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Fungi present in the root zone of *Amaranthus hybridus*

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ABSTRACT: Fungi present in the root zone of *Amaranthus hybridus* were isolated and identified. The fungi were *Aspergillus niger, Aspergillus terreus, Aspergillus versicolor, Rhizopus stolonifer, Mucor pusillus, Cladosporium* sp.' *Alternaria alternata, Aspergillus fumigatus, Penicillium oxalicum, Chaetomium* sp., *Penicillium citrinum* and *Rhizopus oligosporus. R. stolonifer, A. niger, A. terreus* and *P. oxalicum* predominated in both the rhizosphere soil and the rhizoplane. *Aspergillus versicolor, Alternaria altenata* and *Aspergillus fumigatus* were present in the root zone but were absent from the non-rhizopsphere soil. The experimental soil was sandy loam in texture. Rhizosphere effect was well pronounced and it increased progressively with increase in plant age until the tenth week after sowing and then declined.

Key Words: Root zone fungi; *Amaranthus hybridus;* Rhizosphere effect.

Introduction

The root zone (1) is an area of intense microbial activity (2). This is because microorganisms depend on easily available organic compounds for survival. Such compounds occur in the root zone in the form of root exudates and sloughed off root cells (3,4). Microorganisms in the root zone are not passive. They may influence both positively or negatively some aspects of plant growth like root morphology, root-to-shoot weight ratios, uptake of calcium and rubidium, uptake of phosphorus and sulphur, rate of development, onset of flowering and crop yield (2). Microorganisms present in the root zone vary with soil types and plant species (2,5,6) because different plant species produce different effects upon the microorganisms (2,7-9). Fungi represent an important component of the soil microbial community (10). Fungi in the root zone may play a role in the nutrition and well being of the plant or contribute to the plant's resistance to soil borne pathogens (11,12).

Reports are available on the root zone mycoflora of a number of plants (6,11,13-16). However, scanty information is available on the root zone mycoflora of *Amaranthus hybridus* which is a vegetable consumed by millions of Nigerian. The present study is on the root zone mycoflora of this plant from ecological point of view and in comparison with the non-rhizosphere soil.

Materials and Methods

Texture, organic matter content, pH, moisture content and water holding capacity of the soil were determined prior to sowing of seeds. The physical and chemical characteristics were determined by the method of Pramer and Schmidt (17) and that of Olaitan and Lombin (18).

Rhizosphere soil, non-rhizosphere soil and plant root samples were collected and serial dilutions were prepared from them as previously described (11, 16, 19, 20), using fresh samples in each case. Isolation of fungi was made from desired dilutions and the plates were incubated at $30^{o}C$. Potato dextrose agar (PDA) and malt extract agar (MEA) were the culture media used and to each medium was added appropriate amounts of streptomycin and rose Bengal (21). Colony counts and subculturing were carried out after 72 hours. Representative colonies were taken out for identification and stock cultures were prepared on PDA slants in McCartney bottles and preserved in the refrigerator. reference was made to appropriate literature (22,23) to get the names of the isolates.

The ratio of the number of fungi in the rhizosphere soil and non-rhizosphere soil (R/S ratio) was calculated using the formula:

$$\frac{\text{No. of fungi/g of rhizosphere soil (R)}}{\text{No. of fungi/g of non-rhizosphere soil (S)}}$$

Results and Discussion

The experimental soil was sandy loam (Table 1). Sandy loam has been used for the cultivation of plants by some previous workers (16, 24). Greater variety of fungi occurred in the rhizosphere than in the rhizoplane (Table 2). This could be attributed to the fact that the roots are the source of exudations. These exudations have selective effect on microorganisms in the vicinity of roots (2). This effect will be most marked at the root-soil interface (25, 26) reducing in intensity with increasing distance from the root surface. Therefore, less check will be exercised on fungi growing some distance away from the roots, thereby allowing a greater range of fungi to develop than on the root surface. Odunfa (6) also encountered more fungal species in the rhizosphere than in the rhizoplane of sorghum.

Table 1: Some physical and chemical characteristics of the experimental soil (prior to sowing of seeds).

Characteristics	**Values**
Water holding capacity	0.28 ml/g
pH	7.4
Moisture content	4.5%
Organic matter	3.0%
Mineral fraction:	
Sand	84.10%
Silt	5.77%
Clay	10.13%
Soil texture	Sandy loam

Table 2: Frequency of occurrence of fungi in the rhizosphere soil and rhizoplane of *Amaranthus hybridus* and the non-rhizosphere soil.

Isolates	Period of sampling (weeks)						
	2	4	6	8	10	12	14
From rhizosphere soil							
Aspergillus niger	50.0	30.2	32.3	34.0	35.1	30.6	31.0
Aspergillus terreus	–	27.0	26.6	30.2	30.4	28.2	25.3
Aspergillus versicolor	–	–	–	–	–	2.6	2.4
Rhizopus stolonifer	38.2	16.9	24.0	21.8	20.7	20.0	20.0
Mucor pusillus	–	–	–	–	3.0	2.3	3.5
Cladosporium sp.	7.3	–	–	–	–	–	–
Penicillium oxalicum	–	20.0	13.0	10.0	7.6	14.9	17.4
Aspergillus fumigatus	4.5	2.3	–	–	–	–	–
Alternaria alternata	–	3.6	4.1	4.0	3.2	1.4	1.4
From rhizoplane:							
Rhizopus stolonifer	30.1	28.0	26.6	27.0	20.2	19.2	19.1
Aspergillus niger	26.0	22.7	23.0	20.1	21.6	20.0	20.0
Aspergillus terreus	20.0	23.6	27.3	28.1	29.1	29.7	29.9
Penicillium oxalicum	16.7	19.4	19.9	24.8	25.0	25.8	26.5
Aspergillus versicolor	–	–	–	–	4.1	2.8	2.5
Alternaria alternata	–	–	–	–	–	2.5	2.0
Aspergillus fumigatus	7.2	6.3	3.2	–	–	–	–
From non-rhizosphere soil:							
Aspergillus niger	23.1	23.9	36.0	61.3	62.0	50.3	44.5
Aspergillus terreus	30.0	25.1	23.8	–	–	–	–
Penicillium oxalicum	26.2	27.0	–	–	–	–	–
Chaetomium sp.	20.7	24.0	40.2	38.7	38.0	39.6	40.1
Penicillium citrinum	–	–	–	–	–	10.1	15.4

The number of fungi in the rhizosphere and rhizoplane increased as the plants aged, reaching a maximum at the 10th week and subsequently declining (Fig. 1). Rovira (2) reported that generally the number of organisms in the rhizosphere and the rhizoplane increased with age of the plant. It was found in this study that the fungi present in the rhizosphere differed both quantitatively and qualitatively from those present in the rhizoplane, throughout the period of plant growth. Similar pattern had been reported by previous workers (6, 11, 26). Brown (27) also submitted that fungal populations differ in the two areas of the root region and change as plants mature.

Throughout the period of this study, more fungi occurred in the rhizosphere than in the non-rhizosphere quantitatively (Fig. 1). This is also reflected in the R/S ratios obtained (Fig. 2). Bowen and Rovira (12) reported that microbial growth is much more stimulated in the rhizosphere than in soil free of palnt roots, a phenomenon called the rhizosphere effect. Such increase in the number of fungi in the rhizosphere over those in the non-rhizosphere has been observed by previous workers (6, 24, 28).

The number of fungi in the rhizosphere increased progressively as the plants aged until the 10th week, and subsequently declined (Fig. 1). Similar progressive increases in microbial populations in the rhizosphere of plants up to a particular stage of growth, with a subsequent fall thereafter have been reported by some workers (2, 3, 28, 29).

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