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Discrepancies in the Pollen Grain Contents under the Influence of Differential Status of Environmental Contamination

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A B S T R A C T

The anthropocene is witnessing a great hike in the industrial and corporate growth. The countries around the globe are trying to overcome constrains in economic growth by forcing the growth of production sector. Subsequently, one way or another all such activities lead to the environmental contamination. In turn, the contaminated surrounding affects the biological processes in the vicinity. Pollen grains being one of the chief components of aerosol showed great susceptibility with respect to shape, size, morphology, composition, etc. In this view, investigation was carried out to evaluate the differential pollution effects on the pollen contents of various crop plants common to selected sites. It was interesting to note that total reducing sugar, carbohydrate and moisture contents in the pollen grains were found to be decreased; whereas, nitrogen, protein and lipid contents were increased in the pollen collected from treatment site than control site.

Keywords: Pollen, Pollution, Environment, Crop plants.

1. Introduction

Today, one of the primary characteristics of locations with high levels of global human population density must be considered is atmospheric pollution[1,2]. Since the discovery of the miners' canary about a century ago, vegetation has been used as a biological indicator of environmental quality. Studies have demonstrated the viability of utilizing natural plants for pollution monitoring[3-6]. Industrial expansion has distorted the course of natural changes in the biological world.

It is well recognized that gases and other air pollutants have an impact on pollen grains in a variety of ways, with the protein composition of the pollen being one of the most significant. The content of total soluble proteins has been reported to alter regularly in the literature, however some inconsistent findings suggest that exposure to pollutants may cause an increase, decrease, or perhaps no change[7-10].

In this view, it was hypothesized that the pollen grain contents are susceptible to the environmental pollution status. The current research findings revealed the comparative analysis of the pollen contents collected from two different sites having differential status of the environmental contamination.

2. Materials and Methods

2.1 Sampling Sites

Two different sampling sites in Amravati Taluka were selected. The site nearer to the highway was treated as polluted site or treatment site (20.87324N 77.74830E) and a site far form highway was treated as less/non-polluted site or control site (20.86018N 77.66291E) (Figure 1).

Figure 1: Map of Amravati showing two different sampling sites (Treatment and Control Sites)

2.2 Pollen Material

The pollen grains of the crop plants grown in the selected sampling sites were selected as the plant material for the various parameters under study. Those crop plants that are commonly available in selected sites of the agriculture field were considered for the study, viz. *Cajanus cajan* (L.) Millsp., *Cicer arietinum* L., *Gossypium herbaceum* L., *Glycine max* (L.) Merr. and *Triticum aestivum* L.

2.3 Effects on Pollen Contents

The 50 mg of sun-dried pollen samples were subjected to the various biochemical analyses such as estimation of total reducing sugars[11], carbohydrates by Anthrone method[12], nitrogen by Micro-Kjeldahl method[13], soluble proteins by Lowry method[14], lipid content[15] and moisture content[16]. These experiments were performed in replicates and the collected data was subjected to the appropriate statistical analysis for interpretation of the results.

3. Results and Discussion

Out of the six parameters in the current report, total reducing sugar, carbohydrate contents and moisture contents in the pollen grains of all studied crop plants were found to be reduced, while, nitrogen, protein and lipid contents were found to be enhanced in treatment site as compared to the control site; without any exception.

The maximum reducing sugar was noted in *Triticum aestivum* (10.8 mg/ml) from control site and the minimum contents of reducing sugar was found in *Cicer arietinum* (5.2 mg/ml) from treatment site. The most susceptible plants if compared both the site was *Gossypium herbaceum* and *Glycine max* (Figure 2). In case of carbohydrates, the maximum amount was noted in *Triticum aestivum* (53.0 mg/ml) from control site and the minimum contents of carbohydrate was noted in *Cajanus cajan* (16.0 mg/ml) from treatment site. The most vulnerable plant when compared both the site was *Cajanus cajan*. In *Cajanus cajan*, the decrease in the carbohydrate concentration was observed by 9.5 mg/ml. While, the minimum decrease in the carbohydrate contents was noted in *Glycine max*. Where, the contents were decreased by 1.0 mg/ml (Figure 2).

In examining the nitrogen, the maximum percentage was noted in *Glycine max* (6.22 ± 0.74) from treatment site and the minimum contents of nitrogen was noted in *Gossypium herbaceum* (1.71 ± 0.21) from control site (Figure 4.30). The most vulnerable plant when compared both the site was *Cajanus cajan* (Figure 4). In the protein evaluation, the maximum protein was noted in *Glycine max* (136.0 mg/ml) from treatment site and the minimum contents of protein was noted in *Gossypium herbaceum* (43.5 mg/ml) from control site. The most vulnerable plant when compared both the site was *Glycine max*. In *Glycine max*, the increase in the protein concentration was noted by 18.0 mg/ml (Figure 2).

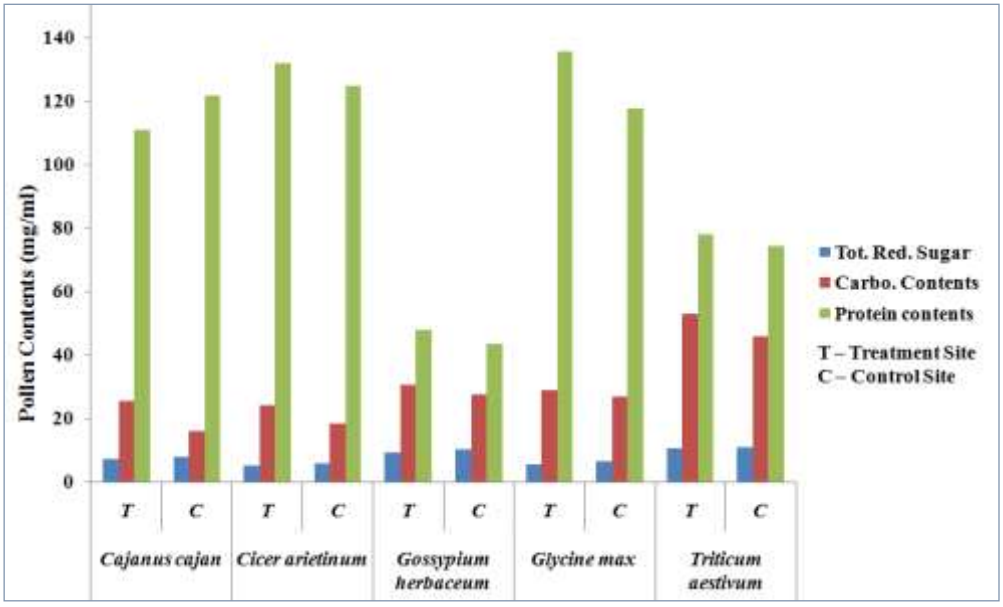

Figure 2: Comparative assessment of Total reducing sugar, Carbohydrate and Protein contents in crop plants collected from selected sampling sites.

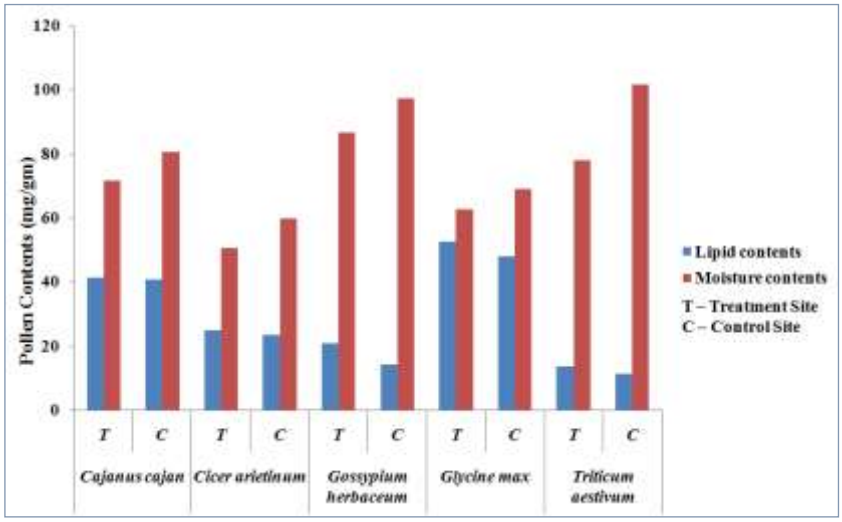

Figure 3: Comparative assessment of Lipid and Moisture contents in crop plants collected from selected sampling sites.

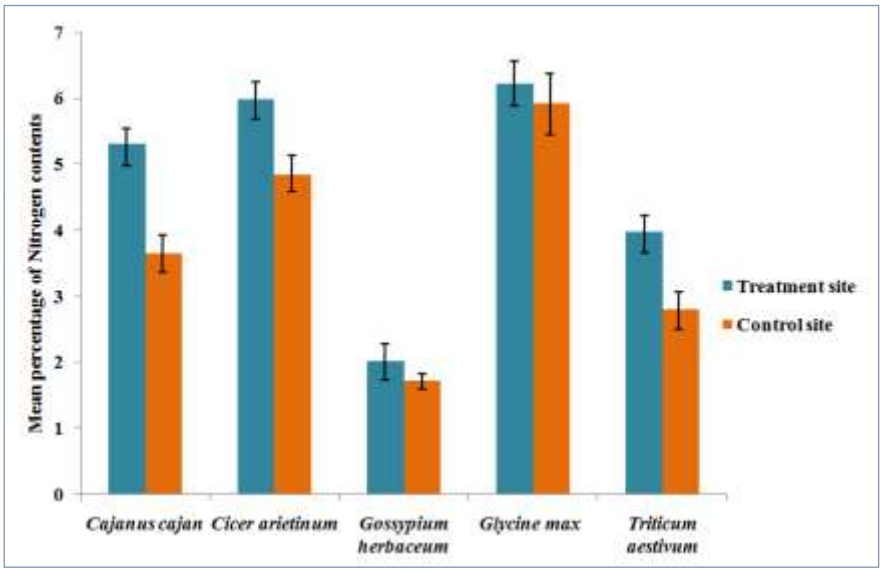

Figure 4: Comparative quantification of nitrogen content in crop plants from selected site.

The lipid content was noted maximum in *Glycine max* (52.63±3.84 mg/gm) from treatment site and the minimum contents of lipid was found in *Triticum aestivum* (11.36±2.63 mg/gm) from control site. The most susceptible plants if compared both the site was *Gossypium herbaceum* (Figure 3). The highest moisture content was noted in *Triticum aestivum* (101.48±3.38 mg/gm) from control site and the minimum contents of moisture was found in *Cicer arietinum* (50.48±4.22 mg/gm) from treatment site. The most susceptible plants if compared both the site was *Triticum aestivum*. Here, the maximum reduction in moisture content from treatment site was noted by 23.72 mg/gm. While, the minimum reduced moisture was found in *Glycine max*. There, the contents were found to be increased by 6.44 mg/gm (Figure 3).

Unlike to present report, Rezanejad et al.[17] findings revealed that *Lagerstroemia indica* L. pollen extracts from contaminated locations had less soluble protein when exposed to SO_2, NO_2, CO, and Aerial Particulate Matter (APM). In a different report, Rezanejad[10] found that pollen grains from the contaminated area were smaller than the control area, and exhibited broken exine. HPLC showed that polluted pollen accumulates flavonoids much more than unpolluted pollen, whereas, SDS-PAGE does not clearly distinguished between pollen from polluted and non-polluted sites. In the evaluation of the impact of air pollution on the release of allergy pollen proteins in *Cassia siamea*[18], it was reported that pollen extract taken from polluted sites caused a greater response in Swiss albino mice than pollen extract collected from unpolluted sites.

In the report on *Acer negundo* pollen[9], results showed lower protein content in pollen exposed to SO_2 had while pollen subjected to NO_2 had slightly greater protein content. When SO_2 and NO_2 were exposed jointly, the amount of soluble protein gradually decreased with an increase in the concentration range ($P<0.05$)[19]. Similar kinds of studies were reported on the effects of air pollution on the morphology and pollen contents[20-23].

4. Conclusion

Pollen is a cosmopolitan biological entity that is susceptible to changing environmental conditions. The environmental contaminant affects the pollen contents in susceptible plants to the extent that it can cause severe alterations in the pollen properties. The influence of the pollution is uncertain and it may cause either elevation or reduction in the pollen contents.

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