

# EFFECT OF METEOROLOGICAL PARAMETERS ON POLLEN CONCENTRATION IN THE ATMOSPHERE OF ISLAMABAD

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## **Abstract:**

*This study is aimed to find meteorological factors affecting pollen concentration in Islamabad. For that purpose, five years data (2003-2007) of pollen concentration and meteorological parameters is utilized. Pollen concentration in the atmosphere is measured using RotoRod sampler. Extremely high pollen concentration in the month of March and relatively less high concentration in July are recorded. These high concentrations are mainly due to Paper mulberry tree. Meteorological parameters affect pollen concentration in the atmosphere by two ways (1) production (2) dispersion. Different meteorological parameters like relative humidity, max temperature, min temperature, mean temperature, precipitation, and wind speed are correlated with total pollen count (TPC) to draw a relationship which is useful for allergy patients. The results showed that relative humidity, max temperature, min temperature and precipitation of winter months (DJF) are the factors which influence pollens of paper mulberry tree and hence TPC in March-April. These parameters were used in order to develop a predictive model.*

**Keywords:** *Pollen, Paper Mulberry, Meteorological Parameters, Multiple Regression, Predictive model*

## **Introduction:**

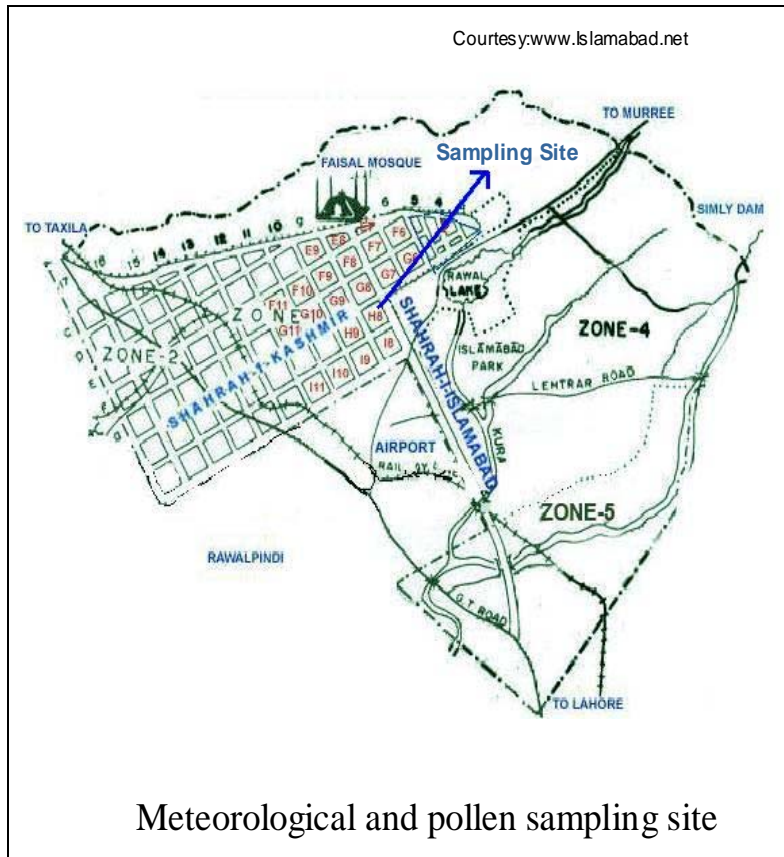
Pollen has a very important role to trigger allergic respiratory diseases. Human health is directly affected due to the presence of their high concentration in the atmosphere. Main aim of this study is to identify meteorological factors which are affecting pollen in the atmosphere of Islamabad, the capital city of Pakistan. Its location on the world map is 33° 42' N, 73° 10' E. The climate in Islamabad varies from an average daily low of 2° C in January to an average daily high of 40° C in June. Half of the annual rainfall occurs in July and August, averaging about 255 millimeters in each of these two months. The remainder of the year has significantly less rain, amounting to about fifty millimeters per month. Hailstorms are common in the spring.

In Islamabad, there is an excess of vegetation, and a lot of wild plants which produce their pollens, at different times of the year, usually from early spring till late autumn. But there is a peak of pollen allergies in spring season. Although, there are other types of plants, e.g., grasses, cannabis, dandelion, alternaria, pines, whose pollen are also known to cause allergies in spring, the paper mulberry tree has been the focus of

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attention ever since pollen allergy was first recognized as a threat to human health in Islamabad. Most of the people who suffer severe allergy symptoms, like asthma attack, are allergic to the pollen of paper mulberry.



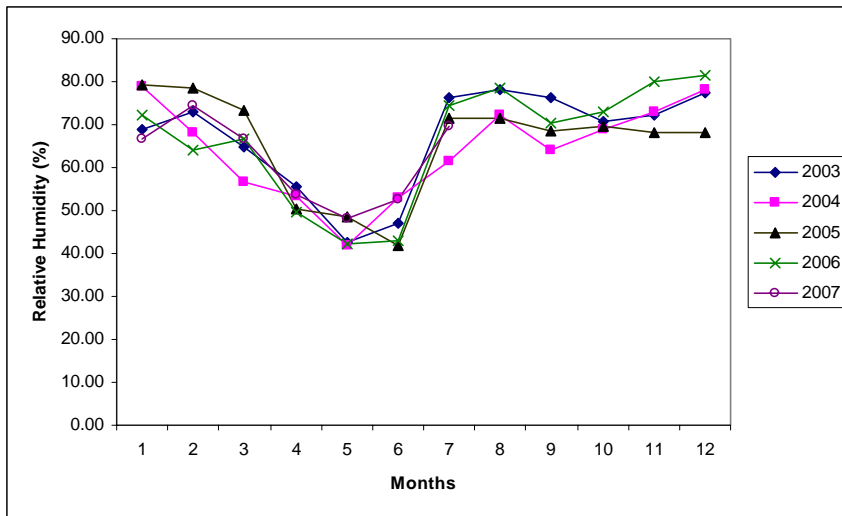
Previously many studies have been conducted to examine pollen of different species and its relationship with meteorological parameters. In those studies max temperature, min temperature, mean temperature, relative humidity, precipitation, wind speed, wind direction, sea level pressure, sunshine hours and dew point temperature were correlated with pollen concentration (e.g. Carmen Galan et.al 1999,Edita Stefanic et.al 2005,Elzbieta Weryszko-Chmielewska et.al 2006 ).Some authors predicts onset of the main pollen season by applying statistical approaches (Mohamed Laaidi et.al 2003).No such study has yet been published for Islamabad . This study is aimed to find meteorological factors affecting pollen concentration in the atmosphere of Islamabad.

### Materials and Methods:

Five years data (2003-2007) of daily pollen concentration and meteorological parameters is used in this study. Pollen monitoring is done using a Rotorod sampler. The sampler is located on top of the Pakistan Meteorological Department building. The rod is coated with silicon grease to trap the pollen grains. Everyday sampling rod is

detached and pollens are analyzed under a microscope and are manually counted for total pollen count (TPC).

Meteorological data was obtained from Pakistan Meteorological Deptt. Meteorological parameters like min temperature, max temperature, mean temperature, relative humidity, precipitation and wind speed are analyzed. The relationship between Meteorological parameters and daily total pollen concentration was calculated by using spearman's correlation coefficient. Multiple regression analysis technique was also used. This



analysis was performed by using statistical package SPSS 13.0 for windows.

Figure 1: Relative Humidity

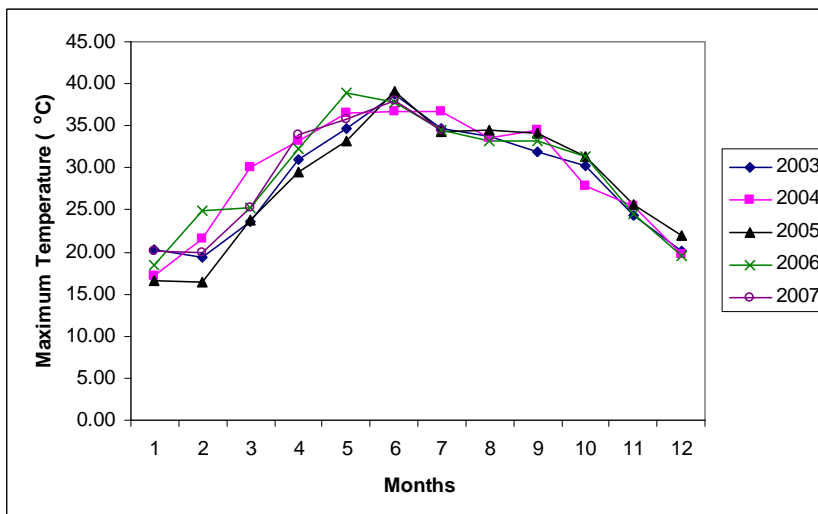


Figure 2: Maximum Temperature

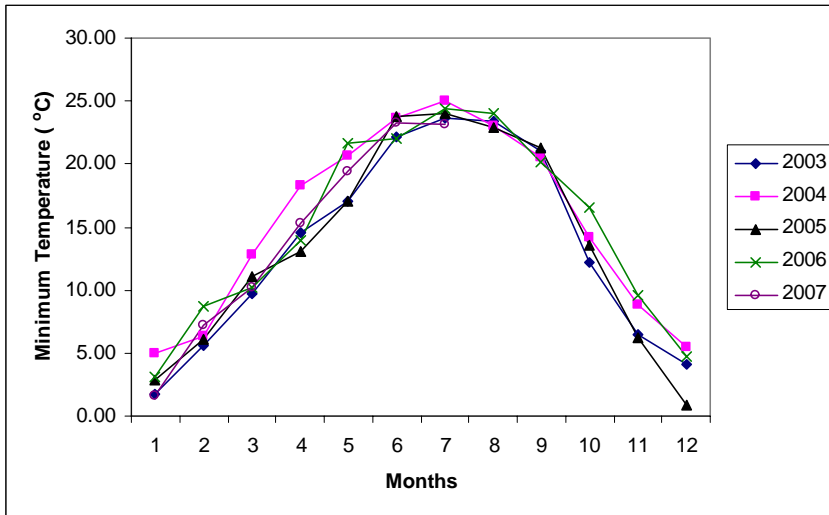


Figure 3: Minimum Temperature

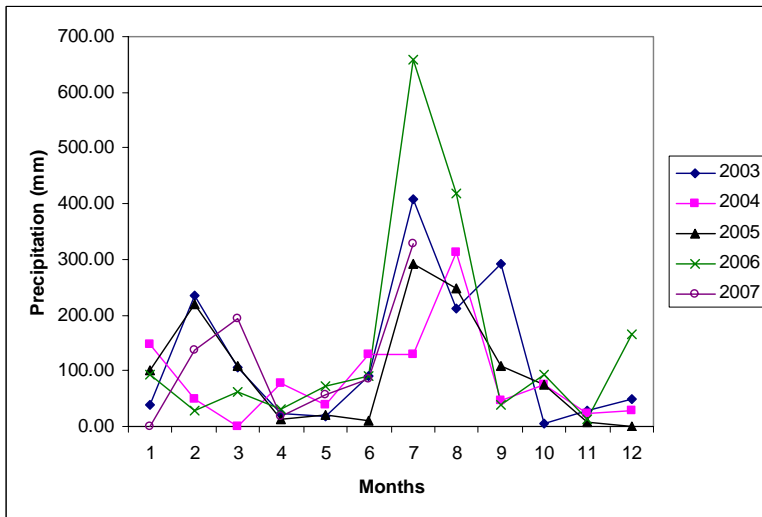


Figure 4: Precipitation

### Results and Discussion:

Table 1 provides the information about the pollen season for paper mulberry pollen throughout the study period. This type of the pollen is present in the atmosphere in spring season mainly (March - April). Mean starting date of the pollen season is 24 March. Average duration of the spring season pollen is 37 days. Maximum

concentration of the pollen was on 26 Mar 2005. The highest value recorded was 48080 (pollens/m<sup>3</sup>). Average number of days when pollen concentration remains very high is 43 days.

Table 1: **Main pollen season**

Years	2003	2004	2005	2006	2007
Peak day	28-Mar	13-Mar	26-Mar	27-Mar	26-Mar
Peak Count	38946	33151	48080	42845	39694
Season duration	18 Mar - 25 Apr	4 Mar - 7 Apr	16 Mar - 23 Apr	16 Mar -22 Apr	14 Mar - 15 Apr
No of Days of Season	39	35	39	38	32
No of Days throughout the year when Daily Count > 200 & < 500	33	53	68	49	44
No of Days throughout the year when Days Count > 500 & <1500	31	35	29	24	22
No of Days throughout the year when Daily Count > 1500	47	39	53	53	40

Daily total pollen concentration data was correlated to the daily meteorological data through out the study period (Elena Gottardini et. al, 1997 & Paul John Stennett et. al, 2004). No significant correlation was found except precipitation. This negative correlation shown in the Table 2 explains the washed out impact of precipitation on the pollen concentration in the atmosphere. This effect is clearly visible in the month of July as shown in the Fig 3.

Table 2: **Monthly Correlations of daily Precipitation and Total Pollen Count throughout the study period**

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PPTN	-0.3760	-0.2036	0.1194	-0.1582	-0.0601	-0.0649	-0.1397	-0.1554	-0.1677	-0.1364	0.2552	-0.0299

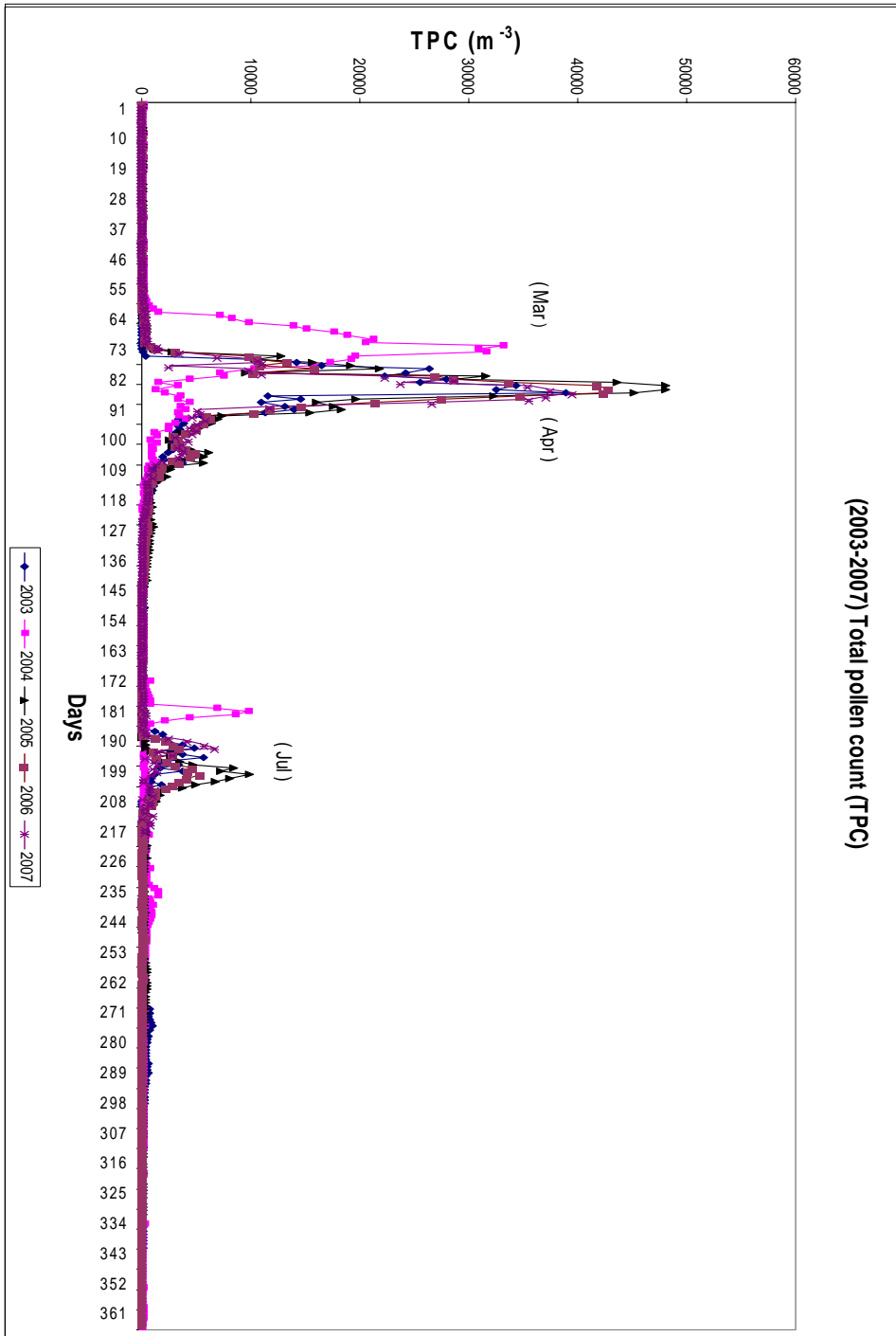


Figure 5: Yearly Total Pollen Count throughout the study period



### The Multiple Regression:

In order to find a relation between pollen in spring season and meteorological parameters, multiple regression technique was used according to the following equation

$$Y = a_1X_1 + a_2X_2 + ..... + a_kX_k + c$$

Meteorological parameters that is to say maximum temperature, minimum temperature, relative humidity, precipitation of winter months (DJF) were used as independent variables and TPC of the month of March was used as dependent variable. (Mohamed Laaidi, 2001)

By using these parameters, a predictive model for the year 2007 was made. This model very well predicts the peak values. The model statistics are given as under

**Model Summary<sup>b</sup>**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.955 <sup>a</sup>	.912	.853	5458.73649	.912	15.532	12	18	.000	1.675

a. Predictors: (Constant), PPTN3, PPTN1, RH2, PPTN2, TempMin1, TempMin3, TempMin2, RH3, RH1, TempMax1, TempMax3, TempMax2

b. Dependent Variable: TPC

**ANOVA<sup>b</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6E+009	12	462806631.4	15.532	.000 <sup>a</sup>
	Residual	5E+008	18	29797804.04		
	Total	6E+009	30			

a. Predictors: (Constant), PPTN3, PPTN1, RH2, PPTN2, TempMin1, TempMin3, TempMin2, RH3, RH1, TempMax1, TempMax3, TempMax2

b. Dependent Variable: TPC



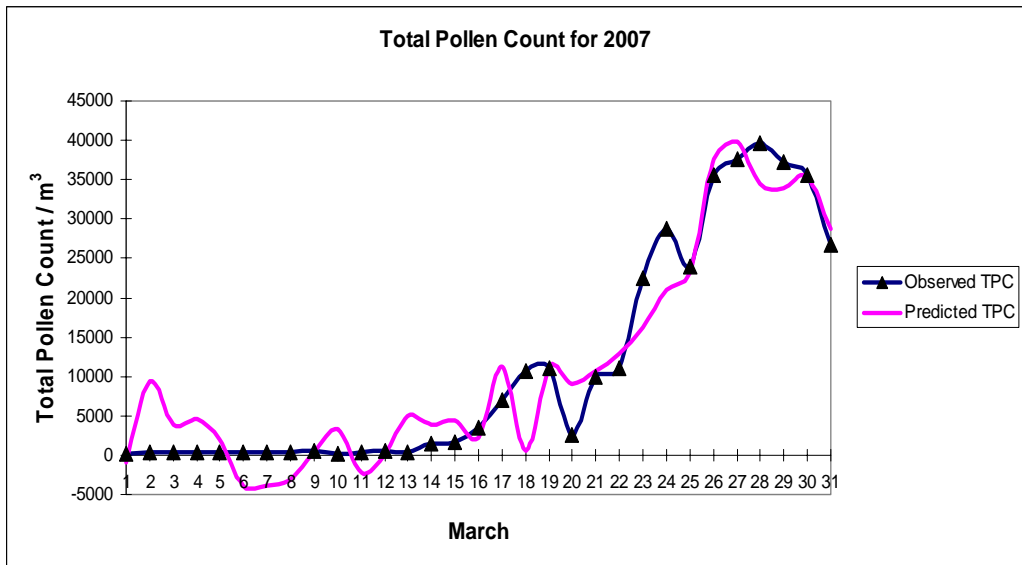


Figure 6: Observed & Predicted values for March 2007

## Conclusions:

Paper mulberry pollen is the most plentiful pollen type present in the atmosphere of Islamabad. Its peak values start from mid March and ends in mid April. This duration is very critical for allergy patients in the investigated region. Statistically significant day to day correlation was observed between selected meteorological parameters and pollen count in some months of the study years but only precipitation was the factor which gives negative correlation in most of the months of the study period. We have also applied a multiple regression technique on one year data in order to derive a predictive model. This model predicts the peak values with 85% accuracy. Our main aim is to make a best predictive model which can be helpful for forecasting the main pollen season prior to its start.

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