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Two New Foliicolous Fungus on Pearl Millet – Tropical Forage from Bahraich (U.P.) India

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Abstract

During survey for the foliicolous fungi from diversified habitats of Bahraich (U.P.) India the authors came across an important crop for the locality *Pennisetum typhoidis* (L.) R. Br. which belongs to Plantae, Tracheobionta, Spermatophyta, Magnoliophyta, Lijiopsida, Commeliinidae, Cyperales, Poaceae- the grass family is commonly called pearl millet, bulrush millet, cattail millet, candle millet, bajra, bajri etc. On critical study of pearl millet plants, we found the living leaves to be infected with *Alternaria* and *Drechslera* sp.. On critical morphotaxonomic study it was found to be new species and the same taxon has been described and illustrated as *Alternaria penneseti* sp. nov. and *Drechslera rajendralla* sp nov. The review of available literatures reveals that there has been no record of these fungus from India on this host so far. Therefore, this host for the two new species is a new record to Indian mycoflora from Bahraich (U.P) India.

Keywords: Foliicolous; Fungi; Pearl Millet; North Central; Bahraich; Uttar Pradesh; India.

Introduction

Fungi are ubiquitous in nature and have occupied almost all places in the biosphere. These are the most important organisms in the universe. Because of their vital functions in the maintenance of ecosystem, on human beings and their related activities. Fungi are often directly involved in our day to day life and play a crucial role in the nutrient cycling, decomposition and nutrient transport from soil to plants. These are extremely adaptable and can break down many substances including some toxic substances. This adaptability accounts for the presence of fungi in different environment around the world.

Some are plant and human pathogens, where as others are mutualistic symbionts. They are of great economic importance in brewing, baking, pharmaceutical industries, biometrical tools and several have been cultivated as substitute for food. Fungi also cause huge economic loss each year by causing spoilage of food, destruction of materials used by man, disease of plants, etc. Hence, fungi have both positive and negative effect of the mankind. These roles are played by fungi because of their diversity and abundance, roles in natural and altered ecosystem, land use, planning and management, etc. Fungi differ in their morphology, ecology, life history strategies, etc. The world of fungi provides an endless source of biodiversity. Only a very small part of the total fungal wealth has been subjected for the scientific studies. Thus we have very little information available with us. Further study has to be made to explore the hidden wealth of fungi.

Owing to the diverse climatic and altitudinal conditions, India is rich in the phanerogamic flora which is the chief hosts for the parasitic fungi. In comparison with phanerogams, the number of fungi known for this country is too less obviously because of the partial exploration.

The fungi, in general, which attack the cultivated plants, have got much importance because of their direct effect on mankind. Several other groups of fungi whose occurrence are mostly restricted to wild plants are less destructive to cultivated plants and hence

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receive less attention.

The leaves provide a very suitable habitat for the growth and development of fungal pathogen by providing ample surface area and nutrient supply. Such leaf inhabiting fungi are known as Foliicolous Fungi and the invaded area of the leaf appears as leaf spot or leaf lesion. Taxonomic studies of such fungal forms have been generally considered as only of academic interest but the taxonomic treatment of a fungal organism is the first requirement for any study concerning its biology. Correct identification of a fungus absolutely free from ambiguities is vital for its employment in applied disciplines. In fact without being equipped for ascertaining the correct identity of a fungal pathogen all studies concerning its phytopathological aspects would be misleading. The weed and forest plants serve as reservoirs of leaf spot pathogens which may spread to agricultural and horticultural plants.

India is located to the north of the Equator, lies between 8^o 4' and 37^o 6' north latitude and 68^o 7' and 97^o 25' east latitude, The country measures 3214 kilometres from south to north and 2933 km from east to west with a total land area being 32,87,263 square kilometres. India is the one of the twelve mega biodiversity countries of the world lying in between Tropic eighteen biodiversity hot spots located in the Western Ghats and in the Eastern Himalayas. The Himalayas rise as of a Capricorn and Tropic of Cancer, and has two of the world's virtual wall beyond the snow line. Above the alluvial plain lies the Tarai strip, a seasonally marshy zone of sand and clay soil. The Tarai region has higher rain fall than does the plains, and downward rushing rivers originating from the Himalayas slow down and spread out in the flatter tarai zone depositing fertile silt and reproductive spores during the monsoon season and receding in the dry season. The Tarai, as a result has high water level and moist subtropical conditions a luxuriant turnover of green vegetation year around. The climatological and topographical conditions also favour the luxuriant growth and development of foliicolous fungi. The North Tarai Region of Uttar Pradesh is next only to Eastern and Western Ghats, as having the highest biodiversity in general and the highest diversity of plant inhabiting fungi in particular. The region's high biodiversity offers an ideal opportunity for the morpho taxonomic exploration of the fungal organisms in general and foliicolous fungi in particular. We surveyed the North Tarai forests for Foliicolous Fungi during kharif season of 2014 & 2015 near surrounding agricultural fields of Bahraich Forest Range representing Bahraich Forest Division, Bahraich (U.P.).

Scope of Study

The Foliicolous Fungi causes huge losses every year in different parts of the world. The fungal pathogens producing leaf spots infect a large variety of hosts including most of the crops, forests and other plants. The destruction caused by these pathogens is a serious problem before us. The focus of this research is identification & documentation of foliicolous fungi which may assist in the development of new fungicides and ideas how to reduce the severity of infection as well as in in the protection of floral diversity from the infection of these pathogens as well as in the conservation of valuable flora of the area.

Materials and Methods

During survey and collection, infected plant parts where noticed were collected carefully in the field and notes were made regarding their pathogenicity, nature of colonies infection, locality, altitude. For each collection a separate field number was given. Each infected plant parts was collected separately in polythene bags along with host twig preferably with the reproductive parts to facilitate the identity of corresponding hosts. These collections were pressed neatly and dried between sheets of blotting papers. The host plants were identified by matching them with authentic herbarium material and also consulting the experts.

In the laboratory, Hosagoudar, Biju & Appaiah (2006) nail polish technique was used to study the structural and morphological characters of fungi. Since the desired quality and quantity of nail polish is difficult to procure from the market, the problem is resolved by preparing a xylene - thermocol solution. Five millilitersi or desired quantity of xylene is poured in a container. Very bright and clean thermocol cut into minute pieces is added to xylene. It is mixed thoroughly till getting it to a particular consistency and poured it into air tight bottle for the use. A drop of xylene – thermocol solution applied on the selected colonies, carefully thinned with the help of a fine brush without disrupting the colonies.

The treated colonies along with their host plants kept in dust free chamber for half an hour. When the applied solution dried, a thin colorless "film" or flip is formed with the colonies firmly embedded in it. A drop of DPX was added on a clean slide and flip was spread properly on it. Care was taken to avoid air bubbles while mounting. One or two more drops of DPX were again added on the flip and clean cover glass brings out the excess DPX and it was removed

after drying. These slides were labelled and placed in dust free chamber for one or two days for drying. Slides were prepared in cotton-blue lacto phenol mixture and were examined. Camera Lucida drawings were made and the morpho taxonomic determination of the taxa was done using available literature. The fungal taxa were identified using microscopic preparation. The fungal holotype specimen has been deposited for allotment of accession number from HCIO. The Mycobank No. from the Fungal Database Nomenclature and Species Banks was procured.

Result and Discussion

During our survey of the surrounding fields of crop plants for foliicolous micro fungi during kharif season of 2014 & 2015 we came across fields of *Pennisetum typhoides* commonly called as pearl millet, bulrush millet, cattail millet, candle millet, bajra, bajri etc severely infected with leaf spot pathogen It is a tall, erect, stout, annual upto 2.5 m high. Leaves 15-60 x 1-4 cm, linear or linear-Lanceolate, Panicles cylindric, very dense, spike-lets deciduous, oblong, Caryopsis ovoid or ovovoid ellipsoid, smooth, free Phenology-September-October. It is cultivated for grains as well as fodder.

The crop is a significant dietary food for one third of the world population. It is a major source of dietary energy and nutritional security for poor farmers and consumers because of the essential minerals. and nutrients.

Bajra is very high in protein and energy content and is used in rotis (bread), rice, sprouted and porridge. Bajara millet is a great source of starch, making it a high-energy food. It is also an excellent source of protein and fiber. It is said that the amino acids in the pearl millet are more easily digestible than the ones found in wheat. Due to essential nutrients such as methionine (an amino acid), B complex vitamins (niacin, thiamin, and riboflavin), folic acid, lecithin, potassium, magnesium, manganese and zinc, millets are very effective in several roles. Niacin reduces cholesterol while magnesium is essential for maintaining good heart health, as it lowers blood pressure and reduces the risk of heart attacks.

Pearl millet is a rich source of phosphorus, which plays an important part in the structure of body cells. Phosphorus, found in pearl millets, is a significant component of several necessary compounds including adenosine tri phosphate (ATP). This element is also a crucial component of nucleic acids, which are the building blocks of the genetic code.

Phosphorus is a constituent of lipid-containing structures such as cell membranes and nervous system structures.

It had been proved that regular consumption of pearl millets help in preventing gall stones in women. They contain insoluble fibers which not only speed up intestinal transit time but also reduce the secretion of bile acids. Pearl millets are known to increase insulin sensitivity and lower the level of triglycerides.

Regular intake of millets provides protection against breast cancer in pre-menopausal women. Apart from that, it has also shown a considerable reduction in the occurrence of wheezing and asthma in children.

Millets contain an essential phyto nutrient, lignins, which is very beneficial for the human body. With the help of natural flora, lignans get converted to mammalian lignins and they fight against hormone-dependent cancers and reduce the risk of cardiac arrests.

Consumption of pearl millets helps in minimizing the risk of type 2 diabetes. Being a good source of magnesium, millets act as a cofactor in a number of enzymatic reactions.

India being a rich source of raw material may provide a health promoting food, promising for the economic growth of the country and nutritious food at low cost may be processed for global utilization (Mall and Tripathi, 2016).

On consultation of the literature available viz, Fungi of India (Bilgrami and & Jamaluddin,1979 & 1981; Sarbhoy, Varshney and Agarwal, 1996), forty six fungal species representing twenty eight fungal genera had been recorded on this host plant. On primarily stage of study two different type of spores were noticed. On critical study the living leaves were found to be infected with a dematiaceous hyphomycetous fungi belonging to the genus *Alternaria* and *Drechslera* On critical examinations (Ellis, 1971; Ellis, 1976; Ellis and Ellis, 1997) and comparison with other known species with, *Alternaria alternate* (Fr..) Keissler and *Drechslera* State of *Cochliobolus setariae* found on the same plant also it was found to be a new species. The same are named as *Alternaria penniseti* sp. nov. and described as *Alternaria penniseti* Mall, Tripathi and Kumar sp.nov. & *Drechslera rajandrella* sp. nov. and described as *Drechslera rajandrella* Mall, Tripathi and Kumar sp. Nov

Alterneria penniseti sp.nov.

Infection spots amphigenous, circular to irregular, spreding on entire leaf surface, brown 2-8 micron in diameter. Colonies amphiphylious, effuse, brown.

Mycelium internal. Stroma absent. Conidiophore in fascicle, macromematous, mononematous, straight or flexous, simple, cylindrical branch to unbranched, and thick walled 5-7 septate, brown 45-70 micron long and 4-6 micron wide. Conidiogenous cells integrated terminal, sympodial, polyteretic, bearing thickened conidial scars. Conidia acropleurogenous, solitary to catenate, dry obclavate to ellipsoidal to ovoid, rostrum present, 4 transversely sepate and two obliquely seplate, unbranched brown, base obtuse, hilum thickemed, 30-50 micron in diameter, germinating conidia present.

On living leaves of Pennisetum typhoides (Linn.) R.Br. (Poaceae), Barapatthar, Bahraich Forest Division, Bahraich (UP) India, GPS 27°33' 39.265" Latitude; 81° 36' 35.407" Longitude; 374 ft. Attitude Leg; T.P. Mall S.C. Tripathi and Ajay Kumar BRH- 03878 AK-0478 (Icotype), HCIO-Holotype , Mycobank MB:818884/ 29.10.2016.

Perusal of available literature indicates that as yet no specific species of *Alternaria* (Rangaswami, 1970) has been described on this host. Therefore, the morphotaxonomic comparision is done with *Alternaria*

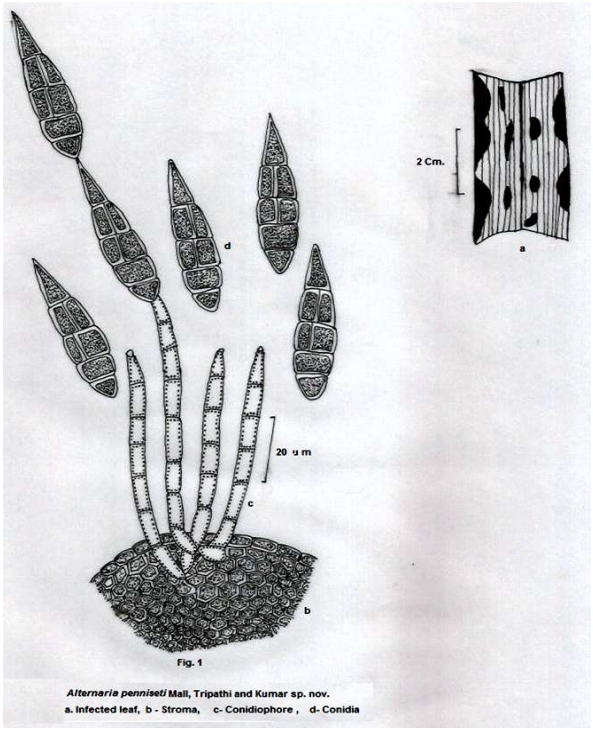
Table 1: Comparison of morphotaxonomic features of *Alternaria alternate* (Fr.) Keissler 1912 with *Alternaria penniseti* sp. nov.

Morphotaxonomic Features	***Alternaria alternata (Fr.) Keissler 1912***	***Alternaria penniseti* sp. nov.**
Symptoms	-------	Infection spots amphigenous, circular to irregular, spreding on entire leaf surface,
Colonoies	Colonies usually balck or olivaceous black	Colonies amphiphyllous, effuse, brown
Mycelium	--------	Mycelium internal, Stroma absent
Conidiophore	Conidiophore arising singly or in small groups, simple or branched, pale to golden brown 50x3-6 micron with one several scars	Conidiophore in fascicle, macromematous, mononematous, straight or flexous, simple, cylindrical branch to unbranched, thick walled, 5-7 septate, brown 45-70 micron long and 4-6 micron wide.
Conidia	Conidia in straight or branched chains, obclavate upto 8 transverse and serval longitudinal septa Conidia 20-63x9-18 micron	Conidia acropleurogenous, solitary to catenate, dry obclavate to ellipsoidal to ovoid, rostrum present, 4 transvercely sepate and two obliquely septate, Conidia 30-50 micron, 3-4 septate

alternata (Ellis,1971).

The above comparative account shows that the morphotaxonomic features of the present collection is different from those of *Alterneria alternate,* therefore,

Fig. 1:



proposal of a new taxon of separate species rank, for the present collection, is deemed justified.

Drechslera rajendralla sp. Nov

Infection spot amphyphyllous, thin, dark brown to black, confluent coalescing to cover almost entire leaf surface with original shape intact, Conidiophores simple emerging solitary dark brown to obivaceous, geniculate bearing 3-5 conidia occasionally more, producing the first conidium at a distance of aboust 30 micron from the base. The size of the conidiophores is 215-220x4-6 micron. The conidia are bulbous fuliginous 25-35x6-11 micron 4-5 celled, straight some times slightly curved tapering slightly at both ends with abruptly rounded end.

On living leaves of Pennisetum typhoides (Burm. F.) Stap f & C.E. Hubb (Poaceae), Barapatthar Bahraich Forest Division, Bahraich (UP) India, GPS 27° 33' 39.265" Latitude; 81° 36' 35.407" Longitude; 374 ft. Attitude Leg; T.P. Mall S.C. Tripathi and Ajay Kumar BRH-AK (Icotype), HCIO- Holotype , Mycobank MB:818885/29.10.2016.

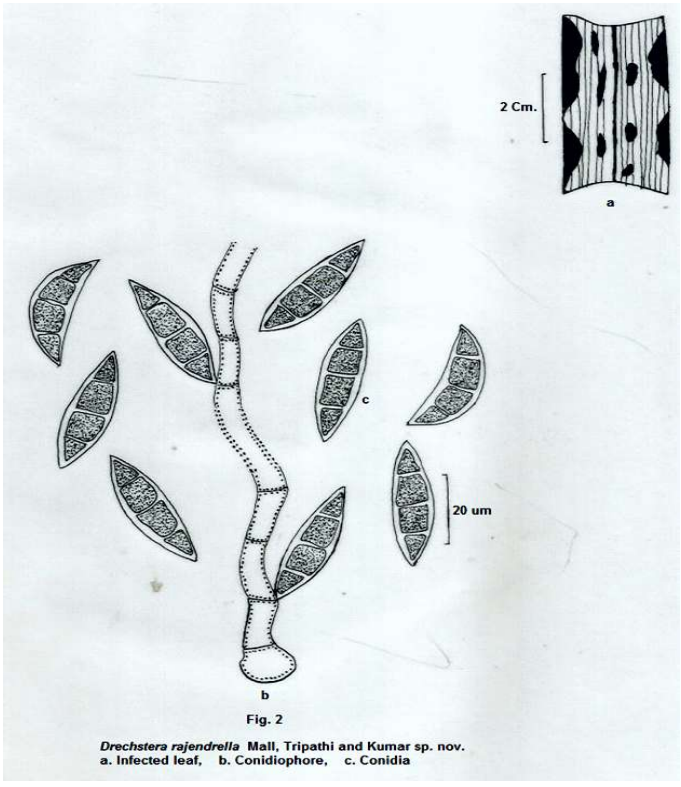
The perusal of the literature available indicates that *Drechslera* state of *Setosphaeria taurica* has been reported and decribed on the leaves of Pennisetum typhoides from Balaghat, M.P. India. Therefore, the morphotaxonomic comparison is done with above mentioned strain (Ellis, 1971) which is found to be comparable.

Table 2: Comparison of morphotaxonomic features of *Drechslera rajendralla* sp.nov with *Drechslera* state of *Setosphaeria taurica* Ellis, 1971

Morphotaxonomic Features	***Drechslera* state of *Setosphaeria taurica* Ellis, 1971**	***Drechslera rajendralla* sp.nov .**
Symptoms	Amphiphyllous black covering large areas.	Amphiphyllous thin dark brown to black, conflument coalising upto entire leaf surface
Conidiophore	Conidiophore arising singly or in small groups, straight or flexuous, mid to dark brown, upto 250x5-8 micron	Emerging solitary dark brown to obivaceous, geniculate with 3-5 conidia, 215-220x4-6 micron.
Conidia	Conidia curved tepering towards the rounded ends, 3-100x12-18 micron with 7-8 pseudo septa, hilum not very consupicuous	Conidia bulbous, fuliginous 25-35x6-11 micron 3-4 septate straight sometimes slightly curved Tapering at both ends but abruptly rounds at the ends

The above compairative account shows that the marphotaxonomic features of the present collection is different from those of *Drechslera* state of *Setosphaeria*

Fig. 2:



taurica Ellis, 1971 therefore, proposal of a new taxon of separate species rank, for the present collection, is deemed justified.

Conclusion

The above comparative accounts shows that the morphotaxonomic features of the present collection are quite different from there comparable fungal strains. Therefore, proposal of the new taxon of both species rank, for the present collection is justified.

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References

1. Barde AK and Awasthi SN. New host records from India. Indian Phytopath. 1084; 37:744-745.
2. Bilgrami KS, Jamaluddin and Rizwi MA. Fungi of India Part-I. List and references. Today and tomorrow's Printers and Publishers. New Delhi. 1979.
3. Bilgrami KS, Jamaluddin and Rizwi MA. Fungi of India Part-II Host Index and Addenda. Today and tTomorrow's Printers and Publishers. New Delhi. 1981.
4. Ellis MB. Dematiaceous Hyphomycetes. CMI, Kew, U. K. 1971.
5. Ellis MB. More Dematiaceous Hyphomycetes. CMI, U. K. 1976.
6. Ellis MB and Ellis JP. Microfungi on Land Plants: An Identification Hand Book New Enlarged Edition Richmond Publishing Co. Ltd England. 1997.
7. Hosagoudar VB., Biju H in the second line above figureand Appaiah KA. Studies on foliicolous fungi-XX. Microfungi of Coorg, Karnataka. Journal of Mycopathological Research, 2006; 44(1):1-25.
8. Mall TP and Tripathi SC. Millets – The Nutrimental Potent Ethnomedicinal Grasses: A Review. World Journal of Pharmaceutical Research 2016; 5(2):495-520.
9. Rangaswami G, Seshari VS and Lucychammamma, KA. Fungi of south India, University of Agriculture Sciences, Bangalore 1970.pp193.
10. Ramkrishnan TS. A leaf spot disease of Andropogon sorghum caused by Cercospora sorghi. Mem. Dept. Agri. India. Bot. Ser. 1031; 18:259-279.
11. Sarbhoy AK, Varshney JL and Agarwal DK. Fungi of India (1982-92). CBS Publishers and Distributers New Delhi. 1996.