RHIZOSPHERE FUNGI OF GUNUNG HALIMUN NATIONAL PARK

Nandang Suharna

Microbiology Division, Research Centre for Biology-LIPI

ABSTRACT

An ecological study was conducted to assess the occurrences of rhizosphere fungi in three dominating trees *(Altingia excelsa, Schima wallichii* and *Castanopsis javanica)* within Gunung Halimun National Park. Rhizosphere trees in Gunung Halimun National Park was mainly dominated by *Trichoderma* (47%), followed by *Penicillium* (16%), *Cunninghamella* (10%), *Mortierella* (15%), *Acremonium* (7%), and *Humicola* (6%). *Similar* composition of rhizosphere fungi was shown by the three trees and mainly consisted of *Trichoderma* and *Penicillium.* There was negative correlation of rhizosphere to fungal composition which was shown by *C. javanicus* and the positive correlation was shown by *A. excelsa* and *S. wallichii.*

Based on total of fungi encountered, *Trichoderma* was found to be the most common and dominant fungus in rhizosphere of those trees. Other fungi were also considered common were *Penicillium, Mortierella, Cunninghamella, Acremonium* and *Humicola.* Based on the number of samples, the frequency of the occurrence of *Trichoderma* was the highest (100%), followed by *Penicillium* (88%), *Cunninghamella* (59%), *Humicola* (47%), *Acremonium* (41%), *Mortierella* (35%), *Verticillium* (18%), *Cylindrocladium* (12%), *Aspergillus* (6%), and *Gliocephalotrichum* (6%).

Key words: Rhizoshere fungi, ecological study, Gunung halimun national Park.

INTRODUCTION

It has been known that fungi play essential role in decomposition, mineralization, and mutualism fungi-plant interactions which affect movement of elements in soil toward plant roots (Christensen, 1989). Therefore, occurrence of rhizosphere fungi will affect on plant growth. Several fungi *Aspergillus* and *Penicillium* are known in solubizing phosphate that bound to metal such as Alumunium, Iron and Calcium (Das, 1963). *Trichoderma,* especially *T. harzianum,* has been known well for its antagonistic properties against some soil plant pathogenic fungi such as *Rhizoctonia solani, Fusarium* spp., *Sclerotium rolfsii* and *Phytium* spp. Recently, this fungus is reported to produce plant growth promoter (Ousley *et al,* 1994). Therefore, besides decomposer of organic materials, their occurrences are very advantageous for plant growth. On the contrary, many detrimental fungi may occur that they are harmful to trees.

This ecological study was aimed to see the occurrences and abundance of rhizosphere fungi in Gunung Halimun National Park. This paper describes briefly on fungi encountered mostly referred to Domsch *et al.* (1980).

MATERIAL AND METHOD

Site Sampling

Seventeen sampling sites were located at Suzuki II Plot near to Cikaniki Research Station of Gunung Halimun National Park. This location was at 1,100 meter above sea level.

This area was predominated by three plant species. The most predominant was *Altingia excelsa* followed by *Schima wallichii* and *Castanopsis javanica.*

Soil Sampling

Soil sampling was carried out at four-points of rhizosphere area of each plant in each sampling site. Subsequently, samples of each plant were then mixed to composite.

Fungal Analysis

Every fungal analysis was carried out by soil plate method ((Durrel and Shields, 1960). Taoge extract agar (TA) (Saono *et al.,* 1969) + rosebengal (50 ppm) was used as selective medium for fungal analysis. TA also was used as growth medium for all isolates. After transferring soil onto the medium and incubating at 25°C for several days. Every isolates was then identified down to species or genus by referring Domsch *etal.* (1980), Barnet

(1969), Rifai (1969), Bisset (1984, 1991a, 1991b, 1991c). Every fungal colony was then determined to species or genus level. Occurrence of every fungus was scored 0 to 4, which 0 not found, 4 abundant.

RESULTS

There were 104 fungi encountered when it was analyzed by *soil plate* method using TA 6% as growth medium. Analysis data indicated that *Trichoderma* was the most abundant (47%) fungus encountered in rhizosphere of GHNP, followed by *Penicillium* (16%), *Cunninghamella* (10%), *Mortierella* (15%). Other fungi were *Acremonium* (7%), *Humicola* (6%), *Cylindrocladium, Gliocephalotrichum, Verticillium* and *Aspergillus japonicus.*

Trichoderma was also found to be the most abundance in rhizosphere represented by X. *hamatum.* Other *Trichoderma* species were found were *T. aureoviride, T. fertile, T. harzianum, T. koningii, T. longibrachiatum, T. polysporum, T. pseudokoningii, T.* Wrens, and *T. viride* (Table 1 and Table 2).

Rhizosphere of the most predominant *A. excelsa* mainly consisted of *Trichoderma* spp. (3.7) represented by *T. hamatum, Penicillium* sp. (3), and *Acremonium* sp. (2.2), *Mortierella* sp. (1) and *Humicola fuscoatra* (1). Other *Trichoderma* species were also found were *T. koningii* (1.7), *T. polysporum* (1.2), *T. fertile* (0.7), *T. aureoviride* (0.2), *T. longibrachiatum* (0.2), and *T. viride* (0.2). The other fungi were rarely encountered were *Cunninghamella echinulata* (0.7), *C. elegans* (0.3), *Gliocephalotrichum* sp. (0.2), *Humicola grisea* (0.5) and *Verticillium* (0.2). *S. wallichifs* rhizosphere consisted of *Trichoderma* (2.7) represented by *T. hamatum, Penicillium* (2.7), *C. elegans* (1.8), *Acremonium* (1.3) and *Mortierella* (1.2). Other *Trichoderma* species were also found were *T. koningii* (1),), *T. polysporum* (0.3), *T. viride* (0.8), *T. virens* (0.8) and *T. viride* (0.8). Other fungi were encountered were *Verticillium* (0.7), *Cunninghamella fuscoatra* (0.5), *Cylindrocladium scorparium* (0.2), *Humicola fuscoatra* (0.2) and *H. grisea* (0.2) (Table 1 and Table 2).

While *C. javanicus's* rhizosphere was inhabited by *Trichoderma* (1.8) represented by *T. hamatum* and *Penicillium* (1.8). Other *Trichoderma species* were found were *T. pseudokoningii* (0.7), *T. virens* (0.7), *T. harzianum* (0.3), *T. koningii* (0.3), and *T. longibrachiatum* (0.3). Other fungi were encountered were *Aspergillus japonicus* (0.2), *C. echinulata* (0.5), C. *elegans* (0.3), *Humicola grisea* (0.3), *Cylindrocladium* sp. (0.2), and *Gliocephalotrichum* sp. (0.2) (Table 1 and Table 2).

Based on occurrence and composition of fungi encountered it was clearly shown that *A. excelsa*'s rhizosphere was rich of fungi besides *S. wallichii's* rhizosphere and *C. javanicus* was the poorest (Table 1, Table 2 and Figure 1). Figure 2 shows that there was differences on occurrence and abundance level of rhizosphere fungi in the three tree species. Total number of species of rhizosphere fungi encountered in *A. excelsa, S. wallichii* and *C. javanicus* was 16, 14, and 13 respectively. Total score of abundance level of rhizosphere fungi encountered in *A. excelsa, S. wallichii* and *C. javanicus* was 17, 14.4, and 13 respectively. Index of abundance level of rhizosphere fungi encountered in *A. excelsa, S. wallichii* and *C. javanicus* was 1.06, 1.03, and 0.58 respectively. Based on these data it was clearly shown that there was difference composition of rhizosphere fungi amongst the three trees species.

DISCUSSION

The phenomenon of different composition of rhizosphere fungi amongst the three predominant trees was clearly indicated that there was allelochemical effect on fungal growth. According to Hale *et al.* (1978), allelochemical effects

between organisms range from inhibition to stimulation, from repellant to attractants, and from nutrients and toxins. The term allelochemics describes interorganismic chemical effects. The role of exudates in chelation of nutrients, pH of soil, solubilizing nutrients, or effects on aggregation of soil particles, are examples of the role of root exudates affecting the abiotic physical environments of roots. In the sphere of influence of the root in soil, the rhizosphere, a complex of reaction and interaction occurs between roots and soil inhabiting organisms. Allelophaty effect was seemingly shown by *C. javanicus.* This plant might produce exudates which made inhibition to fungal growth. Allelophaty describes the effects of allelochemical that inhibit organisms other than the producer (Hale *et al,* 1978).

Rhizosphere fungi encountered in this study are common in general of their occurrence in soils, included forest soil. *Trichoderma* are well known fungi with it regard with its worldwide occurrence. They are saprophytic in soil or in on wood, very common. Some species reported as parasites on other fungi (Barnett, 1960; Domsch *et al,* 1980). *Trichoderma* was also reported for its dominant occurrence in forest soil in Ilelem, Wamena, Irian Jaya (now Papua) (Suharna, 1994) and in forest soil after forest fires in Gunung Masigit, Gunung Gede-Pangrango in 1998 (Suharna dan Sunarko, 2001). *Trichoderma* was the commonest genus found in rhizosphere in Mount Leuser National Park, South Eastern Aceh (Suharna, 1998). The fungi were 100% of its frequency of isolation from 15 rhizosphere samples of different trees. One member of this genus, *T. viride* can be ranked as one of the most widely distributed of all soil fungi. On account of its rapid growth this fungus is easily isolated by all techniques, particularly using immersion tubes and plates. Other common species are *T. koningii* and *T. hamatum* (Domsch *et al,* 1980).

Penicillium are very large genus consisting both parasitic (producing rots or fleshy plant parts) and saprophytic species (Barnett, 1960). *Penicillium* together with *Aspergillus* are ubiquitous saprophytes which their conidia are easily distributed through atmosphere. Whereas *Aspergillus* occurs primarily in warmer regions and on heat-generating substrates, *Penicillium* species predominate in soil of the temperate regions. In soil analysis by dilution plate technique, *Penicillium* are detected with particular frequency. Because it is known that they frequently produce antibiotic metabolites, *Penicillium* is, with regard to biochemistry, one of the most thoroughly investigated genera of fungi (Domsch *et al,* 1980). All strain thus for tests have been able to solubize metaphosphates and utilize them as their phosphorus source. *Penicillium* were also the commonest and abundant fungi found in soil of Gunung Susu, Wamena, Irian Jaya (now Papua) (personal data) and in rhizosphere in Mount Leuser National Park, South Eastern Aceh (Suharna, 1998).

Cunninghamella are common and saprophytic fungi in soil (Barnett, 1960). *C. echinulata* and C. *elegans* are cosmopolitan species predominating warmer zones. Soil depth and pH have a little influence on its distribution. *C. elegans* occasionally has shown its prevalence in acid soils (Domsch *et al.,* 1980). *Cunninghamella* were found in rhizosphere in Mount Leuser National Park, South Eastern Aceh (Suharna, 1998).

Species of *Mortierella* are amongst the commonest soil fungi as they can grow fast and often sporulate freely. They can be isolated by conventional techniques. They probably play their minor role in soil metabolism but are generally capable of decomposting chitin. *Mortierella* species can be divided into two ecological groups according to their preferences for particular pH ranges (Domsch *et al,* 1980). Some *Mortierella* species such as *M. elongata, M. gamsii, M. humilis,*

M. hyalina, M. isabellina, M. minutissima and *M. ramanniana* are distributed worldwide and are common in forest soil (Domsch *et al,* 1980). *Mortierella* were also common found in that area found in rhizosphere in Mount Leuser National Park, South Eastern Aceh (Suharna, 1998) and in soil in Gunung Susu, Wamena, Papua (Personal data).

Several members of *Acremonium* are cosmopolitan and occur in various types of soil, included forest soil. The particular species *A. murorum* is saprophyte and worldwide distributed with wide range of its substrates, specially forest soil. Other common *Acremonium,* are *A. butiry, A. cerealis, A. furcatum, A. fiisidioides,* and *A. kiliense* (Domsch *et al,* 1980). *Acremoium* were also common found in that area found in rhizosphere in Mount Leuser National Park, South Eastern Aceh (Suharna, 1998).

Humicola species are widely distributed in neutral or alkaline soils. They are infrequently isolated by dilution and soil plate techniques but more frequently detected by selective methods using cellulosic substrates. *H. fuscoatra* is worldwide distributed and isolated at various type of soils. *H. grisea* distributes worldwide and is most isolated and found in various type of soils included forest soils (Domsch *et al,* 1980).

Verticillium comprises numerous saprophytic species and several plant-pathogenic species mostly cause vasicular wilt; of these, *V. arboatrum* and *V. dahliae* are amongst the best known root inhabiting fungi; whilst others darkening species are primarily soil inhabitant (Domsch *et al,* 1980).

CONCLUSION

Rhizosphere trees in Gunung Halimun National Park was mainly dominated by *Trichoderma* (47%) fungus encountered in rhizosphere of Gunung Halimun National Park, followed by *Penicillium* (16%), *Cunninghamella* (10%), *Mortierella* (15%), *Acremonium* (7%), and *Humicola* (6%).

Similar composition of rhizosphere fungi was shown by the three trees and mainly consisted of *Trichoderma* and *Penicillium.*

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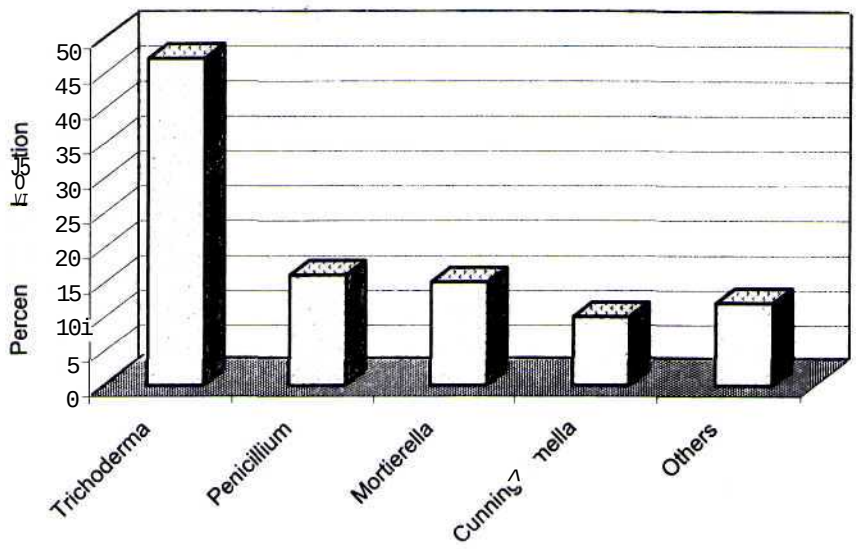

Figure 1. Abundance of Rhizosphere Fungi in Gunung Halimun National Park.

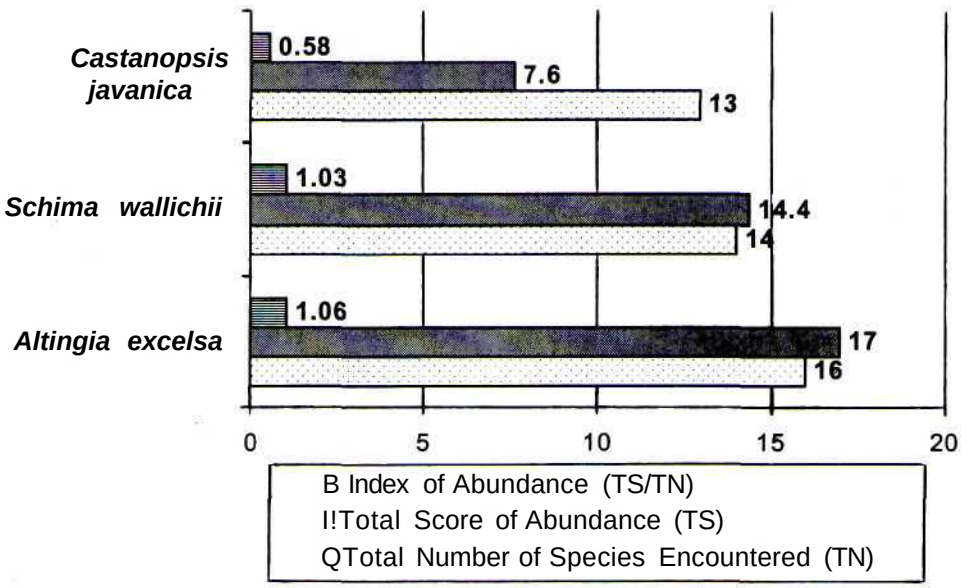

Figure 2. Comparison of Occurrence and Abundance Level of Rhizosphere Fungi in Three Plant Species in Gunung Halimun National Park

Table 1. The Occurrence and Abundance Level of Rhizosphere Fungi of The Three Predominant Trees Species in Gunung Halimun National Park.

Fungi Species	Trees Species		
	Altingia excels a	*Schima wallichii*	*Castanopsis javanica*
Acremonium sp.	2.2'»	1.3	0
Aspergillus japonicus	0	0	0.2
Cunninghamella echinulata	0.7	0.5	0.5
Cunninghamella elegans	0.3	1.8	0.3
Cylindrocladium scorparium	0	0.2	0
Cylindrocladium sp.	0	0	0.2
Gliochepalotrichum	0.2	0	0.2
Humicola fuscoatra	1	0.2	0
Humicola grisea	0.5	0.2	0.3
Mortierella sp.	1	1.2	0
Penicillium spp.	3	**2.7**	1.8
Trichoderma auroviride	0.2	0	0
Trichoderma fertile	0.7	0	0
Trichoderma hamatum	3.7	2.7	1.8
Trichoderma harzianum	0	0	0.3
Trichoderma koningii	1.7	1	0.3
Trichoderma longibrachiatum	0.2	0	0.3
Trichoderma polysporum	1.2	0.3	0
Trichoderma pseudokoningii	0	0	0.7
Trichoderma virens	**0**	0.8	0.7
Trichoderma viride	0.2	0.8	0
Verticillium sp.	0.2	0.7	0

"Scale of occurrence which range from 0 to 4, which 0=not found, 4=abundant.

Table 2. Occurrence and Abundance of Rhizosphere Fungi in Sampling Sites at Suzuki Plot II near to Cikaniki Research Station, Gunung Halimun National Park.

Tree Species		Fungi Species Encountered																					
		Acr[1]	Asj	Cec	Cel	Cys	Cyp	Gli	Huf	Hug	Mor	Pen	Tau	Tfe	Tha	Thz	Tko	Tlo	Tpo	Tps	Tren	Tde	Ver
Altingia excelsa																							
	Site 1	4[M]	0	0	0	0	0	1	3	3	3	4	0	0	3	0	3	0	0	0	0	0	0
	Site 2	4	0	0	0	0	0	0	0	0	2	4	0	0	4	0	3	0	3	0	0	0	0
	Site 3	4	0	2	0	0	0	0	2	0	1	4	0	0	3	0	0	0	0	0	0	0	1
	Site 4	0	0	0	0	0	0	0	0	0	0	2	0	0	4	0	2	1	0	0	0	1	0
	Site 5	1	0	0	0	0	0	0	1	0	0	2	1	4	4	0	0	0	0	0	0	0	0
	Site 6	0	0	2	2	0	0	0	o	0	0	2	0	0	4	0	2	0	4	0	0	0	0
	mean	2.2	0	0.7	0.3	0	0	0.2	1	0.5	1	3	0.2	0.7	3.7	0	1.7	0.2	1.2	0	0	0.2	0.2
Schima wallichii		Acr	Asj	Cec	Cel	Cys	Cyp	Gli	Huf	Hug	Mor	Pen	Tau	Tfe	Tha	Thz	Tko	Tlo	Tpo	Tps	Tren	Tde	Ver
	Sitel	0	0	2	1	0	0	0	1	1	0	3	0	0	4	0	0	0	0	0	2	0	0
	Site 2	3	0	1	1	0	0	0	0	0	4	3	0	0	3	0	0	0	0	0	0	3	0
	Site 3	0	0	0	2	0	0	0	0	0	0	2	0	0	4	0	0	0	1	0	0	0	0
	Site 4	3	0	0	4	1	0	0	0	0	3	3	0	0	1	0	0	0	1	0	3	0	0
	Site 5	2	0	0	0	0	0	0	0	0	0	2	0	0	2	0	4	0	0	0	0	2	0
	Site 6	0	0	0	3	0	0	0	0	0	0	3	0	0	2	0	2	0	0	0	0	0	0
	mean	1.3	0	0.5	1.8	0.2	0	0	0.2	0.2	1.2	2.7	0	0	2.7	0	1		0.3	0	0.8	0.8	0
Castanopsis javanica		Acr	Asj	Cec	Cel	Cys	Cyp	Gli	Huf	Hug	Mor	Pen	Tau	Tfe	Tha	Thz	Tko	Tlo	Tpo	Tps	Trert	Tde	Ver
	Sitel	0	0	0	0	0	1	0	0	0	0	3	0	0	3	0	2	0	0	0	2	0	0
	Site 2	0	0	3	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	0	0
	Site 3	0	1	0	2	0	0	0	0	1	0	0	0	0	1	2	0	2	0	2	0	2	0
	Site 4	0	0	0	0	0	0	1	0	1	0	3	0	0	2	0	0	0	0	2	0	0	0
	Site 5	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	2	0	0
	mean	0	0.2	0.5	0.3	0	0.2	0.2	0	0.3	0	1.8	0	0	1.8	0.3	0.3	0.3	0	0.7	0.7	0.3	0

[1] *Acr= Acremonium, Asj=Aspergillus japonicus, Cec=Cunninghamella echinulata, Cel=C. elegans, Cys= Cylindrocladium scoparium, Cyp= Cylindrocladium* sp., *Gli= Gliocephalotrichum* sp., *Huf=Humicola fuscoatra, Hug= H. grisea, Mor= Mortierella* sp., *Pen=Penicillium* sp., *Tau= Trichoderma aureoviride, Tfe= T. fertile, Tha=T. hamatum, Thz= T. harzianum, Tko= T. koningii, Tlo=T. longibrachiatum, Tpo=T. polysporum, Tps= T. pseudokoningii, Tren= T.* Wren, *Tde= T. viride, Ver= Verticillium* sp.. [M] Scale of occurrence which range from 0 to 4, which O=not found, 4=abundant.