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Host Specific Plant Litter Decomposers in The Environment

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ABSTRACT

Most of the microorganisms have wide range to colonise the plant litters whereas each species has its own specific flora, some of these may be host specific. The primary microflora Heraeleum spondylium and Utrica dioica were similar but there was mush diversity in respect of individual secondary microflora. Study revealed that specificity in the mycoflora colonizing different components even within same species, since different but specific fungal species were found to colonize the internodes and the leaves of the wheat straw. The study of interspecific association for understanding biological relationship among different plant species has been carried out. The term association was used for the specific combination of microfungi on decaying organic substrates. For examples the occurrence of Cladosporium herbarium, Alternaria tenius and Stemphylium sps. on cereal stubble, the occurring together Cladosporium herbarium, Alternaria tenius and Aureobacidium pullulans on weathered cotton.

KEYWORDS : Decomposition, specificity, association.

Chesters (1950) noted that within limits, each tree species has its own specific flora; some of these may be host-specific, whereas others are found on a wide range of host species. Lal and Yadav (1964); as also Dickinson (1965, 1967) found *Cladosporium herbarum, Alternaria* spp. as most common primary colonizers. Dickinson believed that Penicillia and Aspergilli formed a group of casual inhabitants and their presence merely reflects the relative abundance of spores in the atmosphere. Yadava (1966), Yadava and Madelin (1968) studied the succession and distribution of microfungi on each internode of decaying stems of *Heracleum sphondylium* and *Urtica dioica*. It was found that fungal colonizers could be divided into two groups: (a) primary microflora, appearing on stems in the year of their growth, and (b) secondary microflora, appearing in the winter and the following summer. The primary microflora of these plants were similar but there was much diversity in respect of individual secondary microflora. Pugh (1958) studied the fungal succession on *Carex paniculata*. He found that late colonizers are able to compete with early colonizers but not vice versa. Gremmen (1957) found that the colonization of naturally fallen needles and the needles shed after infection by a parasite, was quite distinct from the colonization of needles of felled trees. Siddiqi (1964) found that the flora of the stems and branches was more closely allied to that of soil than the flora of leaves or fruits. Visser (1964), Visser and Middleton (1969) observed that when litter of *Cyperus papyrus* and *Deuterium microcarpum* was submerged, the fungal population decreased while bacterial population increased. Berg (2000) developed a three phase conceptual model of plant litter decay driven largely by the biological availability of different fractions of organic matter. Ivarson (1973) found that temperature affected the frequency of specific fungi on litters at low temperature range. Jensen (1974) believed that differences being observed in mycoflora colonizing litter from different forest types may, in part, be due to the occurrence of species-specific fungi; and, in part, due to the use of different experimental methods.

Robinson et al. (1994) attempted to determine the extent of diversity of saprobic fungi on different components (internodes and leaves) within the same plant (wheat), Singh and Charaya (2003) also investigated the diversity of saprobic fungi on different component wheat crop residuces *viz*., internode, leaves,chaff and mixed straw, they found discernible specificity in the mycoflora colonising different components even within same species, since different but specific fungal species were found to colonise the internodes and the leaves of the wheat straw. Among the studies on decomposition of lower plants, mention may be made of those by Kox (1954), Benda (1957), Racovitza (1959), Clymo (1965),Chastukhin (1967 a, b), Kilbertus (1968 a, b), Minchevich (1969), Henderson (1972), Kilbertus (1972), Nilsson and Rulcker (1992), Thormann et al. (2002). Decomposers vary in their abilities to use different litter substrates, and shifts in functional groups of microorganisms occur as different resources become available (Waldrop & Firestone, 2004; Hanson *et al*., 2008). For instance, a typical fungal succession includes Zygomycetes, such as sugar fungi, which are commonly associated with the availability of sucrose and cellulose early in decay, followed by Ascomycetes and finally Basidiomycetes that degrade lignin in later stages (Frankland, 1998; Charaya and Singh 2005; Torres *et al*., 2005).

Among the work carried out on the decomposition of pteridophytes, the studies by Frankland (1966, 1969), Kamal and Singh (1970, 1975) as well as Kamal and Srivastava (1975) deserve special mention. Though studies in the rhizosphere mycoflora abound, not many ecological studies have been made of fungi involved in the decomposition of roots. Waid (1957) studied the penetration of inner tissues of decomposing roots of *Lolium perenne*. Aseptate mycelium of an endophyte was an early colonizer of healthy root. As roots turned brown, the cortex was invaded by thin, brown, septate mycelia similar to those found by Nicolson (1959) on roots of a range of decomposing grasses. As the cortex decomposed, other fungi like *Fusarium culmorum* invaded followed by *Penicillium* amd Mucorales. Mahiques (1966) investigated the succession of fungi on decomposing roots of *Vicia faba*. Some fungi such as *Pythium debaryanum, Mucor globosus, Penicillium janthinellum* and *Trichoderma viride* were abundant initially but their number declined as root decay proceeded while some like *Trichoderma* sp., *Penicillium* sp. and *Cylindrocarpon* sp. disappeared by one week. Other fungi such as *Fusarium oxysporum, F. solani, Gliocladium roseum* and *Humicola grisea* increased in abundance as roots decayed whereas other fungi not present on living roots, such as *Chaetomium globosum* and *Stysanus stemonites* became abundant during the last days. Caldwell (1963) found distinct fungal flora in the decomposing bark and wood of roots of *Fagus*. Root bark was colonized by Mycelium *Radicis atrovirens* and rootwood by *Trichoderma viride*. The next most abundant fungi in both the root substrates were *Cylindrocarpon* spp. Dickinson and Pugh (1965 b) followed the decay of excised roots of *Halimione portulacoides* and found no effect of excision on the mycoflora. It has been observed that as dead roots decompose, the abundance of the non-sporulating mycelia increases (Das, 1963; Caldwell, 1963). Holland (1966) studied the fungal succession on the decomposing roots of *Casuarina humilis*. Initially, the species of *Mortierella* and other `Phycomycetes' were abundant and during the first year of soil cultivation *Penicillium* spp., *Phoma* spp., *Curvularia* spp. and sterile mycelia became prevalent in the given order and were abundant until the end of second year. Ascomycetes, in particular *Peziza* sp., fruited on the root residues during the second and third years. In the following third and fourth years, clamp- bearing mycelia of Basidiomycetes became dominant and many of these were connected by mycelia to the fruiting bodies of an *Amanita* sp.

Factors for specificity: Mishra (1979) studied the decomposition of wheat roots. It was found that the distributional pattern of the fungal species was regulated, among other factors, by their enzymic activities. Ascomycetes and Basidiomycetes were not observed in appreciable numbers. Forms with saccharase activity were mostly the early colonizers and were followed by those with pectinase and cellulase activities.

A recent theoretical model by Schimel & Weintraub (2003) proposed that enzyme production by decomposers is controlled by relative demands for C and nutrients, and that different substrates yield different C and nutrient returns. This suggests that microbial preferences for various substrates are based on their return on investment in enzyme production. Singh e*t al.,* (2015d) find out that the biochemical changes in the wheat crop residues *viz*., internodes, leaves, chaff and mixed straw and suggested that different components within the same plant serve as different C sources and also litter structure and anatomy influence specificity. The last to colonize were those exhibiting ligninase activity. Singh *et al*., (2015a) and Rani *et al*., (2015) studied lignocellulolytic potentials of *Aspergillus terreus* and *Coriolus versicolor* respectively. Chaturvedi and Dwivedi (1983) studied the succession of microfungi on the decomposing roots of *Triticum aestivum*. The succession of fungi on rice roots was studied by Das (1963). He obtained his data by selection of roots at different stages of decomposition. This method is definitely less precise than buried sample method (Waid, 1974).

Association analysis: The importance of the study of interspecific association for understanding biological relationships among different plant species has been emphasised by Forbes (1907), Cole (1949), Goodall (1952, 1953), Cochran (1954), Omura and Hosokawa (1959), Pielou (1960), Smith and Cottam (1967), Singh (1967, 1969), Mall and Das (1973); and Gupta and Yadav (1977).

Westerdijk (1949) proposed the term 'association' for the specific combinations of microfungi on decaying organic substrates. Among many examples quoted were : (a) the occurrence of *Cladosporium herbarum, Alternaria tenuis* and *Stemphylium* spp. on cereal stubble; (b) the occurring together of *Cladosporium herbarum, Alternaria tenuis* and *Aureobasidium pullulans* on weathered cotton; the association of these three been reported on flax by White et al. (1948) also. Tribe (1966) found that the non-cellulolytic *Pythium oligandrum* grew on cellulose so long as it was introduced alongwith cellulolytic *Botryotrichum piluliferum*. The association of `saprophytic sugar fungi' alongwith cellulose-decomposers is a part of the scheme of fungal succession proposed by Garrett (1963). But attempts to evaluate the associations between specific pairs of fungi are scarce. Aneja (1978) evaluated about 153 combinations of fungi isolated from decomposing *Chenopodium album* and *Desmostachya* litter. Charaya (1985) evaluated about 105 combinations of fungi isolated from decomposing wheat and paddy crop residues. Jain (1989) conducted association analysis for 104 combinations of species isolated from soil and litter. Singh (2004) evaluated about 136 combinations of fungi isolated from decomposing wheat crop residues *viz*., internode, leaves, chaff and mixed straw .

Conclusion: The host specifity of decomposers is very much usefull to develop the microbial based technology for proper decomposition of plant litters. Selective decomposers should be utilized for specific plant litter. This will reduse the time span of decomposition and increase the rate of decomposition.

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