Natural Occurrence and Distribution of Entomopathogenic Fungi from Chhattisgarh

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ABSTRACT

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.

Keywords
Entomopathogenic fungi, Beauveria bassiana, Metarhizium anisopliae, insect pathogen

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 biopesticides, 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 entomopathogenic 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 1<sup>st</sup> week of September to 2<sup>nd</sup> week of January while maximum in September followed by October month. During 1<sup>st</sup> week of September to 2<sup>nd</sup> week of October the environmental conditions were found favourable for occurrence of insects cadavers infected with EPF in soybean and Groundnut crops. whereas 2<sup>nd</sup> 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 entomopathogenic 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/Sept           | Mungeli-Farmers     | 22°03'37.4"N          | Mungeli   | Soybean | Spodoptera     | EPF-05 |
| No. | Season | Date | Location | Latitude/Longitude | Crop | Pests | EPF Code |
|-----|--------|------|----------|--------------------|-------|-------|----------|
| 6   | Kharif-17/Sept | 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 | 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 | 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 | 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 | 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 | 17/Sept | Bhatapara/Khaparadih farm (DKCARS) | 21°44'15.4"N 81°58'16.2"E | Bhatapara Soybean | Spodoptera litura | EPF-11 |
| 12  | Kharif-17/Sept | 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 | 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  | 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  | 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  | 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  | 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 | 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/-     | 17/- | Bilaspur/Farmers | 22°16'25.2"N | Bilaspur Mustard | Lipaphis | EPF-19 |
| Date       | Crop     | Location                  | Coordinates                  | Pest          | EPF Code |
|------------|----------|---------------------------|------------------------------|---------------|----------|
| 18/Jan     | Kharif   | Raipur/IGKV farm          | 21°13'47.0"N 81°42'57.6"E    | Soybean       | EPF-20   |
| 18/August  | Kharif   | Mungeli/Chatarkh           | 22°04'05.1"N 81°38'31.5"E    | Groundnut     | EPF-21   |
| 18/Sept    | Kharif   | Mungeli/Chatarkh           | 22°04'05.3"N 81°38'30.7"E    | Groundnut     | EPF-22   |
| 18/Sept    | Kharif   | Bilaspur/Takhatpur         | 22°07'42.4"N 82°05'10.9"E    | Groundnut     | EPF-23   |
| 18/Sept    | Kharif   | Bhatapara/Endri            | 21°44'16.4"N 81°58'15.4"E    | Soybean       | EPF-24   |
| 18/Sept    | Kharif   | Bemetara/farmers          | 21°26'28.5"N 81°27'32.6"E    | Soybean       | EPF-25   |
| 18/Sept    | Kharif   | Bilaspur/BTCCAR S farm     | 22°06'19.2"N 82°08'16.8"E    | Groundnut     | EPF-26   |
| 19/Jan     | Rabi     | Bilaspur/BTCCAR S farm     | 22°06'28.0"N 82°21.7"E       | Mustard       | EPF-19   |
| 18/Sept    | Kharif   | Bilaspur farmer field /    | 22°12'37.1"N 82°07'05.7"E    | Groundnut     | EPF-28   |
| 19/Sept    | Kharif   | Ambikapur/Mainpat          | 22°46'05.5"N 83°15'53.3"E    | Potato        | EPF-29   |
| 19/Nov     | Kharif   | Bilaspur KVK Farm          | 22°06'18.4"N 82°08'41.5"E    | Pigeonpea     | 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) suggested rainy 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., (2018); Clifton et al., (2018) also reported that mostly cadavers were collected from soybean crop and maximum from dense crops.

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Vinod Kumar Nirmalkar, N. Lakplae and Tiwari. R.K.S. 2020. Natural Occurrence and Distribution of Entomopathogenic Fungi from Chhattisgarh. Int.J.Curr.Microbiol.App.Sci. 9(01): 1990-1998. doi: https://doi.org/10.20546/ijcmas.2020.901.225