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Natural Occurrence and Distribution of Entomopathogenic Fungi from Chhattisgarh

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A B S T R A C T

Extensive survey was conducted for collection of insects cadavers from agriculture fields and forest area and isolated different entomopathogenic fungi viz,. *B. bassiana*, *M. anisopliae*, *Nomurea rileyi* from different crops i.e. Soybean, groundnut, Pigeonpea crop insects. The infected insects cadavers was covered partially or fully with powdery white to green spores. Presence of powdery spores on insects revealed *B. bassiana* infection, green spores depicts infection of *M. anisopliae* or *Nomuraea rileyi. N. rileyi* infected larvae attached to the leaves with posterior portion and anterior portion of the body hanging in air and presence of yellowish spores on larval body indicating *Aspergillus* infection**.** Entomopathogenic fungi infected cadavers were found maximum between 1st week of September to 2nd week of January while maximum in September followed by October month.

Introduction

Fungi which control the insect pest population are associated with agricultural crops are called as entomopathogenic fungi. There are naturally occurring organisms, such as bacteria, viruses and fungi for the control of crop pests, which can act as a parasite of insects and kills or seriously disables them. In recent years, microbial pathogens like viruses, bacteria, fungi and protozoa have been recognized for the biological suppression of many insect pests.

About 1.5 million species of fungi alone are known to occur worldwide out of which nearly half of the species have been identified. Amongst these, several asexual stages of fungi are associated with insect

infection. Entomopathogenic fungi are naturally occurring organisms which perceived as less damaging to the environment (Tahira, *et al.*, 2014). Among biopesticdes, entomopathogenic fungi played a significant role in insect pathology and especially in microbial control.

Most of the entomopathogenic fungi belong to either entomopthorales (Zygomycotina) or hyphomycetes (Deuteromycotina). Prominent genera that have been exploited for the pathogenic properties include *Nomuraea, Beauveria, Metarhizium, Verticillium, Hirsutella, Aspergillus, Coelomomyces, Lagenidium, Paecilomyces* and *Tolypocladium* of which the first five are the best known cosmopolitan insect pathogens.

Occurrence and distribution of entomopathogenic fungi (EPF) in diverse habitats are divided in to main two ecosystem; manmade agriculture and natural habitat (aquatic, forest and non forest). EPF of aquatic habitats belongs to Mastigomycota and Zygomycota and these have ability to produce motile spore, presence of thick wall spore, has capacity in absence of water and adapted to semi permanent habitats. Tropical humid forests are rich in various entomopathogen and agriculture ecosystems have diverse entomopathgenic fungal species. Environmental factors i.e. temperature, humidity and light, play major role in field persistence of entomopathogenic fungi. One of the critical factors in the effective use of microbial agents is their relatively short persistence on leaf surfaces (Khachatourians, 1996).

Agro ecological condition of Chhattisgarh favored the local isolates of entomopathogenic fungi which play a vital role in suppressing pest population because their degree of virulence, survival, adoption, commercialization and successful are most importance that's why need to identify novel new indigenous isolates, shelf life, development of formulation, evaluate the efficacy of entomopathogenic fungi for cost economic, safe production, physicals factors, nutritional requirements. Very limited studies on these aspects in the state and to identified alternate biological insect management measures under organic farming in the state.

Materials and Methods

Extensive surveys were conducted during *Kharif* and *Rabi* seasons of 2017-18, 2018-19 and *Kharif* 2019-20 for collection of entomopathogenic fungi from different localities of Chhattisgarh state i.e. Bilaspur, Raipur, Bhatapara, Mungeli, Kawardha, Bemetara, Jangir-champa, Jagdalpur and Korba districts from farmers fields and forests of Chhattisagrh.

Thirty insect cadavers infected with fungus were collected and placed in separate sterilized glass vessels. After collection, these insect cadavers were brought to laboratory, made fairly dry to avoid further deterioration and stored in refrigerator. The collected insect cadavers were coded. During the survey different information was gathered i.e. Latitude and Longitude, crops, insects, location, seasons etc.

Results and Discussion

The extensive surveys was conducted for collection of insect cadavers from agriculture fields and forest area during *Kharif* and *Rabi* season of 2017-18, 2018-19 and *Kharif* of 2019 to know the occurrence, distribution and biodiversity study of indigenous fungi prevalent in Chhattisgarh. The study was conducted in different districts of Chhattisgarh state i.e. Bilaspur, Jangir champa, Mungeli, Kawardha, Bemetara, Raipur, Korba, Ambikapur and Jagdalpur

between August and February of every year. During twenty-eight surveys, thirty insects cadavers was collected from different crops i.e. Soybean, Groundnut, Sugarcane, Paddy, Pigeonpea and Mustard of various cropping systems **.** Out of thirty cadavers collect 23 were from *Spodoptera litura* of different crops (Soybean 15; Groundnut 7 and Potato (1). *Helicoverpa armigera* from Pigeonpea (2), *Pyrilla perpusilla* from Sugarcane (1), *Lipaphis erysimi* from Mustard (3) and *Scirpophaga incertulas* from Paddy (1).

Different instars of insects were found infected with fungi showing various symptoms/colours. The infected insect's cadaver was covered partially or fully with powdery white to green spores. Powdery spores suspected with *B. bassiana* infection and infected larvae generally found in upper leaf surface. Green spores infection was mostly with *M. anisopliae* or *Nomuraea rileyi. N. rileyi* infected larvae attached to the leaves with posterior portion and anterior portion of the body hanging in air and presence of yellowish spores on larval body indicating *Aspergillus* infection**.** Entomopathogenic fungi **(**EPF) infected insects were generally hardened (Table 1, plate 1.1 , 1.2 and 1.3).

Entomopathogenic fungi infected cadavers were found maximum between 1st week of September to 2nd week of January while maximum in September followed by October month. During 1st week of September to 2nd week of October the environmental conditions were found favourable for occurrence of insects cadavers infected with EPF in soybean and Groundnut crops. whereas 2nd week of September to last week of December, environmental conditions favours Sugarcane crop insect infection by EPF. November to December was ideal months for infecting *H. armigera* of Pigeonpea crop. No insect cadaver was found from forest area, all were collected from agriculture habitats. It was observed that population of EPF was higher in unmanaged field.

Table.1 Details of survey for collection of entompathogenic fungi

S.N.	Season /Months of Survey	Location of Survey	Latitude and longitude	Districts	Crop	Insect Cadavers	Sample Code
1	*Kharif*-17/ Sept	Bilaspur-BTCCARS farm	22°06'19.2"N 82°08'17.2"E	Bilaspur	Groundnut	*Spodoptera litura*	EPF-01
2	*Kharif*-17/ Sept	Bilaspur-BTCCARS farm	22°06'19.4"N 82°08'16.9"E	Bilaspur	Groundnut	*Spodoptera litura*	EPF-02
3	*Kharif*-17/ Sept	Bilaspur-Farmers field/Ranigaon	22°14'40.5"N 82°08'23.2"E	Bilaspur	Sugarcane	*Pyrilla perpusilla*	EPF-03
4	*Kharif*-17/ Sept	Bilaspur-BTCCARS farm	22°06'21.1"N 82°08'32.9"E	Bilaspur	Soybean	*Spodoptera litura*	EPF-04
5	*Kharif*-17/	Mungeli-Farmers	22°03'37.4"N	Mungeli	Soybean	*Spodoptera*	EPF-05

	Sept	field /Damapur	81°38'25.3"E			*litura*	
6	*Kharif*-17/ Sept	Mungeli- Farmers field /Damapur	22°03'35.5"N 81°38'23.1"E	Mungeli	Soybean	*Spodoptera litura*	EPF-06
7	*Kharif*-17/ Sept	Mungeli- Farmers field /Chalan	22°03'54.3"N 81°38'30.1"E	Mungeli	Soybean	*Spodoptera litura*	EPF-07
8	*Kharif*-17/ Sept	Raipur IGKV farm	21°13'50.8"N 81°43'03.6"E	Raipur	Soybean	*Spodoptera litura*	EPF-08
9	*Kharif*-17/ Sept	Raipur IGKV farm	21°13'47.7"N 81°43'01.1"E	Raipur	Soybean	*Spodoptera litura*	EPF-09
10	*Kharif*-17/ Sept	Bilaspur/farmers field/ Pendarwa	22°13'47.1"N 82°08'39.3"E	Bilaspur	Paddy	*Scirpophaga incertulas*	EPF-10
11	*Kharif*-17/ Sept	Bhatapara/Khapara dih farm (DKCARS)	21°44'15.4"N 81°58'16.2"E	Bhatapara	Soybean	*Spodoptera litura*	EPF-11
12	*Kharif*-17/ Sept	Bhatapara/Alesure farm (DKCARS)	21°43'46.3"N 81°59'14.4"E	Bhatapara	Soybean	*Spodoptera litura*	EPF-12
13	*Kharif*-17/ Sept	Bhatapara/ Khaparadih farm (DKCARS)	21°44'15.7"N 81°58'16.7"E	Bhatapara	Soybean	*Spodoptera litura*	EPF-13
14	*Kharif*-17/ Oct	Kawardha/KVK farm	22°01'37.1"N 81°15'13.1"E	Kawadha	Soybean	*Spodoptera litura*	EPF-14
15	*Kharif*-17/ Oct	Kawardha CARS farm	21°59'14.6"N 81°14'17.9"E	Kawardha	Soybean	*Spodoptera litura*	EPF-15
16	*Kharif*-17/ Oct	Kawardha/ Farmer field /Newari	22°01'26.5"N 81°15'25.8"E	Kawardha	Soybean	*Spodoptera litura*	EPF-16
17	*Kharif*-17/ Dec	Bilaspur/ Farmer field /Amane	22°16'23.1"N 82°00'40.1"E	Bilaspur	Piegonpea	*Helicoverpa armigera*	EPF-17
18	*Rabi*-17-18/Jan	Bilaspur/Farmers field /Amane	22°16'22.9"N 82°00'38.8"E	Bilaspur	Mustard	*Lipaphis erysimi*	EPF-18
19	*Rabi*-17/-	Bilaspur/Farmers	22°16'25.2"N	Bilaspur	Mustard	*Lipaphis*	EPF-19

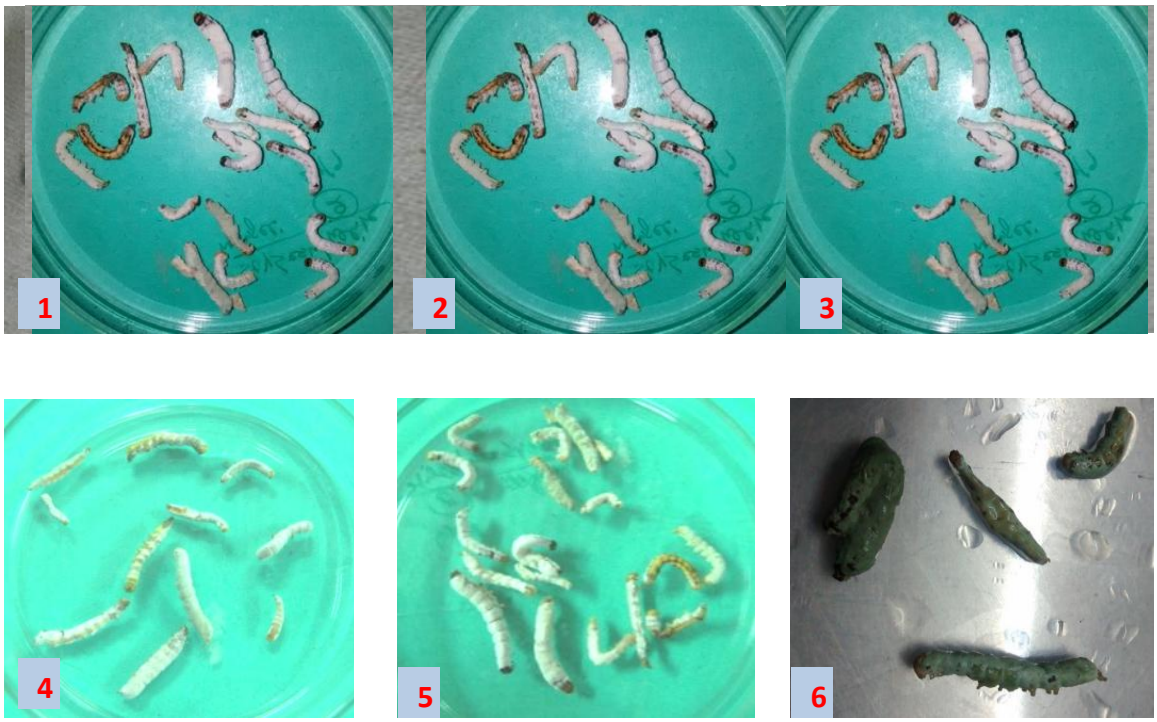
	18/Jan	field /Amane	82°00'39.9"E			*erysimi*	
20	*Kharif*-18/August	Raipur/IGKV farm	21°13'47.0"N 81°42'57.6"E	Raipur	Soybean	*Spodoptera lituar*	EPF-20
21	*Kharif* - 18/Sept	Mungeli/Chatarkhar	22°04'05.1"N 81°38'31.5"E	Mungeli	Groundnut	*Spodoptera litura*	EPF-21
22	*Kharif* - 18/Sept	Mungeli/Chatarkhar	22°04'05.3"N 81°38'30.7"E	Mungeli	Groundnut	*Spodoptera litura*	EPF-22
23	*Kharif* - 18/Sept	Bilaspur/Takhatpur	22°07'42.4"N 82°05'10.9"E	Bilaspur	Groundnut	*Spodoptera litura*	EPF-23
24	*Kharif* - 18/Sept	Bhatapara/Sendri farm (DKCARS)	21°44'16.4"N 81°58'15.4"E	Bhataparar	Soybean	*Spodoptera litura*	EPF-24
25	*Kharif* - 18/Sept	Bemetara/farmers field/ Chandi	21°26'28.5"N 81°27'32.6"E	Bemetara	Soybean	*Spodoptera litura*	EPF-25
26	*Kharif* - 18/Sept	Bilaspur/BTCCARS farm	22°06'19.2"N 82°08'16.8"E	Bilaspur	Groundnut	*Spodoptera litura*	EPF-26
27	*Rabi*18-19/Jan	Bilaspur/BTCCARS farm	22°06'28.0"N82°08'21.7"E	Bilaspur	Mustard	*Lipaphis erysimi*	EPF-19
28	*Kharif* - 18/Sept	Bilaspur farmer field /	22°12'37.1"N 82°07'05.7"E	Bilaspur	Groundnut	*Spodoptera litura*	EPF-28
29	*Kharif*-19/Sept	Ambikapur/Mainpat, KVK field	22°46'05.5"N 83°15'53.3"E	Ambikapur	Potato	*Spodoptera litura*	EPF-29
30	*Kharif*-19/Nov	Bilaspur KVK Farm	22°06'18.4"N 82°08'41.5"E	Bilaspur	Pigeonpea	*Helicoverpa armigera*	EPF-30

Collection of insect cadavers from Groundnut fields

Insect cadavers from Soybean fields

Plate.1.1 Collection of insect cadavers from different location showing varying symptoms of infection of *B. bassiana*

Plate 1.2 Typical symptoms of larvae infected by Nomuraea rileyi (1-6)



Collection of insect cadavers from different farmers field in soybean crop
Plate.1.3 Different instars of larvae of *Spodoptera litura* (1-6)

Survey findings indicated that for the infection of EPF on insects, moderate to low temperature along with moisture required. Proper moisture and moderate temperature were maintained naturally during the months of September to October and goes slow down. Similarly in December to January temperature goes low and proper moisture was maintained.

Various researchers were also doing such types of survey from agricultural fields, conserved and reserved forest and finding agreed to our results as they concluded that mostly EPF were collected from September to January from various orthopodos, Hemiptera, Homoptera insects. Gupta (2003) suggesed rainly days and amount of rainfall also play a role for infection of EPF, Thakur and Sandhu (2010); Prasad *et al., (*2011); Omoloye *et al.,* (2015); Moorthi *et al.,* (2015); Nidhi *et al.,* (2018); Clifton *et al.,* (2018) also reported that mostly cadavers were collected from soybean crop and maximum from dense crops.

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