ARBUSCULAR MYCORRHIZAL FUNGI AT DIFFERENT ECOSYSTEMS OF GUNUNG HALIMUN NATIONAL PARK

[Jamur Mikoriza Arbuskula pada Ekosistem Berbeda di Taman Nasional Gunung Halimun]

Suciatmih* [1571] **and K. Kramadibrata** **

* Bidang Mikrobiologi, Puslit Biologi - LIPI
•* Bidang Botani, Puslit Biologi - LIPI

ABSTRAK

Telah berhasil dikoleksi tujuh jenis jamur mikoriza arbuskula (MA) dari tiga macam ekosistem (masing-masing dari satu tempat yang tidak terganggu dan dua tempat yang terganggu) di Ciptarasa, Taman Nasional Gunung Halimun (TNGH). Jamur-jamur tersebut adalah *Acaulosporafoveata, A. morrowiae, Glomus cf. aggregation, G. etunicatum, G cf. glomerulatum, G. cfmultisubstensum* and *Scutellosspora projecturata.* Keanekaragaman jamur MA ada kecendeningan menurun oleh adanya perusakan ekosistem. Tempat yang rusak pada ketinggian 500 m dan 700 m dpi, mempunyai keanekaragaman jamur lebih rendah, yaitu masing-masing satu dan dua jenis dari pada tempat yang tidak rusak pada ketinggian 1000 m dpi (6 jenis).

Kata kunci: Jamur MA, keanekaragaman, ekosistem tergannggu, ekosistem tidak terganggu, Tainan Nasional Gunung Halimun. .

INTRODUCTION

Mycorrhizae playing a major role in plant nutrition, growth improvement, successful afforestation, reforestation and land reclamation programmes for the improvement of the environment (Kormanik *et al.* 1977 cit Raman *et al.* 1991). About 90 % of higher plants are mycorrhizal with 300.000 species forming arbuscular mycorrhizae (AM) (Kendrick and Berch, 1985).

Arbuscular micorrhizal fungi (AMF) are found in most ecosystems like dense rain forest, scrubs, savanna, heaths, sand dunes and semi-deserts (Hayman, 1981 cit. Ganesan *et al.*, 1991). In the humid tropics, most wild and cultivated plants are associated with AMF (Janos, 1977; St. John, 1980). The study of AMF in the tropical forest such as Gunung Halimun National Park (GHNP) is gaining attention because forests are the gene pools.

GHNP is the largest conservation area of tropical rain forest in Java. According to Sudarmadji *et al.* (2000), this area has a potential attractive scenery, and endowed with a high diversity of flora and fauna. In this area will also be found microorganisms doing several profitable activities for other living organisms such as cellulolitic, lignolitic and phosphate solubilizing fungi (Suciatmih and Sulistinah, 2001), cellulolitic bacteria (Sudiana *et al.*, 2001), and nitrogen fixing and phosphate solubilizing bacteria (Widawati dan Suliasih, 2001). So far, knowledge on the mycorrhizal association in this area has not been reported. However, many such studies were carried out in other places of Indonesia, as those of Kramadibrata *et al.* (1995; 2000), Ekamawanti (1999), Ervayenri *et al.* (1999), and Silviana *et al.* (1999). Therefore, this inventory of AMF at different ecosystems of GHNP will provide better information on biodiversity of AMF of this area.

MATERIALS AND METHODS

Collection of soil samples and production of trapping pot.

Soil samples were collected from three different ecosystems namely degraded site (agricultural and weedy land) and non degraded

land (natural forest). All sites located in Ciptarasa, GHNP. The degraded site at 700 m altitude was dominated by weedy species like *Ageratum conyzoides, Eupatorium odoratum, Imperata cylindrica,* and *Lantana camara* while the degraded one (agricultural land) at 500 m altitude was rhizosphere of clove, banana, and rice plants. The non degraded land at 1000 m altitude was dominated by *Castanopsis acuminatissima, Litsea cubeba, Macaranga rizinoides, Podocarpus neriifolius* and *Schima waliichi.*

For clove and banana plants, soil samples were taken from 50-100 cm away from stems and 0-20 cm depth. Four samples were taken from each location then mixed and air dried. For weedy and rice plants and natural forest, soil samples were collected randomly from a depth of 0-20 from five points in each site. The soil samples from each site were mixed together and air dried. Two hundred and fifty g of air dried sample was used for trapping the fungi. The soil was filled into 250 g plastic pots and planted with *Prueraria* sp. as a host for trapping. After three months, shoots of plants were cut and the soil left to dry for 3-4 weeks. Dried soil containing spores were used as the source of spores for AMF identification and pure culture. One hundred g of soil was sieved and decanted for spore recovery using the method of Gerdemann and Nicolson (1963) and centrifuged following the method of Brundrett *et al.* (1994). Sieved spores were mounted on slides in PVLG medium.

Identification of arbuscular mycorrhizal fungi.

Spores were separated based on morphological characters i.e. shape, color, attached hyphae, and spore ornamentation. Spore identification used the manual for identification of VA mycorrhizal fungi by Schenck and Perez (1990) and other references. Spores were observed under compound microscope.

Living pure culture

Attempt to produce pure culture was made. A tissue paper contained several AMF spores from "trapping pot" was enclosed around roots of *Prueraria* sp. then these plants were planted into pots and maintained in a growth room. Johnson's solution was used when needed.

RESULTS

Table 1 is a list of the species of AMF from three different ecosystems of GHNP. Totally, seven species of AMF belonging to various taxa were collected namely *Acaulospora foveata, A. morrowiae, Glomus cf. aggregatum, G. etunicatum, G. cf. glomerulatum, G. cf. multisubstensum* and *Scutellospora projecturata.*

The most abundant species from three different ecosystems was found in the non degraded site. **Out** of seven, there were six species identified (Table 1). The six species were belonged to three genera. In the degraded site where weedy is dominating, two species from one genera was identified. **The** same species from one genera was also isolated from rhizosphere of banana, rice and clove **plants (agricultural** land).

The fungi such as *Acaulospora foveata, Glomus cf aggregatum, G. etunicatum, G. cf. glomerulatum, G. cf. multisubstensum* and *Scutellospora projecturata* were found at 1000 m altitude and acid soil (3.89), whereas at 500 and 700 m altitudes and slightly neutral soil (6.10) were *A. morrowiae, G etunicatum* and *G. glomerulatum* (Table 2 and Table 3).

Of the seven AMF tested, three isolates of *A. morrowiae* and one isolate of *G. cf. glomerulatum* isolated from rhizosphere of clove, rice and banana plants; and weedy plants respectively could be multiplicated with *Prueraria* sp. as a host plant.

DISCUSSION

Diversity of AMF tend to decrease by the destruction of ecosystems. The degraded site at 500 and 700 m altitudes, appeared to have lower AMF diversity namely one, two species respectively than the non degraded one of 1000 m altitude, namely six species (Table 1 and Table 3). Lower AMF species in the degraded site is in accord with results reported by Ekamawanti (1999). It may due to soil disturbances lead to a reduction and possibly the elimination of AM propagules.

The number of species of AMF identified in two different degraded sites was different. The degraded site where weedy dominating had more species (two species) than the degraded one (planted host species i.e. banana, clove, and rice plants) (one species). In this present study was recorded pH soil of both sites was the same (6.10). It may be because of soil type.

Acaulospora foveata, Glomus cf. aggregatum, G. cf. multisubstensum, and *Scutellospora projecturata* were only found in the non degraded site whereas *A. morrowiae* was only in the degraded site (agricultural land). *Glomus etunicatum* and *G. cf. glomerulatum* were found both in the degraded (weedy plants) and the undegraded sites. Some of AMF species examined in present study were also found in other studies. These include *Scutellospora projecturata, A. foveata, G. etunicatum,* and *G. cf. aggregatum* found in the Gede-Pangrango National Park and Cibodas Botanical Garden (Kramadibrata *et al,* 2000), the rhizosphere of soyabean crop, Lampung (Kramadibrata *et al,* 1995), the rhizosphere of mangosteen, Bogor (Silviana *et al,* 1999), and Kolli Hills of Tamil Nadu, India (Raman *et al.,* 1991) respectively.

Glomus etunicatum and *G. cf. glomerulatum* seemed to have wider distribution in terms of soil pH and elevation. These fungi were identified from soil pH 3.89 at 1000 m altitude and 6.10 at 700 m altitude. This indicates that the fungi were more adapted to acid soil and the higher site. The wider distribution of *G. etunicatum* in terms of soil pH is in accord with results reported by Silviana *et al.* (1999). They informed that this fungus was found from soil pH 3.8 to 6.6.

Of the seven AMF tested, three isolates of *A. morrowiae* and one isolate of *G. cf. glomerulatum* could be multiplicated with *Prueraria* sp. as a host plant. This is an interesting finding because it added living collection of AMF then these fungi can be used as source of inoculum to increase plant growth.

Table 1. The occurrence of AMF at Different Ecosystems in Ciptarasa, GHNP.

No.	Species of AMF	Ecosystems		
		Degraded (Agricultural)	Degraded (Weedy)	Undegraded (Natural forest)
1	*Acaulospora foveata* Trappe & Janos	-	-	+
2	*A. morrowiae* Spain & Schenck	+	-	-
3	*Glomus cf. aggregatum* Schenck & Smith	-	-	+
4	*G. etunicatum* Becker & Gerdemann	-	+	+
5	*G. cf. glomerulatum* Sieverding	-	+	+
6	*G. cf. multisubstensum* Mukerji, Bhattacharjee & Tewari	-	-	+
7	*Scutellospora projecturata* Kramadibrata & Walker	-	-	+

+= present; -= absent

Table 2. Arbuscular Mycorrhizal Fungi at Different Soil pH in Ciptarasa, GHNP.

No	Species of AMF	Soil pH	
		3.89 (acid)	6.10 (slightly neutral)
1	*Acaulospora foveata* Trappe & Janos	+	-
2	*A. morrowiae* Spain & Schenck	-	+
3	*Glomus cf. aggregatum* Schenck & Smith	+	-
4	*G. etunicatum* Becker & Gerdemann	+	+
5	*G. cf. glomerulatum* Sieverding	+	+
6	*G.cf. multisubstensum* Mukerji, Bhattacharjee&Tewari	+	-
	Scutellospora projecturata Kramadibrata & Walker	+	-

+ = present; -= absent

Table 3. Arbuscular Mycorrhizal Fungi at Different Altitude of Gunung Halimun

No	Species of AMF	Altitude of gunung Halimun (m)		
		500	700	1000
1	*Acaulospora foveata* Trappe & Janos	-	-	+
2	*A. morrowiae* Spain & Schenck	+	-	-
3	*Glomus cf. aggregatum* Schenck & Smith	-	-	+
4	*G. etunicatum* Becker & Gerdemann	-	+	+
5	*G. cf. glomerulatum* Sieverding	-	+	+
6	*G.cf. multisubstensum* Mukerji, Bhattacharjee&Tewari	-	-	+
7	*Scutellospora projecturata* Kramadibrata & Walker	-	-	+

+= present; -= absent

CONCLUSION

Seven species of arbuscular-mycorrhizal fungi were identified from three kinds o." ecosystems in Ciptarasa, GHNP. They were *Acaulospora foveata, A. morrowiae, Glomus cf. aggregatum, G. etunicatum, G. cf. glomerulatum, G. cf multisubtensum,* and *Scutellospora projecturata.*

Diversity of AMF tends to decrease by the destruction of ecosystems. The degraded site at 500 and 700 m altitudes, appeared to have lower AMF diversity namely one, two species respectively than the non degraded one of 1000 m altitude, namely six species.

The number of species of AMF identified in two different degraded sites was different. The degraded site where weedy dominating had more species (two species) than the degraded one (planted host species i.e. banana, glove, and rice plants) (one species).

Glomus etunicatum and *G. cf. glomerulatum* were found both in the degraded site (weedy land) and the non degraded site (natural forest). The fungi were also found on soil pH 3.89 at 1000 m altitude and soil pH 6.10 at 700 m altitude.

In future study four living culture isolates of AMF (three isolates of *A. morrowiae* and one isolate of *G. cf. glomerulatum)* will be screened to find out a good inoculum to increase **plant** growth.

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