Aeromycological Indoor Environmental Study of Bharat Hitech Polyhouse Katurli, Amgaon, Gondia, (Maharashtra) India

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Abstract

Fungal spores in indoor air may come from outdoors by ventilation or they may originate within. When these spores get favourable conditions, they proliferate and cause the deterioration. An aero mycological study verifies the presence and quantifies the concentration of fungal propagules in the air. It is important in the polyhouse setting because of the increasing numbers of fungal diseases and their effect on production. The objective of this study was to determine the concentration of fungi in the air of the two sections of the polyhouse such as the plantation and storage section. A total of 1233 colonies were trapped from feb. 2023 to January 2024 by the exposure petri plate method. Out of 1233 colonies, a total of 633 colonies were found in the plantation and 600 colonies were found in the storage section in the poly house. More fungal spores were recorded in the plantation section as compared to the storage section of the polyhouse. A Total of 5640CFUs/m3 are observed by Hi - media air sampler method. Therewere2860 CFUs/m3 found in plantation section while 2780 CFUs/m3 where found in the in-storage section. Dominant fungi found in the indoor environment of a polyhouse are Aspergillus, Cercospora, Mucor, Penicillium, Rhizoctonia, Cladosporium, Rhizopus and Alternaria.

Keywords: Aerobiology, spore, indoor, concentration, polyhouse

INTRODUCTION

Polyhouse cultivation is the concept of growing potential crops in the modified natural environment for ensuring optimum growth of the crop plants without any or least stress and hence offers great scope to harness this potential of growing the high value crops by achieving independence of climate and weather, and to grow these crops during off - season and in marginal environments. Globally, there is a need to increase productivity and quality of the produce to meet the demand of ever-increasing quality and health-conscious consumers. Most vegetable growers are growing vegetables in conventional techniques in their fields. During vegetable cultivation many diseases and insect incidence occur in their crops at different stages and damaging the vegetable crops and deteriorating the quality. For the management of pests and disease growers are applying the insecticide indiscriminate way. As a result they are getting low yield and poor quality. Growers get a low return due to high expenses on pesticides during vegetable production. Present day it has been proved that growing vegetables under protected cultivation techniques will give higher yield with better quality, and growers can get higher returns per unit area[1].

Aerobiological survey of intramural or extramural environments is the most important aspect in aero-microbiology. Microorganisms like moulds and yeasts are very common in the air, so fungal spores contribute to a major portion of the air spores. Aerobiological survey is of great interest for microbiologists and also has a greater impact on clinicians and allergic patients[2]

Growing crops under polyhouse conditions is gaining importance in the country because of achieving independence from adverse climate and weather, which ultimately influence the overall productivity and quality of the crop produced. Polyhouses are often used in floriculture and nurseries as the economic value of flowers can justify their expense [3]

Fungal diseases constitute one of the biggest groups of foliar pathogens causing immense damage under protected environment [4]. The important fungal diseases include damping-off, crown and root rots, wilts, powdery mildews, downy mildews, *Botrytis* diseases, *Sclerotinia* rot, *Alternaria* diseases, and rust diseases [5]. Proper field sanitation is one of the most important management strategies, since once the buildup of inoculum occurs inside the polyhouse, it is very difficult to manage it.

MATERIAL AND METHOD

Study area:

The investigation was performed in Bharat Hitech Polyhouse Katurli Amgaon Tahsil, in district Gondia (Maharashtra), India, located at Latitude – 21.4590° and Longitude – 80.3130°

Sampling Method

Polyhouse of Katurli, Amgaon Tahsil, in district Gondia, for one year from Feb. 2023 to Jan 2024. Air samples were collected from the two sections of the Polyhouse, viz. Plantation and Storage section by the two methods, such as exposure petriplate method and Hi- media Air sampler Mark-II method. Samples were collected at 15 day intervals with the help of the Petriplate method containing CZapek's Dox Agar (CDA) fortified with streptomycin, two times in a month [6]. The petriplates were kept at five feet from the ground level exposed for 10-12 minutes and then petriplates were properly sealed, marked and incubated at room temperature. After 3-7 days, Colonies were observed, counted and sub - cultured for identification[7].

Air Samples were collected at 15-day intervals with the help of the Hi Air sampler Mark II. Hi Media laboratories, India. Rose Bengal Agar Strips are used in the Sampler, and the sampler is operated for five minutes. Fungal Concentration is expressed as a number of Colonies forming units per cubic meter air, i.e. CFU_s/m^3. After the sampling Rose Bengal Strip removed from the sampler, it is sealed and brought to laboratory for incubation at room temperature, and the growth of fungal colonies is observed.

CFU_s/m^3 is calculated as follows.[8]
$$CFU_s/m^3 = \text{Colonies on agar strip} \times 25$$

Sampling Time in Minute

During the investigation period, climatic variation was found every month; there was more or less rainfall in month of July (232.4 mm) more and less in December, followed by January (5.9mm). Humidity and temperature also vary in every month. Their highest percentage of humidity was in August (85%) and lowest in the month of May (26%), with a high temperature.

RESULT AND DISCUSSION

Anaeromycological indoor environmental study of a polyhouse, data was conducted from February 2023 to January 2024. For this study, two section of polyhouse, such as plantation and storage section were selected. The indoor air sample were collected for one year at fortnightly interval by exposure petriplate method and Hi-media Air sampler Mark-II method..

The total number of colonies trapped by exposure petriplate method in indoor environment of Polyhouse is 1233. Out of total more 633 colonies found in plantation section and less 600 colonies trapped in storage section in (Table 2).

Fungal spore exhibit seasonal variation. The rainy season have highest fungal spore concentration (41.44 %) followed by winter season (32.60%) while summer season have low concentration (25.94%) by petriplate method.

Fungal spores also show monthly variation. The maximum fungal spore concentration was found in month of August (13.54%) followed by September (11.12%), July (9.57%), October (9.40%), November (8.19%), February (7.78%), December (7.70%), January (7.30%), June (7.21%), March (6.65%), April (6.16%) and minimum in month of May (5.35%).

The total number of spores trapped by Hi-media Air sampler method in indoor environment Polyhouse is $5640 CFU_s/m^3$ (Table 3)..

Out of total $5640 \ CFU_s/m^3$ more $2860 \ CFU_s/m^3$ found in plantation section and less in storage section $2780 \ CFU_s/m^3$.

Fungal spore exhibit seasonal variation. The rainy season have highest fungal spore concentration (41.38%), followed by the winter season (32.53%), while the summer season has the minimum concentration (26.05%).

Fungal spores also show monthly variation. The maximum fungal spore concentration was found in month of August (12.85%) followed by September (11.52%), October (9.25%), July (9.21%), November (8.34%), February (8.34%), June (7.80%), March (7.53%), December (7.44%), January (7.00%), April (5.93%) and minimum in May (4.25%). More concentration was found in the plantation section compared to the storage section.

The monthly variation of fungal spore concentration shows similar results by both methods. Fungal spore concentration was highest in the month of August with high humidity and average temperature, while the lowest concentration was found in the month of May having low humidity and high temperature. [9]. Some dominant genera found in the polyhouse indoor environment are *Aspergillus, Cercospora, Mucor, Penicillium, Rhizoctonia, Cladosporium, Rhizopus, and Alternaria.*

Table 1. Meteorological Data of district Gondia (2023-24)

Month	Temperature			Humidity (%)		Humidity Avg. (%)	Precipitation (mm)
	Min.(°C)	Max.(°C)	Avg. (°C)	Min.	Max.		
February- 2023	9	37	23.90	30	89	30	9.4
March- 2023	15	39	26.85	22	79	34	9.1
April -2023	19	42	29.25	20	72	28	7.6
May -2023	19	44	32.00	16	65	26	16.5
June- 2023	22	44	32.57	30	96	55	190.5
July- 2023	22	37	28.37	58	97	83	232.4
August-2023	22	35	27.71	53	98	85	221
September2023	21	37	27.46	49	94	80	137.2
October-2023	16	36	26.64	41	81	65	36.6
November-2023	15	34	23.90	36	75	57	11.9
December-2023	9	32	27.85	34	72	53	5.9
January -2024	8	32	28.55	50	85	50	5.9
Total							**884**

Source - Regional Meteorological Center Nagpur.

Table 2. Exposure Petriplate Method.

Seasons	Month	Total no. of colonies in Polyhouse	Total no. of colonies in Storage Area	Total Fortnightly	Total in monthly	Monthly Percentage (%)	Seasonal Percentage (%)
Summer Season 2023	Feb. 2023	25	24	49	96	7.78	25.94
		24	23	47			
	March 2023	22	21	43	82	6.65	
		20	19	39			
	April 2023	19	20	39	76	6.16	
		19	18	37			
	May 2023	18	17	35	66	5.35	
		15	16	31			
Rainy Season 2023	June 2023	23	22	45	89	7.21	41.44
		23	21	44			
	July 2023	29	27	56	118	9.57	
		32	30	62			
	Aug. 2023	42	40	82	167	13.54	
		44	41	85			
	Sept. 2023	36	34	70	137	11.12	
		34	33	67			
Winter Season 2023-24	Oct. 2023	31	29	60	116	9.40	32.60
		29	27	56			
	Nov. 2023	27	26	53	101	8.19	
		25	23	48			
	Dec. 2023	24	23	47	95	7.70	
		26	22	48			
	Jan. 2024	24	23	47	90	7.3	
		22	21	43			
	Total	**633**	**600**	**1233**	**1233**		

Table 3. Hi - Media air sampler method

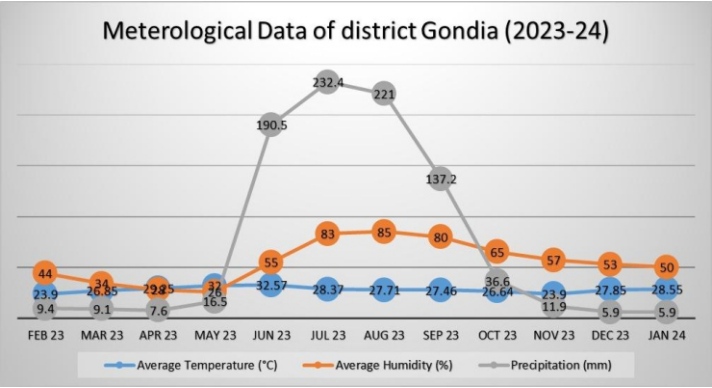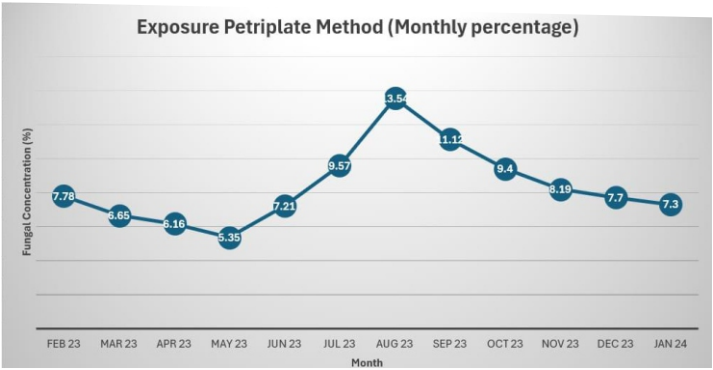| Seasons	Month	Total no. of CFUs/m³ in Polyhouse	Total no. of CFUs/m³ in Storage Area	Total Fortnightly	Total in monthly	Monthly Percentage (%)	Seasonal Percentage (%)
Summer Season 2023	Feb. 2023	125	120	245	470	8.34	26.05
		115	110	225			
	March 2023	110	105	215	425	7.53	
		110	100	210			
	April 2023	90	85	175	335	5.93	
		85	75	160			
	May 2023	60	65	125	240	4.25	
		60	55	115			
Rainy Season 2023	June 2023	105	110	215	440	7.80	41.38
		110	115	225			
	July 2023	130	135	265	520	9.21	
		125	130	255			
	Aug. 2023	180	185	365	725	12.85	
		185	175	360			
	Sept. 2023	165	170	335	650	11.52	
		155	160	315			
Winter Season 2023-24	Oct. 2023	140	145	285	550	9.75	32.53
		135	130	265			
	Nov. 2023	125	120	245	470	8.34	
		115	110	225			
	Dec. 2023	115	95	210	420	7.44	
		110	100	210			
	Jan. 2024	110	95	205	395	7.00	
		100	90	190			
	Total	**2860**	**2780**	**5640**	**5640**		

Figure A. Meteorological Data

Figure B. Monthly variation of fungal spore Concentration by exposure petriplate method in Bharat Hitech Polyhouse Katurli Tah. Amgaon Dist Gondia
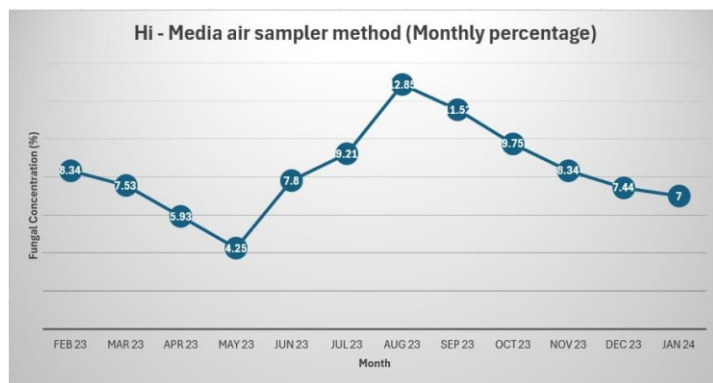
Figure C. Monthly variation of fungal spore Concentration by Hi-media air sampler method in Bharat Hitech Polyhouse Katurli Tah. Amgaon Dist Gondia

CONCLUSION

The highest concentration was found in the plantation section (167 colonies and 725 CFU$_s$/m^3) while the minimum concentration was found in the storage section. The minimum concentration (66 colonies and 240 CFU$_s$/m^3) was found in the month of May which had having less humidity with a maximum temperature. Fungal spore concentration varied seasonally as well as monthly according to meteorological parameters. Spore concentration exhibits seasonal variation; it was maximum in the rainy season, followed by winter, and minimum in summer.

The current study revealed that monthly variation exhibited the maximum fungal spore concentration in the month of August by both methods, having more humidity and moderate temperature and minimum in the month of May, where low humidity and high temperature. Humidity more than 80% and moderate temperature between 25°C to 30°C provide the best environment for fungal growth. The precipitation was more from June to September and fungal spore concentration was high during that period. There were appreciable increases in the indoor fungal spore concentration of the Polyhouse. Dominant fungi found in the indoor environment of a Polyhouse are *Aspergillus, Cercospora, Mucor, Penicillium, Rhizoctonia, Cladosporium, Rhizopus, and Alternaria.*

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