular pollution. Vehicular pollution affects adversely the yield of plants through reduction in pollen germination and pollen tube growth.

2. Materials and Method

Fertility level of collected pollen grains was observed by iodine method on temporary pressure preparations. This method was used to screen the Palynotoxic effect of motor vehicle emissions.

Pollen fertility/sterility:

Fertility of collected pollen grains was examined by use of 2, 3, 5 – triphenyl tetrazolium chloride (TTC) staining technique.1% solution of TTC was added in 60% sucrose solution and stored in dark bottles for staining purpose. Pollen grains were placed on a glass slide and one drop of TTC stain was added. Then slide was covered by cover slip and airtight by didutylphathalate xylene (DPX). The slides were hatched in the daylight for 3 hours. Prepared slides were examined under light microscope. Pollen grains fertility was determined by counting under following categories: -

1) Sterile – Yellow colour pollen grains with shrunken configuration.
2) Fertile – Red or pink colour pollen grains with rounded shape.

Pollen germination (Viability):

Experiment with regard to observe pollen germination was conducted *in - vitro* by the method of standing drop in Brewbaker and Kwack's culture medium (1963) in the laboratory of the Department of Botany, Ganga Singh College, Chapra in suitable relative humidity and other conditions. The germination experiment was conducted in triplicates and average data was used for tabulation work.

For this purpose, pollen grains obtained from sampling sites were put for germination on a culture media having one percent saccharose, 0.6% polyethylene glycol along with 02.5mM MgSO4, 08.3Mm Ca (NO3) 2, 01.6mM H3BO3 and 01Mm KNO3 in dark at room temperature for each species separately. After 24 hours, the samples were transferred on a slide and germinated pollen grains and non - germinated pollen grains were counted randomly under a light microscope. The germinated status was determined by counting pollen grains having pollen tube longer than the size of respective pollen grain. The results were calculated as a percentage of germination of pollen grains may be caused by motor vehicle emissions. Thus these aspects can be used for further scientific research and experiments related to use of pollen grains as bio - indicator for vehicular pollution.

3. Results and Discussion

Percentage of fertile and sterile pollen grains and pollen germeability can indicate vehicular pollution. The pollutant presents in air harm the generative structures of flowering plants leading to change in biodiversity and also allergenic potential of pollen grains of specific species of plants. The palynotoxic effect of motor vehicle emissions can be examined on the basis of the pollen fertility indices.

Table 1: Mean Pollen Fertility (%)

Sl. No.	Name of Plant Species	City Centre		Highway area		Suburb (Control)	
		Fertile (%)	Sterile (%)	Fertile (%)	Sterile (%)	Fertile (%)	Sterile (%)
1.	*Acacia arabica*	79.4	20.6	81.2	18.8	92.0	08.0
2.	*Amaranthus spinosus*	60.6	39.4	64.7	35.3	90.0	10.0
3.	*Argemone mexicana*	88.0	12.0	90.0	10.0	94.5	05.5
4.	*Azadiracta indica*	68.2	31.8	60.3	39.7	89.0	11.0
5.	*Brassica compestris*	80.0	10.0	81.0	09.0	94.0	06.0
6.	*Cassica fistula*	68.5	31.5	63.0	37.0	86.0	14.0
7.	*Chenopodium sp.*	71.5	29.5	67.0	33.0	81.5	18.5
8.	*Dalbersia sisso*	89.3	11.7	91.0	09.0	93.0	07.0
9.	*Datura alba*	89.0	11.0	92.0	08.0	91.0	09.0
10.	*Hibiscus rosa sinensis*	90.3	09.7	84.0	16.0	90.0	10.0
11.	*Indigofera cordifolia*	71.5	28.5	73.0	27.0	85.0	15.0
12.	*Mangifera indica*	79.0	21.0	84.3	15.7	93.0	07.0
13.	*Mimosa sp.*	82.0	18.0	85.5	14.5	91.3	08.7
14.	*Parthenium hysteroforus*	56.3	43.7	58.5	41.5	80.0	20.0
15.	*Zea mays*	77.3	22.7	88.5	11.5	90.0	10.0

Data observed regarding pollen fertility and sterility percent for all plant species under this study were presented in Table–1. It became evident from the data mentioned in this table that there were severe effect of pollutants on the pollen grains of *Amaranthus spinosus*, *Azadiracta indica*, *Cassia fistula* and *Parthenium hysteroforus* collected from city centre and Highway area with regard to reduction of pollen fertility as compared to control (pollen grains collected from suburb area).

Maximum reduction of percentage of pollen fertility (56.3 - 58.5%) was observed for *Parthenium hysteroforus* as compared to control (80%) among all 15 observed plant species. More pollen sterility was observed in pollen grains collected from city centre area than pollen collected from highway area for most of the observed plant species. Median effect of air pollutants on pollen fertility was observed for *Acacia arabica*, *Brassica compestris*, *Chenopodium sp.*, *Indegofera cordifolia*, *Mangifera indica*, and *Zea mays*. Less effect of air pollutants on pollen fertility was observed for *Argemone mexicana*, *Dalbergia sisso*, *Datura alba*, *Hibiscus rosa sinensis* and *Mimosa sp.*

Table 2: Mean Pollen Fertility (%)

Sl. No.	Name of Plant Species	City Centre	Near Highway	Suburb (Control)
1.	*Acacia arabica*	76.0	81.0	91.0
2.	*Amaranthus spinosus*	54.0	61.0	80.0
3.	*Argemone mexicana*	73.0	83.0	89.5
4.	*Azadiracta indica*	66.5	58.0	83.0
5.	*Brassica compestris*	75.5	78.0	87.5
6.	*Cassica fistula*	58.0	57.5	81.0
7.	*Chenopodium sp.*	68.5	62.0	80.5
8.	*Dalbersia sisso*	83.0	88.5	91.0
9.	*Datura alba*	82.5	86.5	90.0

10.	*Hibiscus rosa sinensis*	88.5	80.3	88.0
11.	*Indigofera cordifolia*	70.5	71.3	80.5
12.	*Mangifera indica*	76.3	81.5	90.0
13.	*Mimosa sp.*	79.0	80.0	89.0
14.	*Parthenium hysteroforus*	50.5	51.0	78.0
15.	*Zea mays*	73.5	79.0	86.5

The viability potential of pollen grains of different plant species obtained from three sampling sites under this research work was ascertained by observation of the percentage of germinated pollen grains. The data observed for this parameter is presented in Table–2. Reduction of pollen germination percentage of almost all plant species was observed in pollen grains collected from city centre and near highway sites as compared to control (suburb site). Less impact of polluted atmosphere on pollen germination of *Dalbergia sisso* and *Hibiscus rosa sinensis* was observed. Drastic reduction of germination percentage was observed for pollen grains of *Amaranthus spinosus*, *Azadiracta indica*, *Cassia fistula*, *Chenopodium sp.* and *Parthenium hysteroforus* collected from polluted areas. Less germeability was observed for *Acacia arabica (*76%), A. *spinosus (*54%), *Argemone mexicana (*78%), *Brassica compestris (*75.5%), *Dalbergia sisso (*83%), *Datura alba (*82.5%), *Indegofera cordifolia* (70.5%), *Mangifera indica (*76.3%), *Mimosa sp. (*79%), *Parthenium hysteroforus (*50.5%) and *Zea mays (*73.5%) obtained from city centre collection site as compared to highway site (81%, 61%, 83%, 78%, 88.5%, 86.5%, 71.3%, 81.5%, 80%, 51% and 79% respectively). As well as less germeability (viability) was observed for *Azaridacta indica* (58%), *Cassia fistula (*57.5%), *Chenopodium sp. (*62%) and *Hibiscus rosa sinensis (*80.3%) collected from highway area as compared to city centre area (66.5%, 58%, 68.5%, 88.5% respectively).

Tashpulatov *et al. (*2004) observed during their research study that increase in temperature of atmosphere determine higher allergen contents in Birch pollen. Johri and Vasil (1961) discussed about different physiological aspects related to pollen grains. Shivanna *et al. (*1992) described about pollen viability and pollen vigor during different environment stress conditions. According to Gokbayrak and Engin (2018), pollen viability and pollen germination depends on different factors including environmental stress. The results of present study also correspond with results obtained by Gokbayrak and Engin (2018).

Vehicular emissions containing NO2 decreases viability of pollen grains. Cuinica *et al. (*2014) observed decreased level of viability of pollen grains of *Betula sp.* Wolters and Martens (1987), on the basis of the results obtained during their research study pointed out that pollen grains may be used as a sensitive indicator of atmospheric pollution. Varshney and Varshney (1981) also supported this fact and stated that pollen grains are useful biological material for air pollution monitoring. SO_2 induces reduction in pollen viability as well as size and shape of pollen grains.

Iannotti *et al. (*2000) observed the effects of vehicular emissions on pollen viability and stated that pollen viability can be used as bio - indicator of air quality. The reduced level of pollen fertility of pollen grains of *Parthenium hysteroforus* collected from polluted sites of Chapra may be used as bio - indicator to determine level of vehicular pollution.

In respect of pollen germination, a marked difference in the same species was observed among pollen grains collected from city centre, near highway and suburb area of Chapra town. The pollen grains of all observed species of plants showed reduction in percentage of germination of pollen grains collected from polluted areas as compared to suburb area. Thus, it became clear that vehicular emission present in atmosphere adversely affects the viability of pollen grains of observed species of plants.

Duro *et al. (*2013) on the basis of the results of their research study stated that air pollutants adversely affect viability of pollen grains. These pollutants also remain responsible for change in pollen sculpturing. Pollen grains absorbs some pollutants from the air in presence of humidity which adversely affects viability of pollen grains. The reduction of percentage of viable pollen grains collected from polluted sites of Chapra as compared to control (suburb area) is in confirmatory with the results obtained by Duro *et al. (*2013).

Sousa *et al. (*2012) observed decrease in the percentage of pollen germination of different species of plants due to NO2 exposure. Duro *et al. (*2013) observed differential effect of air pollutants on pollen germination ability of different species of plants. Their results suggest different levels of pollen sensitivity of different species of plants in same environmental conditions such as decrease, increase or no impact on the capacity of pollen germination. The pollutants accumulation on exine of pollen grains may a reason for decreased level of pollen germiability. It was observed during present study that pollen grains of *Dalbersia sisso* and *Hibiscus rosa sinensis* were not affected by pollutants.

4. Conclusion

This research study was conducted on fertility and viability level of pollen grains having passive exposure of vehicular emissions collected from atmosphere of three localities of Chapra (Bihar). The findings of this study will provide a realistic situation of air pollution. This will be helpful to integrate the short term and long term effects of vehicular pollutants on plants; showing individual susceptibility.

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