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ARBUSCULAR MYCORRHIZAL FUNGI IN PAPAYA PLANTATIONS OF ESPÍRITO SANTO AND BAHIA, BRAZIL

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ABSTRACT

The aim of this study was to obtain knowledge on arbuscular mycorrhizal (AM) associations in papaya (*Carica papaya*, L.) in field soils and nursery conditions. Sixty seven soil and root samples were taken in February and May of 1996, from 47 commercial plantations in the North of Espirito Santo State and the West and South of Bahia State, in Brazil. Samples were used for direct spore counts, root colonization assessment and for trap culture with *Sorghum bicolor* (L.) Moench and *Crotalaria juncea* L. Additional sampling was done in commercial nurseries to evaluate mycorrhizal colonization. Although papaya cropping systems are usually under high input of fertilizers and pesticides, papaya roots showed considerable arbuscular mycorrhizal (AM) colonization, ranging from 6% to 83%. Colonization rates were most influenced by available soil P, correlated positively with percentage of sand and soil pH, but correlated negatively with soil clay content. AM colonization of nursery seedlings was very low in most samples. Field spore numbers varied from 34 to 444/30g of soil. All Glomerales families were represented and 24 fungal species identified. *Glomus etunicatum*, *Paraglomus occultum*, *Acaulospora scrobiculata* and *Gigaspora* sp. were the most common species.

Key words: *Glomeromycota*, agroecosystems, ecology, *Carica papaya*

INTRODUCTION

Arbuscular mycorrhizas (AM) are associations formed by approximately 160 species (10) of fungi of the phylum *Glomeromycota* (22) and roots of most plant species. These fungi experienced 400 million years of coevolution with plants (19) which allowed them a generalized occurrence and distribution in agrosystems and natural ecosystems. However, the occurrence of a defined fungal species or community is rarely predictable because it is influenced by edaphic factors and plant community characteristics. In specific agrosystems, with similar edaphic and climatic characteristics, it is possible to find a pattern of AM fungi ocurrence for a defined crop (12) and for crops from different sites and ages (16). Species richness and diversity of AM fungi have been shown to be influenced by several soil factors. Siqueira *et al*. (24) found 33 AM fungal species during a survey on agrosystems of coffee, fruits, annual crops and ecosystems-Cerrados- in Brazil. *Acaulospora* species were most frequently detected in soils with pH of 6.5 or lower. The authors also found that certain species, such as *Gigaspora margarita*, reached their highest frequencies in soils with high Al^3 content. Similarly, in cacao plantations and nurseries in Venezuela, Cuenca and Menezes (4) detected 15 AM fungal species in all sites surveyed and indicated that species richness and diversity were inversely correlated with available P in soil. AM colonization rates may vary between varieties of a same plant species, as occurred with banana (*Musa* spp) (7). These results suggest effect of shoots and host genetics on mycorrhizal association. Cropping systems are very complex and may cause qualitative and quantitative shifts in AM fungal

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communitites and therefore influence the overall occurrence and community structure of this group of microrganisms.

Considering the complexity of mycorrhizal systems, in particular the unpredictability of species occurrence and functionality, it is necessary to gain a better understanding of the ecology of AM fungi in sites where inoculation or management of native AM fungi populations are intended (24).

Papaya (*Carica papaya* L.) is a highly appreciated fruit crop widely cultivated around the world, particularly in Brazil. In the states of Espirito Santo and Bahia papaya plantations extend to an area of 35.556 ha (9) mainly as a monoculture. Under controlled conditions, papaya plants have shown high capabilities to form AM and to benefit from AM in fumigated (29) and unfumigated soils (27). In field conditions, Mamatha *et al*. (14) have observed that papaya trees respond to inoculation with efficient AM fungi reducing the need for P fertilization at least until the start of production. Considering the importance of AM to plant growth, reduction of fertilizer use and agrosystem sustainability, this work aimed to evaluate the occurrence of AM fungi in nursery and high-yield commercial plantations of papaya in three different regions in Brazil.

MATERIALS AND METHODS

Sixty seven soil samples were collected in February and May, 1996 from 47 papaya plantations located in the North of Espirito Santo State (Linhares and São Mateus counties), and in the West (Barreiras and Luiz Eduardo Magalhães counties) and South of Bahia State (Porto Seguro, Eunápolis and Itabela counties), Brazil. Predominant soil types were Oxisols and Ultisols in Espirito Santo and Oxisols and Entisols in West and South of Bahia. Average air temperatures ranged from 21ºC to 26ºC in Espirito Santo and West of Bahia, and 22ºC to 27ºC in the South of Bahia. Major soil characteristics are presented in Table 1. Papaya varieties differed among orchards. Most varieties (71%) belonged to 'Solo' group (Sunrise Solo, Improved Sunrise Solo "Line" 72/12 and Baixinho de Santa Amália) and the remaining 29% belonged to 'Formosa' group (hybrids Tainung Nº1 and Nº2). Crop ages ranged from 4 months to 3 years. All (except one) sites were irrigated mainly by localized sprinkling. Conventional sprinkling and central pivot were also used. Soil fertilization and chemical control of diseases and pests were common in all orchards.

Samples were taken from homogeneous areas in terms of landscape, crop age and variety, at each site, by collecting 7 to 10 single samples consisting of 0.5 dm^3 of soil and roots of each plant as follows. Each single sample was composed by two sub-samples, collected in opposite positions under the plant canopy, 30-50 cm from the stem and 0 to 20 cm deep. Single samples were pooled to form one compound sample of 0.5 dm^3 of soil per location. Soil samples were analyzed for available P, pH, organic matter and texture (Table 1) and total counts of AM fungal spores. Roots were gently separated from the soil, washed and stained with 0.05% trypan blue (17). Papaya seedlings (45 to 150 days old) were also taken from four commercial nurseries (10 seedlings/nursery) located on South of Bahia. Seedlings were raised on 0.5-1.0 dm^3 plastic bags with a substrate composed of 70% of sieved subsoil and 30% of manure supplemented with P and K, 100 mg/kg substrate, each. Both field and nursery roots were scored for AM root colonization (1).

In order to multiply native AM fungal spores for accurate identification, and to establish single isolate cultures, soil samples were used to set up trap cultures by growing *Sorghum bicolor* (L.) Moench and *Crotalaria juncea* L., together, as host plants. Trap cultures were established by disposing 0.2 L of sterile sand on the bottom of 1 L plastic pots and covering with 0.6 L of a mixture of native soil + sterile sand + vermiculite (2:1:1, v:v:v). Trap plant seeds were sown over this mixture and covered with a third layer of 0.2 L of sterile sand. After five months, plant shoots were removed, and soil and roots were collected, air-dried and stored in a refrigerator (4-10ºC) until use for spore extractions and identification.

Table 1. Crop age, chemical and physical soil characteristics in papaya (*Carica papaya* L.) fields from three regions in Brazil.

Parameter	Age (years)	P (mg dm^{-3})	pH	Organic matter (g kg^{-1})	Coarse sand (g kg^{-1})	Fine sand (g kg^{-1})	Total Sand (g kg^{-1})	Silt (g kg^{-1})	Clay (g kg^{-1})
North of Espírito Santo									
Range	0.35-2.5	7-352	4.7-6.1	16-31	360-730	150-230	520-880	10-180	90-350
Average	0.98	89.7	5.5	24	525	186	710	77	211
West of Bahia									
Range	0.58-3	18-286	5.3-7.4	8-29	150-290	360-660	540-810	60-200	80-350
Average	1.44	90	6.4	14.3	182	549	731	108	160
South of Bahia									
Range	0.58-2.5	3.3-352	4.5-6.5	33-44	460-770	130-280	660-930	40-160	20-230
Average	1.24	83.6	5.5	37	600	207	807	91	100

Spores were extracted and mounted on PVLG and Melzer's reagent. Species identification was done according to Schenck and Pérez (21) and by comparison with reference culture information available in the web page (http://invam.caf.wvu.edu/fungi/taxonomy/speciesID.htm) of the International Culture Collection of (Vesicular) Arbuscular Mycorrhizal Fungi (INVAM) (11).

After identification, the total number of species recovered (T) and AM fungal species richness (R = average of species number per sample) were determined. Repetition index (RI = R/T) was also calculated. This index represents the estimate of the minimum number of sub-samples necessary to cover all diversity present in the group of samples. Frequency (%) was calculated based on the occurrence of a species on trap cultures. Pearson's coefficient was used to correlate soil chemical and physical characteristics with data on spore abundance and root colonization (5).

RESULTS

Arbuscular mycorrhizal colonization of field papaya samples was highly variable between and within each cropping region (Table 2). Values ranged from almost zero up to 83% in the South of Bahia. The lowest variation occurred in the West of Bahia (10-40%). Nursery papaya plants showed low levels of colonization, varying from 0 to 7%. Under this condition, the roots of most samples (44%) showed no evidence of AM colonization. Spore counts from field samples ranged from 34-108 spores/30g of soil in the West of Bahia to 65-444 spores/30g in the North of Espirito Santo. These two regions also had the lowest (67) and the highest (212) average of spore counts, respectively. Root colonization in samples from the North of Espirito Santo and West of Bahia showed negative correlations with soil P (Table 3). Correlation between AM colonization and soil pH was positive and significant only in South of Bahia.

Table 2. Arbuscular mycorrhizal colonization and spore density in rhizosphere samples from papaya (*Carica papaya* L.) fields in three regions in Brazil.

	North of Espírito Santo (Nº = 15)*		West of Bahia (Nº = 18)		South of Bahia (Nº = 34)	
Parameter	Colonization (%)	Spores (nº/30g)	Colonization (%)	Spores (nº./30g)	Colonization (%)	Spores (nº/30g)
Range	6-53	65-444	10-40	34-108	1-83	43-325
Average	33	212	23	67	38	168

* Number of analysed samples in each region.

Table 3. Correlation between arbuscular mycorrhiza colonization, spores density and soil chemical and physical characteristics in papaya crops (*Carica papaya* L.), in three regions in Brazil[1/ 2/].

Characteristics	P	pH	Organic matter	Coarse sand	Fine sand	Total sand	Silt	Clay
				North of Espírito Santo (15)				
Colonization	-0.74 **	0.02	-0.11	0.60 **	-0.07	0.56 *	-0.33	-0.60 **
Spore density	0.04	-0.06	0.11	-0.25	-0.23	-0.30	0.27	0.28
				West of Bahia (18)				
Colonization	-0.45 *	0.00	0.21	0.06	-0.40	-0.36	0.43 *	0.24
Spore density	-0.37	-0.10	0.54 *	0.05	-0.57**	-0.52 *	0.16	0.60**
				South of Bahia (34)				
Colonization	0.00	0.46 **	-0.09	0.05	0.12	0.12	-0.09	-0.11
Spore density	-0.14	-0.22	-0.25	0.34 *	-0.22	0.27	-0.25	-0.23
				All regions (67)				
Colonization	-0.18	0.00	0.32 **	0.40 **	-0.35 **	0.22 *	-0.10	-0.22 *
Spore density	-0.07	-0.44**	0.34**	0.50**	-0.60**	-0.02	-0.16	0.09

1/ Values in parenthesis represent number of samples in each region;
2/ * and ** represent correlation coefficients of Pearson significant at $p<0.05$ and $p<0.01$, respectively.

When all regions were considered, organic matter showed a positive correlation with AM colonization. A similar trend was found for soil texture. Spore density was not correlated with soil P but seemed to be negatively influenced by pH considering all regions (r=-0.44). Coarse sand was positively correlated with spore density while clay showed a similar tendency when only West of Bahia was considered (Table 3). Silt showed no correlation with spore number.

Spore production in the trap cultures was frequent and abundant. Twenty four AM fungal species, representing all five families and seven genera, were identified in the papaya soil samples (Table 4). *Glomus etunicatum* and *Acaulospora scrobiculata* were the most frequent species, being present in more than 50% of the samples, followed by *Paraglomus occultum* and *Gigaspora* sp. with 45% and 41% of frequency, respectively. Most species were detected in less than 20% of the samples (Table 4). Some occurred exclusively in one region, like *G. intraradices* and *P. brasilianum* in the North of Espirito Santo and *A. dilatata*, *A. longula* and *Scutellospora persica* in the South of Bahia, though with very low occurrence index. At the genus level, *Paraglomus*, *Entrophospora* and *Gigaspora* were detected in all regions, being represented by one or two species each, while *Archaeospora* was not retrieved from North of Espirito Santo only. *Glomus* and *Acaulospora* were also detected in North of Espirito Santo and West of Bahia, and the latter outnumbered the former in South of Bahia (Table 4).

Total number of AM fungi species identified was fairly constant, although sampling in the South of Bahia had been more intensive (Table 5). North of Espirito Santo and South of Bahia had species richness values of 5.07 and 4.44, respectively, although both regions had larger and equivalent repetition indices. Papaya plantations of more than 2 years of age showed the lowest species richness (3.89). This characteristic tended to be higher in soils with pH > 5.5 and P levels < 50 mg/dm^3 (Table 6). *A. mellea*, *A. morrowiae*, and *E. colombiana* were more frequent in soils with pH lower than 5.5, while *A. scrobiculata* and *A. delicata* were more frequent in soils with pH above 5.5 (Table 6). *Glomus* species also showed marked differences in their frequencies as a function of soil pH. For instance, *G. etunicatum* occurred more at pH > 5.5 while *G. intraradices* and *G. macrocarpum* reached their highest frequencies at pH < 5.5. Distribution of *Gigaspora* sp. seemed to be related to soil pH, since occurrence in soils with pH above 5.5 was three times higher than that in soils with pH ≤ 5.5. Some species, like *Acaulospora* sp., *G. etunicatum* and *G. macrocarpum*, showed almost the same frequency, regardless the P levels (Table 6). Other species, however, seemed to be less frequent at higher P levels, like *S. pellucida* which had its frequency reduced from 36.4% at P < 50 mg/dm^3 to 16.7% at P > 100 mg/dm^3. A similar trend was observed

Table 4. Arbuscular mycorrhizal fungi species identified in soil samples from papaya (*Carica papaya* L.) fields and respective occurrence index for each region, based on spores recovered from trap culture with *Sorghum bicolor* (L.) Moench and *Crotalaria juncea* L.

Fungal taxon	North of Espírito Santo	West of Bahia	South of Bahia
	Ocurrence index (%)*		
Acaulosporaceae			
A. delicata, Walker, Pfeiffer & Bloss	26.7	12.5	22.2
A. dilatata, Morton	0.0	0.0	3.7
A. longula, Spain & Schenck	0.0	0.0	11.1
A. mellea, Spain & Schenck	33.3	6.3	33.3
A. morrowiae, Spain & Schenck	33.3	0.0	11.1
A. rugosa, Morton	26.7	12.5	0.0
A. scrobiculata, Trappe	18.9	50.0	66.7
Acaulospora sp.	6.7	25.0	11.1
E. colombiana, Spain & Schenck	6.7	12.5	22.2
Entrophospora sp.	0.0	6.3	7.4
Archaeosporaceae			
Archaeospora trappei, Ames & Linderman	0.0	6.3	7.4
Paraglomaceae			
Paraglomus brasilianum, Spain & Miranda	6.7	0.0	0.0
Paraglomus occultum, Walker	73.3	25.0	37.0
Glomaceae			
G. etunicatum, Becker & Gerdemann	73.3	43.8	63.0
G. intraradices, Schenck & Smith	26.7	0.0	0.0
G. macrocarpum, Tulasne & Tulasne	33.3	25.0	11.1
G. mosseae, Gerdemann & Trappe	13.3	12.5	0.0
G. tortuosum, Schenck & Smith	13.3	6.3	0.0
Glomus sp.	13.3	6.3	0.0
Gigasporaceae			
Gigaspora sp	13.3	68.8	40.7
S. cerradensis, Spain & Miranda	0.0	6.3	7.4
S. heterogama, Walker & Sanders	6.7	12.5	0.0
S. pellucida, Walker & Sanders	6.7	12.5	48.1
S. persica, Walder & Sanders	0.0	0.0	7.4

* Percentage of soil samples, in each region, containing the respective specie.

for *A. delicata* and *A. scrobiculata*. Availability of soil P seemed to be very selective for other species. For example, *S. persica*, *S. heterogama* and *Archaeospora trappei* were detected only in soil with 50 to 100 mg/dm^3 of P, while *Paraglomus brasilianum* occurred only in samples with P levels below that range (Table 6).

DISCUSSION

Papaya showed a high diversity of AM fungi in its rhizosphere under field conditions. Species richness was related to soil available phosphorus. Considering that AM fungi are important components of the soil biota in sustainable cropping systems (3), maintaining high P levels as required by a productive papaya crop and low soil pH, may inhibit AM colonization and adversely affect AM fungi. This may hamper crop sustainability, since it becomes more dependent on exogenous supply of nutrients and more susceptible to stressful conditions. Papaya soils may contain as much as 352 mg/dm^3 of P that shows negative correlation with AM root colonization (Table 3).

Finding a correlation between soil physical and chemical properties with AM colonization and spore density was a difficult task and depended on the region sampled (Table 3). Low AM colonization rate and spore density in samples from west of Bahia might be related, partially, to the high content of fine sand and low content of soil organic matter (Table 1). Fine sand contributes to soil pore occlusion and surface crust formation (2) which is known to influence fine root development and, consequently, AM colonization and sporulation. Low AM colonization and spore density in the West of Bahia crops suggest a low inoculum potential in these fields, associated with reduced root production. This may contribute to a cropping system with dependence on chemical fertilizers. As soil physical and chemical characteristics showed varied correlation with root colonization and spore density, other soil and plant characteristics have to be considered like crop age, which was positively correlated with AM colonization in South of Bahia. Saggin Júnior and Siqueira (20), studying the ocurrence of AM fungi in coffee fields, suggested that mycorrhizal colonization is more dependent on AM fungal population differences and respective inoculum potencial than on soil physical-chemical properties.

Results obtained from nursery plants indicated that the management practices adopted for seedlings production are not conducive to AM formation. This is probably due to the use of subsoil, fumigated

Table 5. Number of samples evaluated, total number of species, richness (average species number in a sample) and repetition index of arbuscular mycorrhizal fungi in soils cultivated with papaya (*Carica papaya* L.) in three regions in Brazil.

	North of Espírito Santo	West of Bahia	South of Bahia	TOTAL
Number of samples	15	16	27	58
Number of species (a)	18	18	17	24
Richness (b)	5.07	3.33	4.44	4.29
Repetition index (b/a)	0.28	0.19	0.26	0.18

Table 6. Frequency, number and richness of arbuscular mycorrhizal fungi species in papaya (*Carica papaya* L.) fields with different classes of pH values and available soil P, considering three regions in Brazil.

	Classes of values				
	pH		Soil P (mg dm^{-3})		
	≤ 5.5 (nº=23)	> 5.5 (nº=35)	< 50 (nº =22)	50 - 100 (nº =18)	> 100 (nº =18)
Species number	22	23	19	21	17
Richness	3.5	4.4	4.6	4.4	3.4
Species identified	Frequency (%)		Frequency (%)		
A. delicata	13.0	25.4	27.3	22.2	11.1
A. dilatata	0.0	2.9	0.0	0.0	5.6
A. longula	4.3	2.9	9.1	5.6	0.0
A. mellea	39.1	19.5	36.4	22.2	22.2
A. morrowiae	21.7	9.8	13.6	22.2	5.6
A. rugosa	4.3	14.3	9.1	11.1	11.1
A. scrobiculata	30.4	65.7	72.8	50.0	38.9
Acaulospora sp.	13.0	20.0	18.2	16.7	22.2
E. colombiana	21.7	8.6	18.2	5.6	16.7
Entrophospora sp.	8.7	11.4	18.2	0.0	11.1
Archaeospora trappei	4.3	5.6	0.0	16.7	0.0
P. brasilianum	4.3	0.0	4.6	0.0	0.0
P. occultum	34.8	51.5	50.0	55.6	33.3
G. etunicatum	43.5	68.5	59.1	61.1	61.1
G. intraradices	13.0	2.9	4.6	5.6	11.1
G. macrocarpum	26.1	17.2	18.2	22.2	22.2
G. mosseae	4.3	8.6	4.6	16.7	0.0
G. tortuosum	4.3	2.9	0.0	5.6	5.6
Glomus sp.	4.3	5.6	4.6	5.6	5.6
Gigaspora sp.	17.4	54.3	50.0	38.9	38.9
S. cerradensis	4.3	5.6	4.6	11.1	0.0
S. heterogama	8.7	2.9	0.0	11.1	0.0
S. pellucida	21.7	28.6	36.4	27.8	16.7
S. persica	0.0	5.6	0.0	11.1	0.0

substrate and a high fertility regime as the result of high levels of manure and soluble minerals. Similar findings have been reported in nursery-produced coffee outplants in Brazil (25). But when nursery plants are grown directly in the soil, like some citrus systems, root may appear highly colonized (26). It was showed that nursery substrates mixed with more than 10% of cow manure reduce AM colonization in papaya seedlings (28). The reduced AM formation at nursery stage is consistent with low AM colonization in the early cropping stage in many papaya fields. This may compromise initial development, with consequences for further crop performance.

The intensive sampling on papaya plantations, which represent a monoculture, revealed a high diversity at family and species levels, with all Glomeromycota families being represented and 24 species identified after trapping culture on native soil samples. Papaya mycorhizosphere richness is lower than that found (total of 36 species) in coffee plantations in the south of Minas Gerais (6) but much higher than that found (10 species) in citrus plantations in Bahia and Sergipe (30). Trapping the native soil with suitable hosts and assessment of sporulating species after 3-4 months allows the recovery of cryptic species, which may not be sporulating in the field (15).

A. scrobiculata showed high occurrence in the study, confirming its extensive distribution in tropical environments (4,24,30). The high occurrence of *Gigaspora* sp. in West of Bahia plantations may reflect its tendency to be part of the Cerrado’s bioclimatic region, which have shown high incidence of this genus (24). Alternatively, it may reflects low soil organic matter content as observed by Porter *et al.* (18) and also, soils with pH higher than 5.5 (23). Low soil pH influenced the occurrence of *A. mellea* and *A. morrowiae*, which corroborates other findings regarding the occurrence of these species in highly weathered soils (24,30).

By analyzing the community structure of AM fungi associated with papaya plantations, it was observed that it tended to be dominated by few species, approaching the log series of the abundance model that describes situations where only few factors are controlling the whole community structure (13). In the papaya agrosystem, soil pH and available P are, probably, the main environmental factors determining species occurrence.

A high heterogeneity of species distribution is reflected as a small repetition index, such as found in the West of Bahia, indicating that species are more randomly distributed at that region. Species richness tended to become low in plantations older than 1 year, similarly to what was observed by Sieverding (23) in a monoculture of cassava, and by Siqueira *et al*. (24) studying the shift from native “Cerrado” to agrosystems. Cuenca and Menezes (4) did not observed a reduction of species diversity on cacao plantations and they attributed their results to the simultaneous growth of shadow plants in that system. It has been demonstrated that a short period of growth of different species of plant may change AM fungi diversity, demonstrating the existence of a selection pressure of plants on AM fungal communities (8).

The present study, associated with other finding showing a high response of papaya to AM fungi colonization, may indicate that papaya cropping in Brazil, seems to be highly dependent on chemical fertilization. The reasons could be the extremely low levels of mycorrhizal colonization on nursery papaya seedlings, the highly variable levels of mycorrhizal colonization in the field, the high levels of phosphate in the soil and the tendency to reduce AM fungi species richness over the plantation years and with the use of P fertilization. On the other hand, the rich community of AM fungi associated with papaya found in this study and the results of Trindade *et al*. (27), demonstrate that inoculation with selected fungal isolates under nursery conditions is a reasonable approach towards sustainability. Besides, this community coud be managed by less disturbing soil practices such as reduced phosphorus fertilization and use of intercrops.

RESUMO

Fungos micorrízicos arbusculares em pomares de mamoeiro do Espírito Santo e Bahia no Brasil

O trabalho objetivou a obtenção de conhecimento sobre a associação micorrízica arbuscular (MA) em mamoeiro (*Carica papaya*, L.) em condições de pomar e viveiro. Sessenta e sete amostras de solo e raízes foram coletadas em quarenta e sete pomares comerciais nos meses de fevereiro e maio de 1996, abrangendo o Norte do Espírito Santo e o Oeste e Sul da Bahia. Amostras foram usadas para contagem direta de esporos, avaliação da colonização radicular e para cultivo armadilha com *Sorghum bicolor* (L.) Moench e *Crotalaria juncea* (L.). Amostragens adicionais foram feitas em viveiros comerciais, para avaliar a colonização micorrízica. Embora os sistemas de cultivo do mamoeiro recebam grande quantidade de insumos na forma de fertilizantes e pesticidas, as raízes apresentaram percentagem de colonização radicular variando de 6% a 83%. As taxas de colonização mostraram-se relacionadas com o P disponível do solo, correlacionando-se positivamente com areia e pH do solo, mas negativamente com os teores de argila. Em viveiros, a percentagem de colonização nas plântulas foi baixa na maioria das amostras. Em campo o número de esporos variou de 34 a 444/30g de solo. Todas as famílias do filo Glomeromycota estiveram representadas e 24 espécies fúngicas foram identificadas. *Glomus etunicatum*, *Paraglomus occultum*, *Acaulospora scrobiculata* e *Gigaspora* sp. foram as espécies de maior ocorrência.

Palavras-chave: *Glomeromycota*, agroecossistemas, ecologia, *Carica papaya*

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