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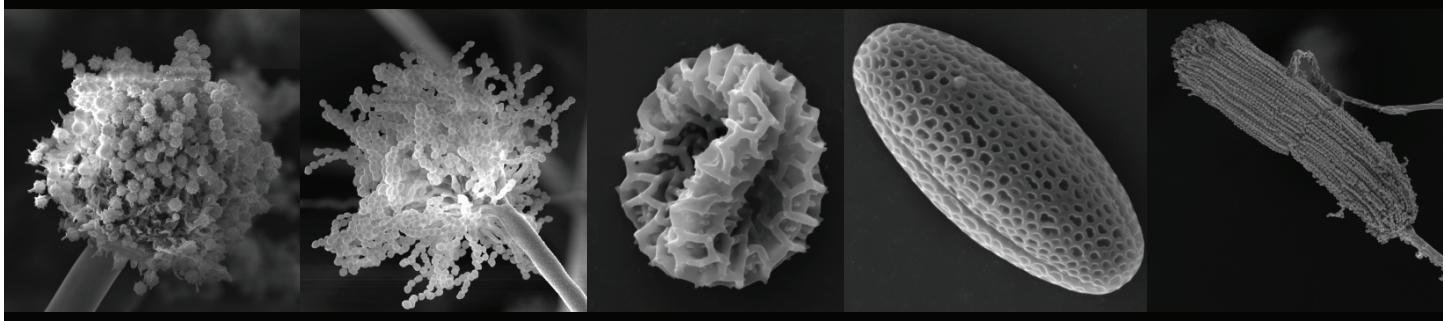

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EXPLORATION OF POLLEN SOURCES AND BEE FLORAL CALENDAR OF GADCHIROLI, MAHARASHTRA

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Honeybees are one of the most important pollinators in nature. The present study was conducted for exploration of diverse polleniferous bee flora and to develop a floral calendar from Gadchiroli District in Maharashtra. Total 83 pollen sources were procured during the study period. Out of which 13 were agricultural crops and 70 wild plants. Among the explored bee forage sources 35 were herbs, 30 trees, 14 shrubs and 4 climbers. Pollen sources were observed in pollen loads belonged to different families. Honeybees visited number of different flowers in a one day. The observed flora was further divided into pollen, nectar and both pollen and nectar yielding plants. During the year 2016 January-June and September- December is the highest honey flow periods except mid June-August were critical dearth periods was observed. This type of bee flora was acted as food source of honeybees throughout the year.

Key Words: Pollen sources, Bee flora, Floral calendar, Exploration .

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INTRODUCTION

Beekeeping is an agro-horticultural and forest-based industry and it is of great importance to farmers for pollination benefit. Insect pollination of agricultural crops is a critical ecosystem service. Honeybees pollinate 16% of flowering plant species in the world and nearly 400 species of agricultural plants[1]. However flowering plants of several plant families are blossoming at different time intervals of the year[2].

Pollen is a reproductive part of male flower. Pollen forms the important primary, secondary metabolites and rich energy source for honey bees. Pollen taxa found in honey and pollen loads are helpful in recognizing bee forage plant.

Every region has its own honey flow and dearth periods of short and long duration. Such knowledge on bee flora will help in the effective management of bee colonies during such periods. Many researchers studied the various aspects of botanical sciences, with special emphasis on floral biology, taxonomy and palynology[3, 4].

The present study was carried out to prepare an inventory of existing polleniferous bee flora and develop floral calendar in Gadchiroli district Maharashtra (India).

MATERIAL AND METHODS

(a) Study sites:

Gadchiroli district is located in the North- Eastern side of the state of Maharashtra. It is situated between 18° 43’ to 21° 50’ North latitude and 780 45’ to 80° 53’

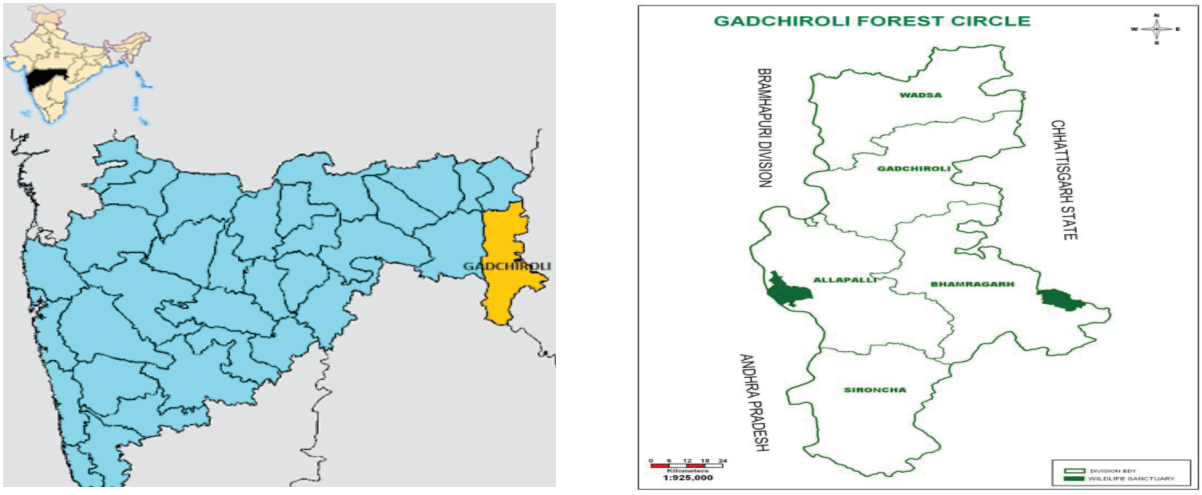

Fig. 1.1: Map of Forest range of Gadchiroli Dist.

East longitude and this essentially indicates the Gadchiroli District is located in the Deccan plateau. District has State borders of Andhra Pradesh and Chhattisgarh and population of district is classifying as backward tribal, land is covered by forest and hills. 78.40% of the land is included in the reserve or protected forest category. District is economically backward and the income source of people is farming because of no industries developed but now very few in progresses. The main crop of the district is paddy. Other agricultural products in district are Jowar, Linseed, Tur, Wheat, and Maize.

(b) Identification of bee-flora from pollen loads:

Each and every month during year 2016 field trips were undertaken to various forest ranges of Gadchiroli District for the collection of bee forage plants (Fig. 1.1). During these visits collection of local flora, study their habits and their utility to honey bees as forage sources were nectar or pollen. The observation of pollen source was based on collection of pollen loads. Polleniferous material of all the identified plants was collected and references slides were prepared using acetolysis method[5]. Enlisting of the plants in the region was made and identified with the help of various flora like The Flora of British India[6], Flora of Madras Presidency[7], Flora of Presidency of Bombay[8], Flora of Maharashtra[9], [10] and relevant research papers and reports.

RESULTS AND DISCUSSION

The present research work was recorded on different polleniferous honeybees foraging plants during January–December 2016. The result revealed that total 83 bee foraging plant species were useful to honeybees (Table 1.1). Out of which 13 were agricultural crops and 70 wild plants. Among the explored bee forage sources 35 were herbs, 30 trees, 14 shrubs and 4 climbers. Pollen sources were observed in pollen loads belonged to different families like Mimosaceae, Amranthaceae, Acanthaceae, Rutaceae, Asteraceae, Liliaceae, Bombaceae, Brassiccaeae, Fabaceae, Combrataceae, Cappraceae, Lecythidaceae, Sapindaceae, Apocynaceae, Caesalpiniaceae, Apiaceae, Commelinaceae, Phyallanthceae, Cucurbitaceae, Cyperaceae, Ebenaceae, Euphorbiaceae, Myrataceae, Convolvulaceae, Lythraceae, Anacadiaceae, Verbanaceae, Solanceae, Lamiaceae, Sapotaceae, Moringaceae, Poaceae, Olacaceae, Punicaeae, Portulacaeae, Pedaliaceae, Malvaceaeand Rhamnaceae. During the year 2016 January–June and September–December is the highest honey flow periods except mid June–August were critical dearth periods was observed (Fig. 1.2).

Analyzed forty-one pollen taxa from seasonal pollen loads at Bursa (Turkey). Most dominant flora/taxa recorded were Brassicaceae, Rosaceae *Centaurea* spp., Fabaceae, *Helianthus annuus* L., *Papaver* spp., *Knautia* spp., Asteraceae, Xanthium spp., *Chrozophora* spp. *Cichorioideae*, *Salix* spp., *Plantago* spp., and *Acer* spp[11]. From Western Ghats of Karnataka studied morphology of Sixty-eight bee forage plants[12].

The study of Anjaneri and Dugarwadi hills, Nashik revealed that 52 plant species were useful to honeybees, out of which 29 were agricultural crops and 23 wild plants. The identified flora was further grouped into pollen, nectar and both pollen and nectar yielding plants. Mid-December to February and mid- July to September were identified as honey flow periods and mid-April to mid-June were the critical dearth periods during the

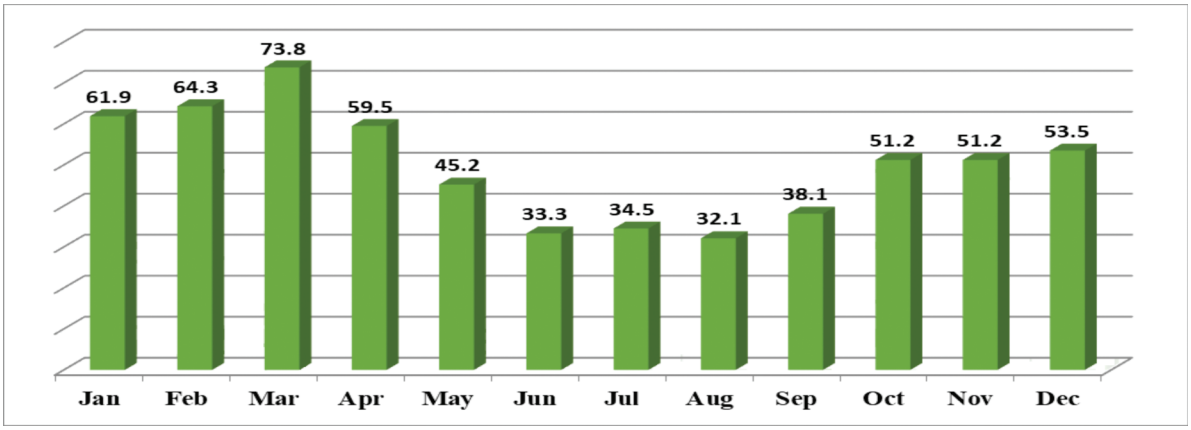

Fig. 1.2: Percent abundance of Total Bee Flora during 2016

year. It was observed that the bee-flora consist of mostly ornamentals, timber, medicinal, fruits, vegetables and other commercially important plants like spices, pulses, cereals, oilseed/yielding, fiber, and fodder crops[13]. Recorded 79 bee forage sources of plants belonging to 24 families. 66 species were recorded as nectar sources, while 77 species as pollen sources[14]. From Nagaland total 69 foraging plants of *A. cerana* and 64 foraging plants of stingless bees in foot hill. The bee flora was observed mostly wild, timbers, ornamentals, medicinal, fruits, vegetables, and other agricultural important plants like pulses, cereals, oil yielding, fiber and fodder crops etc. these plant species served as the good sources of pollen and nectar in the study area. In dearth period when agricultural crops are not in blooming then weeds and wild flowering plants were observed as alternative food sources for honey bees. Wild flora is providing nectar and pollen sources all around the years[15].

Table 1.1: Bee floral calendar of study area

1. *Acacia* spp	-	Mimosaceae	Around year	Tree
2. *Achyranthus aspers* L.	Aghada	Amranthaceae	Oct-Feb	Herb
3. *Adhatoda vasica* Nees	Adulsa	Acanthaceae	Oct-Apr	Shrub
4. *Aegle marmelos* Corr	Bael	Rutaceae	Jan-Apr	Tree
5. *Ageratum conyzoides* L.	Osadi	Asteraceae	Around year	Herb
6. *Albizia procera* (Roxb).Benth	Pandra siras	Mimosaceae	May-Jan	Tree
7. *Allium cepa* L.	Kanda	Liliaceae	Jan-Apr	Herb
8. *Altarnanthera sessilis* R.Br	-	Amranthaceae	Around year	Herb
9. *Amaranthus caudatus* L.	-	Amranthaceae	Oct-Feb	Herb
10. Asteraceae type	-	Asteraceae	Around year	
11. *Barleria prionitis* L.	Katekorati	Acanthaceae	Feb-Jul	Shrub
12. *Bombax ceiba* L.	Katesawri	Bombaceae	Feb-Apr	Tree
13. *Brassica* spp	-	Brassiccaeae	Oct-Mar	Herb
14. *Butea monosperma* (Lam.) Taub.	Palas	Fabaceae	Jan-Apr	Tree
15. *Blumea lacera* L.	-	Asteraceae	Dec-Mar	Herb
16. *Cajanus cajan* (L.) Millsp	Tur	Fabaceae	Oct-Jan	Shrub
17. *Calycopteris floribanda* (Roxb.) Lam.ex Poir	Jhaal/Ukshi	Combrataceae	March-May	Climbing shrub

18. *Capparis grandis* L.f.	-	Capparaceae	Mar-Apr	Climber
19. *Careya arborea* Roxb.	Kumbhi	Lecythidaceae	Feb-Mar	Tree
20. *Cardiospermum halicacabum* L.	Kapalphodi	Sapindaceae	Jul-Dec	Herb
21. *Carthamus tinctorius* L	Kardi	Asteraceae	Mar-May	Herb
22. *Carissa carandas* L.	Karavanda	Apocynaceae	March-June	Shrub
23. *Cassia fistula* L.	Amaltas	Caesalpiniaceae	Mar-May	Tree
24. *Cassia siamea* Lam	-	Caesalpiniaceae	July-May	Tree
25. *Cassia tora* L.	Tarota	Caesalpiniaceae	July-Nov	Herb
26. *Cassia occidentalis* L. var. aristata		Caesalpiniaceae	July-Dec	Shrub
27. *Celosia argentea* L.	Kukada	Amranthaceae	Sept-Mar	Herb
28. *Coriandrum sativum* L.	Dhane	Apiaceae	Nov-Jan	Herb
29. *Commelina benghalensis* L	Kenna	Commelinaceae	Aug-Dec	Herb
30. *Citrus* spp.	-	Rutaceae	Sep-Nov	Shrub
31. *Cleistanthus collinus* Roxb. Benth	Garari	Phyallanthceae	Feb-May	Tree
32. *Cucurbita pepo*	Kohal	Cucurbitaceae	Aug-Oct	Climber
33. *Cyperus rotundus* L.	Nagarmotha	Cyperaceae	Jan-Dec	Herb
34. *Delonix regia* Raf.	Gulmohar	Ceasalpiniaceae	Apr-Jan	Tree
35. *Dalbergia lanceolaria* L.f		Fabaceae	Apr-July	Tree
36. *Echinops echinatus* Roxb.	Utkatar	Ebenaceae	Nov-Apr	Herb
37. *Embelica officinalis* Gaertn.	Amla	Euphorbiaceae	Jan-Mar	Tree
38. *Erythrina indica* L.	Pangra	Fabaceae	Mar- Oct	Tree
39. *Eucalyptus globulus* Labill.	Nilgiri	Myrtaceae	Dec-Mar	Tree
40. *Evolvulus alsinoides* L.	Visnukranthi	Convolvulaceae	Jan-Dec	Herb
41. *Feronia elephantum* Correa	Kawat	Rutaceae	Dec-May	Tree
42. *Helianthus annus* L.	Suryaphul	Asteraceae	Jan-Dec	Herb
43. *Hygrophila auriculata* Heyne	Untskatra	Acanthacaea	Oct-May	Herb
44. *Hyptis suaveolens* poit	-	Lamiaceae	Oct-Jan	Herb
45. *Justicia procumbens* L.	Hucchu	Acanthaceae	Jan-Dec	Herb
46. *Lagerstromia parviflora* Roxb.	Sehna	Lythraceae	Jan-Apr	Tree
47. *Lannea coromondelica* Merr	Hahaiw	Anacardaceae	Feb-Jul	Tree
48. *Lantana camera* L.	Hadadh Kunku	Verbanaceae	Jan-Dec	Shrub
49. *Laecaena leucocephala* (Lamk)	Subabul	Mimosaceae	Around year	Tree
50. *Lycopersicon esculentum* L.	Tomato	Solanceae	Jan-Dec	Herb
51. *Leonotis neptifolia* (L.) R.Br	Kandilpushp	Lamiaceae	Oct-Jan	Herb

52. *Launaea procumbens* (Roxb)	Pathari	Asteracea	Nov-Dec	Herb
53. *Madhuca longifolia* (Koen) Macbr	Moh	Sapotaceae	Mar-Apr	Tree
54. *Mangifera indica* L.	Amba	Anacardiaceae	Dec-Mar	Tree
55. *Mimosa* spp.	-	Mimosaceae	Dec-Mar	Herb/Shrub
56. *Moringa oleifera* Lam.	Mugna	Moringaceae	Nov-Feb	Tree
57. *Momordica charantia* L.	Karla	Cucurbitaceae	Jan-Mar	Climber
58. *Ocimum* spp	Tulsi	Lamiaceae	Jan-Dec	Herb
59. *Oryza sativa* L.	Dhan	Poaceae	Sept-Oct	Herb
60. *Olax psittacorum* (Lam.) Vahl	Hartfari	Olacaceae	Mar-Jun	Shrub
61. *Punica granatum* L.	Dalimb	Punicaeae	Nov-Mar	Tree
62. *Pongamia pinnata* (L.) Pierre	Karanji	Fabaceae	Mar-May	Tree
63. *Portulaca oleracea* L.	Ghol	Portulacaeae	Oct-Jan	Herb
64. Poaceae or Graminea		Poaceae		Herb
65. *Prosopis julifera* (Sw.) DC.		Mimosaceae	Sept-May	Shrub
66. *Schleichera oleosa* Oken	Kusum	Sapindaceae	Feb-Mar	Tree
67. *Sesamum indicum* L.	Til	Pedaliaceae	Jan-Dec	Shrub
68. *Sphaeranthus indicus* L.	Gorkhmundi	Asteraceae	Around year	Herb
69. *Sida acuta* Burn	Tupkadi	Malvaceae	Sept-Dec	Shrub
70. *Sida cordifolia* L.	Bala	Malvaceae	Oct-Dec	Herb
71. *Sonchus oleraceus* L.	Bala	Asteraceae	Oct-Dec	Herb
72. *Solanum melongena* L.	Vanga	Solanaceae	Jan to March, June to July	Herb
73. *Sapindus emarginatus* L.	Ritha	Sapindaceae	Oct-Mar	Tree
74. *Syzygium cumini* L.	Jambul	Myrataceae	Mar-May	Tree
75. *Rungia repens* L.	-	Acanthaceae	Around year	Herb
76. *Tamarindus indica* L.	Chinch	Caesalpiniaceae	Apr-June	Tree
77. *Tectona grandis* L.f	Sagwan	Verbanaceae	Sep-Jan	Tree
78. *Terminalia* spp	-	Combretaceae	Feb-May	Tree
79. *Tridax procumbens* S.L.	Kambarmodi	Asteraceae	Jan-Dec	Herb
80. *Vernonia cinerea* Less.	Sahadevi	Asteraceae	Jan-Dec	Herb
81. *Woodfordia fruticosa* Kurz	Jilbili	Lythraceae	Jan-Apr	Shrub
82. *Xanthium strumarium* L.	Gokru	Astraceae	Jan-Nov	Shrub
83. *Ziziphus mauritiana* Lam.	Bor	Rhamnaceae	July-Oct	Tree

CONCLUSION

The present work was done on 83 plants species useful for bee keeping. As per the observation recorded different fruit, vegetables, cereals, pulses, oil yielding, ornamental, fibers and wild plants species were the provider of nectar and pollen for honey bees. The results also shows that the study area has large number of pollen yielding sources were available. To maintain the existing bee flora and growing more plants or to conserve all bee forage plants in the study area.

REFERENCES

1. Crane, E. & Walker P. 1984. Pollination directory for World Crops. International Bee Research Association, London.
2. Free, J. B. 1970. Insect pollination of crops. Academic press, London, 544.
3. Ramchandran, S. 1936. Beekeeping in South India, Govt. press, Madras, 1936.
4. Deodikar, G. B. 1961. Some Aspects of Bee botany. Prof. S. P. Agharkar Commemoration, 61-78.
5. Erdtman, G. 1960. The acetolysis method, a revised description. Svensk Botanisk Tidskrift 39, 561–564
6. Hooker, J. D. 1892. Flora of British India. Volume 7. London, U.K..
7. Gamble, J. S. &. Fischer C.E.C. Flora of the Presidency of Madras (repr. Ed. 1957. Calcutta). 1915-93.
8. Cooke, T. C. 1958. reprint edition Flora of the Presidency of Bombay Presidency. Volume 1-3. Botanical Survey of India, Kolkata, pp. 435, 474, 478.
9. Almeida, M. R. 1998. Flora of Maharashtra. Volume 2. Bltter Herbarium, St. Xavier's College, Mumbai, pp. 102, 207, 208, 282.
10. Singh, N. P., Lakshiminarasimhan, S. Karthikeyan and P. V. Prasanna 2001. Flora of Maharashtra state, Dicotyledons Vol. II. Botanical Survey of India. Calcutta.
11. Bilisik A., Cakmak, I., Bicaksi, A. and Malyer, H. 2008. Seasonal variation of collected pollen loads of honey bees (*Apis mellifera anatolica* L.). Grana 47: 70-77.
12. Shubharani, R., Roopa, P. & Sivaram, V. 2013. Pollen morphology of selected bee forage plants. Global Journal of Bioscience and Biotechnology 2. (1): 82-90.
13. Bhalchandra, W., Baviskar R. K. & Nikam, T. B. 2014. Diversity of nectariferous and polleniferous bee flora at Anjaneri and Dugarwadi hills of Western Ghats of Nasik district (M. S.) India. Journal of Entomology and Zoology studies 2(4): 244-249.
14. El-Kazafy A. T. 2015. A study on nectar and pollen sources for honeybee, *Apis mellifera* L. in Al-Ahsa Saudi Arabia Journal of Entomology and Zoology studies 3(3): 272-277.
15. Singh A. K. Jaiswal, D. K., Singh, H. K. & Thakur R. K. 2016. Diversity of bees' Ffora and floral calendar of native honeybees in Nagaland, India. Advances in Life Sciences 5(6): 2285-2292.

EFFECT OF ATMOSPHERIC PM_{10} AND GRASS POLLEN GRAINS ON PEAK EXPIRATORY FLOW RATE AMONG THE BOYS ATTENDING A PLAYGROUND IN THE CITY OF HOWRAH, WEST BENGAL, INDIA

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Airborne particulate matters with diameter ≤ 10 μm (PM_{10}) often affects respiratory efficiency. Among atmospheric bioparticles, grass pollen grains frequently induce allergic respiratory problems. Peak expiratory flow rate (PEFR) is an indicator of the respiratory function in response to environmental trigger in human, which can be measured easily in field survey by a portable peak flow meter.

A study was conducted to observe the association of environmental PM_{10} and grass pollen grains on afternoon PEFR level among healthy boys (10-15 years age, n = 31), attending a football playground in an industrial area of Howrah city, West Bengal, India, in the year 2018. The PEFR values were recorded at weekly interval. The concentration of atmospheric PM_{10} of Howrah city were recorded from the website of West Bengal Pollution Control Board. To assess the exposure level, monitoring of local airborne grass pollen was conducted using Burkard 7-day volumetric sampler. The decrease of the afternoon PEFR was found to be significant, mostly in winter – i.e., in December-February, in relation to the reference month of July ($p < 0.05$), indicating optimum level of average PEFR value. The weekly concentration of PM_{10} in the environment of Howrah ranged from 34 $\mu g/m^3$ air (3rd week of August) to 453 $\mu g/m^3$ air (4th week of January). The highest average concentration of airborne grass pollen was recorded in February (45.6 pollen grains/day/m^3 air) and September (29.8 pollen grains/day/m^3 air). In statistical analyses, the percentage change from the baseline PEFR among boys was found to have significant negative correlation ($p < 0.05$) with atmospheric PM_{10} level, which was not significant for the level of airborne grass pollen grains. The study describes the type of association of ambient PM_{10} and grass pollen exposure with the afternoon PEFR of healthy boys in the city of Howrah for the first time.

Key Words: Peak expiratory flow rate (PEFR), health boys, airborne PM10, grass pollen grains, Howrah city.

Received: 15.09.2021 Revised: 28.09.2021 Accepted: 16.10.2021

INTRODUCTION

Various particulate matters are present in the in the atmosphere, which can affect the respiratory function. Among these, the particulate matters with diameter ≤ 10 micrometer (PM_{10}) are important to induce respiratory allergy/asthma in susceptible population[1, 2] and grass pollen grains are well known bioparticles to affect respiratory efficiency[3].

To monitor respiratory efficiency, there are different parameters, which are used for diagnostic purpose. Among these, the peak expiratory flow rate or PEFR (the highest expiratory flow rate just following an optimum inspiration) is very important. PEFR is found to be directly related with forced expiratory volume in 1 second (FEV_1)[4] of lung function test, which is possible to conduct only in diagnostic centres in general. Measurement of peak flow rate can easily be conducted by peak flow meter, which is light-weight, easily portable, low-cost and less time-taking4 for use. As the PEFR value helps to assess the level of the airway obstructions, its measurement is useful to monitor the fluctuations in the lung functions indirectly[5]. PEFR is an indicator of the respiratory function in response to environmental trigger.

The present study was conducted to assess the effect of atmospheric PM_{10} and grass pollen grains on the score of peak expiratory flow rate among the boys of 10-15 years age, attending a playground in an industrial area of the city of Howrah, West Bengal, India.

STUDY DESIGN AND METHODS

Study population and survey on peak expiratory flow rate (PEFR)

The survey on respiratory function was carried out among 48 healthy boys aged 10-15 years (Table 2.1), attending the football playground of Bengal Football Club, situated near Belilious Road in the industrial belt of Howrah city, West Bengal, India (Fig. 2.1), in the year 2018.

Table 2.1: Mean peak expiratory flow rate values among the boys attending the football playground in the city of Howrah, West Bengal.

Age in Years	No. of Boys	Mean Peak Expiratory Flow Rate
10	5	155.35 ± 24.34
11	6	199.8 ± 22.33
12	4	265.5 ± 21.81
13	6	254.45 ± 31.22
14	6	291.65 ± 15.22
15	4	310.5 ± 18.45
	Total = 31	**r value = 0.33, p value < 0.01**

The prior permission was obtained from the parents/guardians of all the children, after describing a clear explanation about purpose of the survey.

The healthy boys aged 10-15 years, attending the playground, were included in the study except those with wheezing, respiratory problems, medication histories related to antihistamine and/or corticosteroids etc., history of recent hospital admission within three months prior to the study, clinically significant anaemia, etc.

A total of 48 boys were enrolled, out of which 17 were excluded due to different causes including the exclusion criteria, irregular attendance and unsatisfactory expiratory efforts during the peak flow measurement. The peak flow rates were then recorded in standing position, following the standardized method[6], with the help of Peak Flow Meter (Life Line Medical Devices, India).

Before testing, the procedure was demonstrated to each boy until their full familiarity was achieved. Each boy was instructed to take a breath deeply and then blow into the peak flow meter as hard and fast as possible. Everyone was given two trial runs. Then they blew into the Peak Flow Meter three times and the highest reading was recorded as the final peak expiratory flow in each case. The mouthpieces were properly washed and carefully sterilized for each subject.

The change of percentage of peak expiratory flow rate (PEFR) from the baseline, specific to each subject was mentioned as the PEFR change from 80% of the personal best PEFR[3]. Here, percentage change in the PEFR = [(Daily PEFR – 80% of personal best PEFR)/80% of personal best PEFR] × 100. The average values of percentage change in the PEFR in each record were calculated.

Collection of atmospheric PM_{10} concentration data

The data of PM_{10} concentration in the atmosphere of Howrah city were collected from the Air Quality Infor-

Fig. 2.1: Location of grass pollen monitoring (Narasinha Dutt College) and respiratory health survey in terms of peak expiratory flow rate of boys (Bengal Football Club) in the city of Howrah, India.

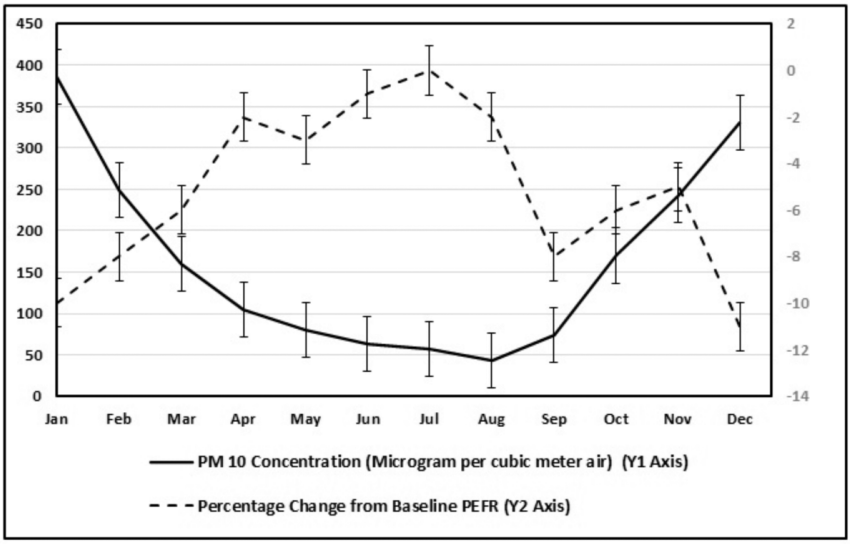

Fig. 2.2: Variation of atmospheric PM10 concentration and the percentage change from the baseline peak flow rate (PEFR) among the boys attending the playground at Howrah city during 2018. (Bars show standard deviation)

mation System of West Bengal Pollution Control Board, (http://emis.wbpcb.gov.in/airquality/ filter_for_aqi.jsp) for the year 2018.

Monitoring of airborne grass pollen

The monitoring of airborne grass pollen grains for the year 2018 was carried with Burkard 7-day volumetric sampler (Burkard Manufacturing Co., U.K.), which was placed on the roof of a building of Narasinha Dutt College, in the city of Howrah (Fig. 2.1). The air suction rate of the sampler was tested as 10 litre/minute by a flow meter. Recording of the atmospheric grass pollen concentrations was done according to the guideline of The British Aerobiology Federation[7].

Statistical analyses

Statistical analyses were performed using SPSS 2.0 software. Here linear regression was observed for the change of percentage of PEFR from the baseline, assumed as the dependent variable upon the environmental PM_{10} and grass pollen in the atmosphere of study area.

RESULTS AND DISCUSSION

The weekly variation of the peak expiratory flow rate of 31 boys in the age group of 10 15 years were recorded throughout the year 2018 at afternoon. All of the boys were the residents of the urban and industrial area of Howrah Municipal Corporation, within the diameter of 500 m from the football playground and the monitoring site of grass pollen at Narasinha Dutt College (Fig. 2.1).

The mean PEFR values are shown in Table 2.1. It was seen that the overall PEF values were increased with the age of the boys. This trend of the increasing PEFR is corroborative to the survey report of Mittal *et al.*[8], among healthy children aged 7 to 14 from Punjab, India. In a cross-sectional study on healthy rural school going children (5-16 years age) at Bellur region of Karnataka, India, significant positive correlation was observed between PEFR and height of the boys ($p < 0.001$, $r = 0.7624$)[9]. As height increases with age in the normally growing human body, this observation seems to be usual, which is supported by the observation from the other parts of the world too[10]. In a recent study from the children of Thailand ($n = 1920$), the age was found as the strongest factor associated with PEFR ($r = 0.838$, $P < 0.001$) in case of boys[11].

The average peak expiratory flow rate among study population was found to be highest during the month of July (Fig. 2.2). The decrease of afternoon PEFR was found to be significant mostly in winter – i.e., in December, January and February, in relation to the reference month of July ($p<0.05$), indicating optimum level of average PEFR value. No significant change was recorded in summer (April-June) and monsoon (August). Regarding the atmospheric particles, the weekly concentration of PM_{10} in the city of Howrah ranged from 34 μg/m3 of air (3rd week of August) to 453 μg/m3 of air (4th week of January), in the study period (Fig. 2.2).

In statistical analyses, the percentage change from the baseline peak flow rate (PEFR) among the subjects and

Fig. 2.4: Variation of atmospheric grass pollen concentration and the percentage change from the baseline peak flow rate (PEFR) among the boys attending the playground at Howrah city during 2018. (Bars show standard deviation)

ing any effect of ambient grass pollen concentration on the PEFR of healthy children till date.

In this way, the observation of the present study clearly depicts that the respiratory efficiency of the healthy boys of study area becomes lower in winter, compared to monsoon and summer. The efficiency showed significant negative correlation with ambient PM_{10} level. A negative correlation was also found between the average PEFR of study population and atmospheric grass pollen count, which is not strongly significant. The result may be useful to get preliminary idea about the effect of atmospheric PM_{10} and pollen grains of study area on the respiratory health of children and its relevant management.

Fig. 2.5: Relation of the percentage change from the baseline peak flow rate (PEFR) among the subjects with the concentration of atmospheric grass pollen of Howrah city during 2018.

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REFERENCES

1. Chakraborty, P., Chakraborty, A., Ghosh, D. Mandal, J., Biswas, S., Mukhopadhyay, U. K. & Gupta Bhattacharya, S. 2014. Effect of airborne *Alternaria* conidia, ozone exposure, PM_{10} and weather on emergency visits for asthma in school-age children in Kolkata city, India. Aerobiologia 30, 137–148. https://doi.org/10.1007/s10453-013-9312-4.
2. Sawitri, N., Rosmajudi, O., Subardja, D. & Melinda, H. 2003. Effect of particulate matter (PM 10) pollutant concentration on peak expiratory flow rate score in junior high school students. Paediatrica Indonesiana 43(3-4): 66-69.
3. Kim, M., Kim, Y. -M., Lee, J. Y., Yang, H. -K., Ahn, S., Baek, S. -Y., Kim, J. & Ahn, K. 2021. Seasonal and monthly variation in peak expiratory flow rate in children with asthma. Asia Pac Allergy 11(2):e19. https://doi.org/10.5415/apallergy. 2021.11.e19.
4. Bheekie, A., Syce, J. A. & Weinberg, E. G. 2001. Peak expiratory flow rate and symptom self-monitoring of asthma initiated from community pharmacies. J. Clin Pharm Ther 26:287-96.
5. Dobra, R. & Equi, A. 2018. How to use peak expiratory flow rate. Arch Dis Child Educ Pract Ed 103:158-62.
6. National Asthma Education and Prevention Program: Expert Panel Report III: Guidelines for the diagnosis and management of asthma. Bethesda, MD. National Heart, Lung, and Blood Institute, 2007. (NIH publication no. 08-4051) www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm (Accessed on September 19, 2018).
7. The British Aerobiology Federation. 1995. A guide to trapping and counting. Kimberly Clark Ltd. U.K.
8. Mittal, S., Gupta, S., Kumar, A. & Singh, K. D. 2003. Regression equations for peak expiratory flow in healthy children aged 7 to 14 from Punjab, India. Lung India 30(3): 183-186.
9. Manjunath, C. B., Kotinatot, S. C. & Manjunatha B. 2013. Peak expiratory flow rate in healthy rural school going children (5-16 years) of Bellur region for construction of nomogram. J Clin Diagn Res 7(12): 2844-2846. https://doi.org/10.7860/JCDR/2013/7758.3773.
10. Agaba, P. A., Thacher, T. D., Angyo, I. A. & Agaba, E. I. 2003. Peak expiratory flow rates in healthy Nigerian children. J Trop Pediatr 49:157 9.
11. Srisingh, K., & Phuaksaman, C. 2021. The reference values of peak expiratory flow rate in Thailand children. Journal of thoracic disease 13(1):31–38. https://doi.org/10.21037/jtd-20-1846.
12. Preutthipan, A, Udomsubpayakul, U., Chaisupamongkollarp, T. & Pentamwa, P. 2004. Effect of PM10 pollution in Bangkok on children with and without asthma. Pediatr Pulmonol 37(3):187-92. doi: 10.1002/ppul.10398.
13. Lee, J. -T., Son, J. -Y. & Cho, Y. -S. 2007. The adverse effects of fine particle air pollution on respiratory function in the elderly. Sci Total Environ 385(1-3):28-36. doi: 10.1016/j.scitotenv.2007.07.005.
14. Central Pollution Control Board. Ministry of Environment and Forests. Government of India. New Delhi. 2008. Assessment of air pollution related respiratory problems in children of Delhi. Environmental Health Series EHS/2/2008. https://cpcb.nic.in/openpdffile.php?id=UmVwb3J0RmlsZXMvTmV3SXRlbV8xNjJfQ2hpbGRyZW4ucGRm (Accessed on 14th March, 2021).
15. Roberts, G., Hurley, C., Bush, A. & Lack, G. 2004. Longitudinal study of grass pollen exposure, symptoms, and exhaled nitric oxide in childhood seasonal allergic asthma. Thorax 59:752– 756.
16. Gruzieva, O., Pershagen, G., Wickman, M., Melén, E., Hallberg, J., Bellander, T., & Lõhmus, M. 2015. Exposure to grass pollen – but not birch pollen – affects lung function in Swedish children. Allergy 70(9): 1181-1183.

PERVASIVENESS AND COGNIZANCE FOR ALLERGIC RHINITIS IN DELHI AND NATIONAL CAPITAL REGION

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Allergic rhinitis (AR) is a global health problem and, defined as a disease of the nasal mucosa characterized by immunological inflammation and manifestation of symptoms for one hour or more on a daily basis without any medication. It is an allergic response to specific allergens affecting around 10-25% of the global population. Therefore, a questionnaire-based cross-sectional study was conducted with 339 randomly selected subjects in Delhi and the NCR of India to investigate the prevalence and awareness for the disorder. 74.92% (254) of the total subjects were experiencing cold and cough at least once a year and were further considered for the study. The majority of the subjects (91.33%) were found sensitive to pollen, grass, dust, temperature change, automobile exhaust, and smog. A high percentage (75.20%) of subjects were unaware of the prospect of this disease. The majority of affected subjects were comfortable using allopathic medications for relief, and few preferred home remedies. As evident from the study, there is a huge hiatus in prevalence and awareness of the disease in India. It is imperative to generate cognizance in the general public for the management of this disease to fill the gap, as in the majority of the cases it remains undiagnosed adversely affecting the general health, quality of life, and social interaction.

Key Words: Allergic Rhinitis, allergens, cold and cough, air pollution, prevalence, awareness.

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INTRODUCTION

Allergic rhinitis is an allergic response to specific allergens affecting around all age groups globally and has various comorbidities associated like, sleep disturbances, fatigue, learning impairment, conjunctivitis, rhinosinusitis, and asthma[1]. Majority of the symptoms of abovesaid disease overlap with respiratory viral infections or cold, thus a plausible factor in late diagnosis of the same. However, AR has a seasonal or perennial component along with clear allergic aggravation and is unlikely to own an accompanying sore throat[2]. Clinically, AR is an inflammatory disorder of the nasal mucosa triggered by IgE mediated inflammation in response to the allergen (pollen, house dust mites, animal dander and molds) and further released histamines stimulate the symptoms like mucus production leading to nasal discharge, nasal itching, sneezing and nasal obstruction. All these symptoms with associated sleep disturbance drastically impact cognitive processes and impair the quality of life[3]. There have been studies to classify AR with respect to various criteria viz: aetiological/allergen causing symptoms, duration of symptoms, severity of symptoms, and pathophysiology. All these classification criteria assist in the diagnosis, and management of the disease[4].

In Asian region, the prevalence of AR is 1.14%–53%[5]. Although in India, prevalence is comparatively high due to high "allergen stockpile" as a result of varied climate, flora, and food habits. A survey by All India coordinated Project on aeroallergen showed that in Delhi, 2002, 20%-30% of the population suffers from AR out of that 15% finally suffered asthma[6]. Again in 2015, it was reported that approximately 30% of Indian population was affected with AR[7]. There is a continuous increase in sensitivity to an allergen in the general population of developed nations. In the United States, approximately 15% population affected with AR and 30% diagnosed by self-assessed nasal symptoms contribute to missed or unproductive time at work and school, sleep problems, and among affected children, decreased involvement in outdoor activities[8]. Therefore, the present study was undertaken to assess the pre-

valence and awareness of the population of Delhi and NCR with respect to AR.

MATERIALS AND METHODS

Questionnaire-based survey

A uniform questionnaire was designed with 36 close-ended questions for obtaining information about the occupational status, mode of transportation, the occurrence of cold and cough and its severity, sensitivity to various allergens, preference to a various mode of medication and adherence to medication as they are the contributing factors in occurrence, diagnosis, and management of the disease. Questions were also designed to check the level of awareness for the disease.

Sample size and data collection

The cross-sectional study was conducted with 339 (29.49% males and 70.51% females) randomly selected subjects belonging to different age groups, residing in Delhi and National Capital Region during June, 2019 to September, 2019. All the participants were assured of confidentiality. Only willing participants were included in the study after receiving written consent.

Data analysis

Collected data were compiled, and analysed by using percentage statistics.

RESULTS

Socio-demographic conditions and analysis of basic symptoms with respect to AR

Among 339 subjects surveyed (29.49% male; 70.51% female), a large proportion of the samples were collected from Delhi only (80.54%). Out of total subjects, 74.93% (n=254) responded in agreement to the first question regarding the occurrence of cold and cough irrespective of frequency, and duration, continued for further study. Among 178 subjects, 70.1% of subjects were experiencing it several times a year or during seasonal changes. The symptoms were more prevalent in females (85.8%, n=205) as compared to males (49%, n=49). Majority of the subjects (54.72%, n=139) were belonging to the age group 11-20 years, and as many as 52 subjects (20.47%) belonging to the age group 21-30 years which is the most efficient age group of any nation. In this concomitant study, a very low number of the subjects (1.57%, n=4) were smokers. It was further studied that 50.79% (n=129) subjects were spectacle users and maximum (85.27%, n=110) belonged to the age group of eleven to twenty years. Also, 91.33% (n=232) were sensitive to a minimum one component including pollen, dust, grass, smog, automobile, heating variation, and air conditioning (Table 3.1).

Study of various symptoms associated with Allergic rhinitis

Symptoms play a major role in discriminating AR from common cold and cough and therefore next step was to study the various symptoms associated. It was found that the majority of the subjects 98.42% (n=250) were experiencing general symptoms like sneezing, running nose, itchy throat, nasal passage, nasal congestion, decreased smell, and snoring during the occurrence of cold irrespective of frequency. Correspondingly, a high percentage of respondents 96.85%, (n=246) had sore, itchy throat with cough, and hoarseness. 73.62% (n=187) subjects were suffered from headache and facial pressure and 74.41% (n=189) with watery, red, itchy eyes, and swollen eyelids. However, only 26.38% (n=67) complaint for breathlessness and 27.56% (n=70) for sleep disturbance. Among 254 subjects, 23.62% (n=60) were forced to miss school or office, showing less productivity (Table 3.2).

Awareness level of about the prospects of the disease, inheritance, and comorbidities

When affected subjects were asked for the prospects of the disease, only 24.8% (n=63) of the subjects among them feel that the occurrence of cold and cough was associated with some disease and not a normal phenomenon. Out of these 63, only 13 (20.63%) subjects believed that symptoms were associated factor for AR and 33.33% (n=21) were in agreement for normal cold and cough, and 20.63% (n=13) as sinusitis.

To assess whether they are aware of the inheritance of disease, a very low percentage of subjects (11.41%) responded that it could be inherited from parents. Among 254 subjects, only 12.6% (n=32) had pneumonia in their past life and 13.78% (n=35) were suffering from asthma (Table 3.3)

Preference for various modes of medications, and surgery for relief

Among 254 subjects, 62.99% preferred to have some medication and only 61.25% (n=98) were relieved. The

majority of subjects 57.5% preferred allopathic medication in the form of pills, nasal spray, inhalers. Preference of homeopathy, ayurvedic and home remedies was 15%, 8.12%, and 19.38% respectively. The overall recovery rate was 61.25% and highest for allopathic medication as 73.91% got relief from the symptoms. In the case of home remedies, the recovery rate was 48.39%.

Only 19.38% of subjects were on regular medication and remaining (80.62%) were taking medication when symptoms got aggravated. Among studied subjects, only 1.69% (n=3) went for nasal surgery and 66.67% (n=2) were again plagued by the disease within three to six months (Table 3.4).

Table 3.1: Socio-demographic conditions and analysis of basic symptoms with respect to Allergic Rhinitis (Figures in parentheses indicate percentage)

Parameter	No. of Subjects (%)
Total Subjects	339
Gender	
Male	100 (29.49)
Female	239 (70.5)
Locality	
Delhi	273 (80.54)
NCR	66 (19.46)
Occurrence of cold	
Yes	254 (74.93)
No	85 (25.07)
Frequency of cold	
Once or twice a year	76 (29.92)
During Seasonal changes	89 (35.04)
Several times a year	89 (35.04)
n	**254 (100)**
Female's segregation	
Symptomatic	205 (85.8)
Asymptomatic	34 (14.2)
n	**239 (100)**
Male's segregation	
Symptomatic	49 (49)
Asymptomatic	51 (51)
n	**100 (100)**
Age of the subject	
11-20	139 (54.72)
21-30	52 (20.47)
31-40	29 (11.42)
41-50	20 (7.87)
51-60	10 (3.94)
61-70	4 (1.57)
n	**254 (100)**
Smoking	
Yes	4 (1.57)
No	250 (98.43)
n	**254 (100)**
Use of spectacle (suffering with cold and cough)	
Yes	129 (50.79)
No	125 (49.21)
n	**254 (100)**
Age from which you are wearing spectacle?	
11 to 20	110 (85.27)
21-30	10 (7.75)
31-40	5 (3.88)
41-50	3 (2.33)
51-60	1 (0.78)
n	**129 (100)**
Sensitive to?	
Pollen/Dust/Grass	85 (33.46)
Pollen/Dust/Grass/Temp. variation/ AC/Smog/Automobile exhaust	57 (22.44)
Smog/Automobile/Heating/AC	90 (35.43)
None	22 (8.67)
n	**254 (100)**

Table 3.2: Study of various symptoms associated with Allergic Rhinitis (Figures in parentheses indicate percentage)

Symptoms	Number of subjects affected with cold & cough once/twice a year	Number of subjects affected with seasonal cold	Number of subjects affected with cold several times a year	Total
Condition of nose during cold Sneezing and running nose, Itchy, Congestion, Decreased smell, Snoring	75 (98.68)	88 (98.87)	87 (97.75)	250 (98.42)
None	1 (1.32)	1 (1.12)	2 (2.24)	4 (1.58)
n	**76**	**89**	**89**	**254**
Condition of throat				
Sore, Itchy, Cough and Hoarseness	75 (98.68)	85 (95.50)	86 (96.62)	246 (96.85)
None	1 (1.32)	4 (4.49)	3 (3.37)	8 (3.15)
n	**76**	**89**	**89**	**254**
Condition of head				
Headache, Facial pressure and Pain	58 (76.32)	61 (68.54)	68 (76.4)	187 (73.62)
None	18 (23.68)	28 (31.46)	21 (23.6)	67 (26.38)
n	**76**	**89**	**89**	**254**
Condition of eyes				
Watery, Red, Itchy and Swollen eyes	56 (73.68)	61 (68.54)	72 (80.9)	189 (74.41)
Dry	0	9 (10.11)	3 (3.37)	12 (4.72)
None	20 (26.32)	19 (21.34)	14 (15.74)	53 (20.87)
n	**76**	**89**	**89**	**254**
Suffer from breathlessness				
Yes	8 (10.53)	22 (24.71)	37 (41.57)	67 (26.38)
No	68 (89.47)	67 (75.28)	52 (58.42)	187 (73.62)
n	**76**	**89**	**89**	**254**
Have your sleep disturbance due to above symptoms?				
Yes	8 (10.53)	31 (34.83)	31 (34.83)	70 (27.56)
No	67 (88.16)	58 (65.16)	58 (65.16)	183 (72.05)
None	1 (1.31)	0	0	1 (0.39)
n	**76**	**89**	**89**	**254**
Have the above symptoms forced you to miss work/school?				
Yes	13 (17.11)	20 (22.47)	27 (30.33)	60 (23.62)
No	62 (81.58)	69 (77.52)	62 (69.66)	193 (75.99)
None	1 (1.31)	0	0	1 (0.39)
n	**76**	**89**	**89**	**254**

Table 3.3: Awareness level of about the prospects of the disease, inheritance and comorbidities (Figures in parentheses indicate percentage)

Parameter	Number of subjects affected with cold & cough once/twice	Number of subjects affected with seasonal cold	Number of subjects affected with cold several time	Total
Are you aware about the disease you are suffering from?				
Yes	14 (18.42)	21 (23.6)	28 (31.46)	63 (24.8)
No	62 (81.58)	68 (76.40)	61 (68.54)	191 (75.20)
n	**76**	**89**	**89**	**254**
If yes, then name				
Food allergy	1 (7.14)	2 (9.52)	3 (10.71)	6 (9.53)
Asthma/Allergy	1 (7.14)	2 (9.52)	1 (3.57)	4 (6.35)
Allergic rhinitis	1 (7.14)	3 (14.28)	9 (32.14)	13 (20.63)
Allergic bronchitis	1 (7.14)	1 (4.76)	2 (7.14)	4 (6.35)
Normal cold and cough	8 (57.15)	9 (42.85)	4 (14.28)	21 (33.33)
Sinus	2 (14.29)	3 (14.28)	8 (28.57)	13 (20.63)
None	0	1 (4.76)	1 (3.57)	2 (3.18)
n	**14**	**21**	**28**	**63**
Do you feel it is genetic?				
Yes	4 (5.26)	9 (10.11)	16 (17.98)	29 (11.41)
No	59 (77.63)	65 (73.03)	67 (75.28)	191 (75.2)
No idea	13 (17.11)	15 (16.86)	6 (6.74)	34 (13.39)
n	**76**	**89**	**89**	**254**
If yes, then inherited from				
Mother	2 (50)	4 (44.44)	5 (31.25)	11 (37.94)
Father	2 (50)	4 (44.44)	9 (56.25)	15 (51.72)
No idea	0	1 (11.11)	2 (12.5)	3 (10.34)
n	**4**	**9**	**16**	**29**
Ever had Pneumonia?				
Yes	9 (11.84)	7 (7.87)	16 (17.98)	32 (12.6)
No	67 (88.16)	82 (92.13)	73 (82.02)	222 (87.4)
n	**76**	**89**	**89**	**254**
Ever had asthma?				
Yes	8 (10.52)	13 (14.61)	14 (15.73)	35 (13.78)
No	52 (68.42)	65 (73.03)	63 (70.79)	180 (70.87)
No answer	16 (21.06)	11 (12.36)	12 (13.48)	39 (15.35)
n	**76**	**89**	**89**	**254**

Table 3.4: Preference for various modes of medications and surgery for relief (Figures in parentheses indicate percentage)

Parameter	Number of subjects affected with cold & cough once/twice	Number of subjects affected with seasonal cold	Number of subjects affected with cold several time	Total
Are you taking medication for relief?				
Yes	34 (44.74)	56 (62.92)	70 (78.65)	160 (62.99)
No	42 (55.26)	30 (33.71)	19 (21.35)	91 (35.83)
No response	0	3 (3.37)	0	3 (1.18)
n	**76**	**89**	**89**	**254**
If yes, is there any relief?				
Yes	18 (52.94)	32 (57.14)	48 (68.57)	98 (61.25)
No	16 (47.06)	24 (42.86)	22 (31.43)	62 (38.75)
n	**34**	**56**	**70**	**160**
Type of medications				
Homeopathy	4 (11.76)	5 (8.93)	15 (21.43)	24 (15)
Allopathy	24 (70.59)	31 (55.36)	37 (52.86)	92 (57.5)
Ayurvedic	4 (11.76)	4 (7.14)	5 (7.14)	13 (8.125)
Home remedies	2 (5.88)	16 (28.57)	13 (18.57)	31 (19.375)
n	**34**	**56**	**70**	**160**
Number of Subjects relieved after medication?				
Homeopathy	4	3 (9.375)	4 (8.34)	11 (11.22)
Allopathy	12	23 (71.875)	33 (68.75)	68 (69.39)
Ayurvedic	2	1 (3.125)	1 (2.08)	4 (4.08)
Home remedies	0	5 (15.625)	10 (20.83)	15 (15.31)
n	**18**	**32**	**48**	**98**
If allopathy, please specify type?				
Pills	15 (62.5)	16 (51.61)	20 (54.05)	51 (55.43)
Nasal spray	4 (16.67)	4 (12.91)	0	8 (8.7)
Pills & nasal spray	2 (8.33)	8 (25.81)	11 (29.73)	21 (22.83)
Others	3 (12.5)	3 (9.67)	2 (5.41)	8 (8.7)
None	0	0	4 (10.81)	4 (4.34)
n	**24**	**31**	**37**	**92**
How regularly you took medicines?				
When required	28 (82.35)	46 (82.14)	54 (77.14)	128 (80)
Regular	6 (17.65)	10 (17.86)	15 (21.43)	31 (19.38)
No answer	0	0	1 (1.43)	1 (0.62)
n	**34**	**56**	**70**	**160**
Have you ever had nasal or sinus surgery?				
Yes	0	1 (1.12)	2 (2.24)	3 (1.18)
No	76 (100)	88 (98.88)	87 (97.76)	251 (98.82)
n	**76**	**89**	**89**	**254**
After surgery did you suffer from allergy again?				
Yes	0	0	2 (100)	2 (66.67)
No	0	1 (100)	0	1 (33.33)
n	**0**	**1**	**2**	**3**

DISCUSSION

Allergic rhinitis is a multifactorial disease affecting both males and females leading to a decline in quality of life. Females are predominantly susceptible to encountering the disease since their adolescence[9]. The role of pollution and climate change in an increased prevalence of nasal allergy is pivotal. The allergy can further aggravate into severe allergic rhinitis and later end up in asthma if remain undiagnosed or undertreated[10]. As allergen load continues to increase leading to worsening of symptoms and overall pathophysiology of the disease. According to a BBC report[11], Delhi was the world's most polluted city in 2015. In the same year, AR survey was conducted in Delhi and 30% of subjects were found to be affected by this disease[7]. According to a study in 2018, the magnitude of pulmonary diseases continuously increasing from the last two decades due to air pollution[12]. In this concomitant study, it was found that 70.1% of young subjects were affected with seasonal and several times cold and cough in a year which could be seasonal or perennial AR, supported by nasal symptoms. It has also been reported that the prevalence of AR is also high in the age group of 10 to 40 years and gradually decline during the later ages[8]. The studied data also signifies the same for the prevalence of cold, cough, and other symptoms which were high in the age group of 11-30 years (75.19%). Parallel disturbance of sleep (27.56%) and breathlessness (26.38%) directly impact the efficiency of subjects.

It has been reported that higher pollution level also exacerbates the pollination cycle of weeds, hence elevate the pollen load within the atmosphere[13, 14]. The climatic conditions along with high humidity are the conducive for the growth of microbial molds and associated with the development of AR and asthma in India[15]. The increased load of pollen, fungal spores, molds, along with dust, pollution (automobile exhaust, smog, etc) and increased temperature causes global warming and contribute to respiratory allergies[16]. In most of cases, lack of awareness leads to an aggravation of symptoms with the season change and misunderstood for normal cold and cough or allergy to normal air pollution.

Most of the subjects experiencing cold and cough showed both nasal and ocular symptoms alongside the use of the spectacle. According to a report, airborne allergens are causative factors for allergic conjunctivitis which can threaten or worsen the eyesight[17]. It was observed that, 50.79% of subjects of the present study were spectacle users and 93.02% of them belong to the age group 11-30 years. Thus, it is plausible to be a general issue of eye-sight weakening in school and college-going children.

Since ancient time in India home remedies are the best medicine for managing cold and cough but in the present study, only 19.37% subjects were using home remedies and the recovery rate was 48.39% as compared to allopathy, a preferred mode of medication (57.5%) and high recovery rate (73.91%). Antihistamines, decongestants, anticholinergic agents, and corticosteroid drug therapy, alone or together, are typically utilized in the treatment of AR. Long-term use have reported side effects like sedation, impaired learning/memory, and cardiac arrhythmias. Therapeutic strategies should seek to decrease the morbidity already associated with this condition. Vitamin C, bromelain (extracted from pineapple plant parts), Urtica dioica or stinging nettle plant, quercetin (a plant pigment), and sometimes N-acetylcysteine (supplement form of cysteine) is advised for the treatment[18].

Health impairment associated with an increase in mental stress and restriction in performing routine activities in case of Allergic rhinitis seriously limits the comfort of an individual thus, it becomes imperative to generate awareness among the population for the same. In the case of allergic rhinitis, late diagnosis or under treatment increases the complications thus, sufficient measures should be taken so that the overlapping symptoms are not being confused for common cold and cough. It is vital to ensure timely and correct diagnosis, and implement appropriate management.

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REFERENCES

1. 1. Cingi, C., Gevaert, P., Mösges, R., Rondon, C., Hox, V., Rudenko, M., Muluk, N. B., Scadding, G., Manole, F, Hupin, C., Fokkens, W. J., Akdis, C., Bachert, C., Demoly, P,, Mullol, J., Muraro, A., Papadopoulos, N., Pawankar, R., Rombaux, P., Toskala, E., Kalogjera, L., Prokopakis, E., Hellings, P. W. & Bousquet, J. 2017. Multi-morbidities of

allergic rhinitis in adults: European Academy of Allergy and Clinical Immunology Task Force Report. Clin. Transl. Allergy 7:17. DOI: 10.1186/s13601-017-0153-z

2. Allan, G. M. & Arroll, B. 2014. Prevention and treatment of the common cold: making sense of the evidence. CMAJ 186: 190-199.
3. Zuberbier, T., Lotvall, J., Simoens, S., Subramanian, S. V. & Church, M. K. 2014. Economic burden of inadequate management of allergic diseases in the European Union: a GA(2). LEN review. Allergy 69: 1275-1279.
4. Emeryk, A., Emeryk-Maksymiuk, J. & Janeczek, K. 2019. New guidelines for the treatment of seasonal allergic rhinitis. Postepy Dermatol Alergol, 36: 255-260.
5. Chong, S. N. & Chew, F. T. 2018. Epidemiology of allergic rhinitis and associated risk factors in Asia. World Allergy Organ J., 1: 17-38.
6. Singh, A. B. & Kumar, P. 2004. Aerial Pollen Diversity in India and Their Clinical Significance in Allergic Diseases. Indian J. Clin. Biochem. 19:190-201.
7. Jaggi, V., Dalal, A., Ramesh, B. R., Tikkiwal, S., Chaudhry. A., Kothari, N., Lopez, M. & Gogtay, J. 2019. Coexistence of allergic rhinitis and asthma in Indian patients: The CARAS survey. *Lung India*, 36: 411-416.
8. Wheatley, L. M. & Togias, A. 2015. Allergic Rhinitis. N Engl J. Med. 372: 456-463.
9. Fröhlich, M., Pinart, M., Keller, T., Reich, A., Cabieses, B., Hohmann, C., Postma, D. S., Bousquet, J., Antó, J. M., Keil, T. & Roll, S. 2017. Is there a sex-shift in prevalence of allergic rhinitis and comorbid asthma from childhood to adulthood? A meta-analysis. Clin. Transl. Allergy 7: 1-9.
10. Settipane, R. J., Hagy, G. W. & Settipane, G. A. 1994. Long-term risk factors for developing asthma and allergic rhinitis: A 23-year follow-up study of college students. Allergy Proc. 15: 21-5.
11. Pandey, V. 2015. BBC News. 'Living dangerously' in polluted Delhi. https://www.bbc.com/news/world-asia-india-33002209.
12. Sharma, A. K., Baliyan, P. & Kumar, P. 2018. Air pollution and public health: the challenges for Delhi, India. Rev. Environ. Health, 33: 77-86.
13. Bhattacharya, K., Sircar, G., Dasgupta, A. & Gupta, B. S. 2018. Spectrum of Allergens and Allergen Biology in India. Int. Arch. Allergy Immunol. 177: 219-237.
14. Shea, K. M., Truckner, R. T., Weber R. W. & Peden, D. B. 2008. Climate change and allergic disease. J. Allergy Clin. Immunol 122: 443-53.
15. Caillaud, D., Leynaert, B., Keirsbulck, M. & Nadif, R. 2018. Mould ANSES working group, Indoor mould exposure, asthma and rhinitis: findings from systematic reviews and recent longitudinal studies. Eur. Respir. Rev. 27: 170137. DOI: 10.1183/16000617.0137-2017.
16. Amato, G. D. & Cecchi, L. 2008. Effects of climate change on environmental factors in respiratory allergic diseases. Clin. Exp. Allergy 38: 1264-1274.
17. Perkin, M. R., Bader, T., Rudnicka, A. R., Strachan, D. P. & Owen, C. G. 2015. Inter-relationship between rhinitis and conjunctivitis in allergic rhinoconjunctivitis and associated risk factors in rural UK children. PLoS One 10: 1-12.
18. Thornhill, S. M. & Kelly, A. M. 2000. Natural treatment of perennial allergic rhinitis. Alternative Medicine Review. A Journal of Clinical Therapeutic 5: 448-454.

FLOWER-VISITORS INTERACTION, POLLEN DISPERSAL AND POLLINATION OF *GELONIUM MULTIFLORUM* A. JUSS. (EUPHORBIACEAE)

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In angiosperms the flowers are the center of pollination where pollen grains are transferred from the anther to the stigma, thereby enabling fertilization and reproduction. Present study examines the flower-visitor interactions, pollen dispersal and pollination of *Gelonium multiflorum* A. Juss., a dioecious species of the family Euphorbiaceae. It flowered during March-May and visited by the members of Hymenoptera, Diptera, Lepidoptera and small Thysanoptera. Pollinators include *Apis* sp., *Trigona* sp., *Vespa* sp., *Camponotus compressus, Ceratina* sp. (Hymenoptera), *Chrysomya* sp., *Eristalinus* sp. (Diptera), *Euploea* sp,. *Borbo* sp. (Lepidoptera) and Thrips (Thysanoptera) which visited flowers for nectar available in a cup-like disc in female flowers and for pollen grains in male flowers. Flowers are small, sessile, and odoriferous with greenish perianth having 61-65 stamens with oblong, dorsifixed anthers crowded on a convex receptacle in male flowers. In average 23,208±185.7 pollen grains were produced by a single male flower and pollen-ovule ratio was 7736:1. Minute style and enlarged staminodes were found in female flowers. During forage, they carry a considerable amount of pollen grains attached to their body parts and helped in pollen dispersal and pollination. Though the plant was visited by different insects, about 8% pollen grains were trapped from the ambient atmosphere at 12:00 hrs. using 'Rotorod sampler' due to the wind-dispersal of pollen grains.

Key Words: Dioecious, flower-visitor, wind- dispersal, pollination, *Gelonium multiflorum*.

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INTRODUCTION

Pollination is a vital phenomenon in the sexual reproduction of flowering plants. This process involves three phases; release of pollen, subsequent dispersal with the help of certain vectors (biotic or abiotic) and placement of pollen on suitable receptive stigma for effective pollination as well as fertilization; all of which occur in succession and show great diversity. The diversity in pollinator species increased as pollinators adapted and coevolved with the expanding variety of plant life. It is widely accepted that a massive loss of biodiversity is occurring worldwide. The application of herbicides and pesticides are growing rapidly in countries harbouring the richest biological diversity. The pollinators are more sensitive and quicker to respond than plants to habitat loss, however, the loss of pollinators is proposed to lead to eventual plant extinctions[1]. Interactions between flowering plants and their pollinators are the result of a long and intimate co-evolutionary relationship. Analysis of fossil records provides insights into the emergence of reproductive structures in certain plants and the selective powers of insect pollinators[2]. In small populations, pollinator's abundance and diversity decrease with decreasing plant population size, and may drop to a point at which pollinator service deteriorates[3]. The plant *Gelonium multiflorum* A. Juss. belongs to the family Euphorbiaceae. It is an important medicinal plant native to the Himalayan mountains, where it is known as the "heavenly fruit" for its medicinal importance[4]. The plant was found to have protein inhibitor[5], anti-HIV[6,7], anticancer[8], and cytotoxic potential[9]. The plant has been identified as a rich source of diterpenoids, and a number of new and novel diter-

penoid lactones[9,10] have been reported from different parts of the plant, along with a few triterpenes[11] and flavonoides[12]. Bark is good tonic for gums, also used in gingivitis and purgative in hepatic troubles[13]. Gelonin, purified from the seeds are used in cation-exchange and gel-filtration chromatography[14]. The goal of present investigation is to study the flower-visitors diversity, their interaction and pollination of *Gelonium multiflorum* growing in and around the University campus at Santiniketan.

MATERIALS AND METHODS

Study site

The study was conducted with the plants growing in and around our university campus at Santiniketan, (87°41′ and 87°42′ east longitudes and 23°42′ north latitude) located in the Birbhum district, West Bengal[15] (Fig. 4.1).

Study species

Gelonium multiflorum is generally dioecious, perennial,

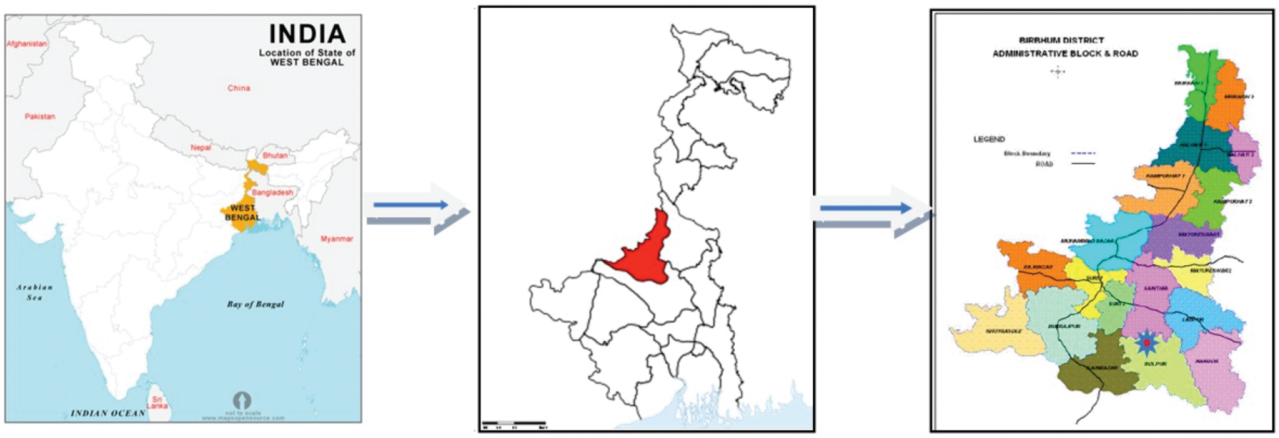

Fig. 4.1: The location of the study area

Table 4.1: Floral morphological and functional characteristics of *Gelonium multiflorum* A. Juss.

	Life form	Small dioecious tree
	Flowering time	March – May
	Flower/Inflorescence	35-56 male flower, 12-18 female flower
	Colour	Greenish
	Odour	Mild Sweet smell
	Shape	Actinomorphic
	Size	Male flower:1-1.2cm in across Female flower:1.5-2 cm in across.
	Perienth	5
	Nectar volume (*µ*l)	2.355 in Male flower, 7.065 in Female flower
	Number of stamens	61-65
	Mode of anther dehiscence	Longitudinal
	Pollen output/Flower	23,208.3±185.7
	Number of Ovules/Flower	Generally 3
	Pollen-Ovule ratio	7736:1
	Pollen type	3 or 4 colporate, Spheroidal, 39.0±0.82×39.4±0.27
Fruit set	**Natural open condition**	62.18±1.08 %
	Netted Condition	26.66±1.25%

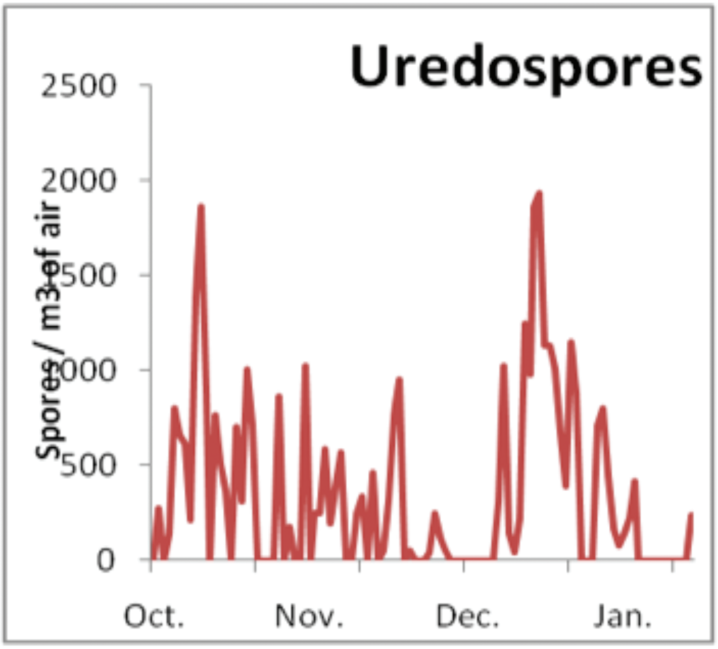

Fig. 5.2: Concentation of smut spores and uredospores in in Rajuri (Navgan), District Beed, Maharashtra.

adverse effect on composition and concentration of airspora. The temperature and high humidity had profound effect on growth and development of spores. This probably justifies high incidence of spores in the months of January and February. The air monitoring surveys undertaken during winter season of the year 2004-2005 showed the peak total airspora concentrastion in winter season (349552/m^3 of air). The weather parameters like monthly mean temperature 22.08°C, monthly mean relative humidity 48.08%, regular irrigation facilities and 4.41 km/hr. wind speed were recorded during the first winter season which incidentally might have favoured increase in the spore load.

The change in humidity occurred during night and early morning hours affect conidial, ascospore and basidiospore liberation[7, 8]. Gregory[7] noted that the atmospheric spore concentration fluctuated with frequent changes in meteorological factors.

Human activities like weeding, interculturing, spraying and dusting affected the composition and concentration of airspora. The fluctuations brought about by such activities were temporary and differed from diurnal and seasonal variations.

REFERENCES

1. Tilak S.T. and Kulkarni, R.L. A new air sampler. Experientia, 1970, 26, 442-443.
2. Durham, O. G., 1943. The volumetric incidence of atmospheric allergens. Spectific gravity of pollen grains. J. Allergy. 14 : 455-461.
3. Durham, O. G., 1946. The volumetric incidence of atmospheric allergens - 3. Rate of fall of pollen grains in still air. J. Allergy. 17 : 70-78.
4. Baruah, H.K. and M. Chetia, 1966. Airspora and allergic human diseases. A study of fungal spores and pollen grains of Gauhati. Ind. J. Exp. Bot., 4: 236-238.
5. Brown, H. M. and F. A. Jackson, 1978. Spore and pollen survey across Britain. The first International conference on Aerobiology, Munich. 1978, pp. 23.
6. Rees, R.G., 1964. The airspora of Brisbane. Aust. J. Bot. 12: 185-204.
7. Gregory, P.H. *The Microbiology* of the Atmosphere, Leonard Hill (Books) Ltd. Interscience Publishers Inc. New York, 1961.
8. Meredith, D. S. Some Components of the airspora in Jamaican banana plantation. *Ann. Appl. Biol.*, 1962, 50, 577-594.

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