WEED INCIDENCE IN AN INTERCROPPING SYSTEM OF BANANA, TYPE PLANTAIN, CV. D'ANGOLA, WITH ASSAI PALM IN DIFFERENT ARRANGEMENTS

Ueliton Oliveira de Almeida[1]; Romeu de Carvalho Andrade Neto[2]; Aureny Maria Pereira Lunz[2]; Sebastião Elviro de Araújo Neto[1]; Leonardo Barreto Tavella[1]

[1]Universidade Federal do Acre. E-mail: uelitonhonda5@hotmail.com; selviro2000@yahoo.com.br; leo_tavella@hotmail.com
[2]EMBRAPA Acre. E-mail: romeu.andrade@embrapa.br; aureny.lunz@embrapa.br

ABSTRACT

The present study aimed at surveying weed species in the banana tree (*Musa* sp.) intercropping with assai (*Euterpe precatoria*). The experiment was performed using a randomized complete block design with six treatments (monocultures and intercropping) and four replications. The weed species were identified and quantified, enabling the calculation of phytosociological parameters. The soil cover and the dry mass of the weeds were evaluated. In general, *Mollugo verticillata* is one of the main species found in the essay. The *E. precatoria* palm monoculture showed a greater diversity of weed species and individuals and dry mass of the aerial part. Areas with banana monoculture or under a banana intercropping with *E. precatoria* palm in different planting arrangements displayed the same amount of dry matter of the aerial part and similar soil cover levels.

Keywords: Phytosociological survey, *Musa* sp., *Euterpe precatoria*

OCORRÊNCIA DE PLANTAS DANINHAS NO CONSÓRCIO DE BANANEIRA, CV. D'ANGOLA, COM AÇAIZEIRO EM DIFERENTES ARRANJOS

RESUMO

O presente estudo objetivou levantar espécies de plantas daninhas na bananeira (*Musa* sp.) consorciada com açaizeiro (*Euterpe precatoria*). O experimento foi conduzido em delineamento em blocos ao acaso, com seis tratamentos (monocultivos e consórcios) e quatro repetições. As espécies de plantas daninhas foram identificadas e quantificadas, possibilitando o cálculo de parâmetros fitossociológicos. A cobertura do solo e a massa seca das plantas daninhas foram

avaliadas. Em geral, *Mollugo verticillata* foi uma das principais espécies encontradas no ensaio. A monocultura de *E. precatoria* apresentou maior diversidade de espécies de plantas daninhas e indivíduos, assim como maior massa seca da parte aérea. Áreas com monocultivo de bananeira ou consorciada com *E. precatoria* em diferentes arranjos de plantio apresentaram a mesma quantidade de matéria seca da parte aérea de plantas daninhas e níveis de cobertura do solo semelhantes.

Palavras-chave: Levantamento fitossociológico, *Musa* sp., *Euterpe precatoria*

INTRODUCTION

Banana is the primary fruit species being produced in the State of Acre, with 102.949 tons for a harvested area of 8.118 ha, while *Euterpe precatoria* Mart. has an estimated production of 3.564 tons, equivalent to 0,8% of the national total (IBGE, 2019). Plantain tree (*Musa* sp.) and assai palm (*E. precatoria*) are strategic fruit plants for intercropping systems in the Amazon region, as the environmental conditions are favorable for crop growth.

One of the critical issues affecting plant cultivation, whether in monoculture, intercropping or agroforestry systems, is the negative interference of weed species (LANZA et al., 2017). These plants undermine agricultural profitability as they compete for resources that are essential to agricultural crops such as water, light, nutrients, space, and CO2, in addition to releasing allelopathic substances and acting as alternative hosts for plagues and diseases (MOURA FILHO et al., 2015). Further, when the intercrop provides a good soil cover, soil temperature will stay relatively low. This prevents burning of the organic matter in the soil and loss of nutrients. It also provides a microclimate that can be favourable for associated crops (OUMA; JERUTO, 2010).

The intercropping system of fruit tree species with other crops, whether annual, semiperennial or perennial, is a good alternative to optimize land use and an important approach to recover degraded areas. Consequently, it is possible to obtain a more efficient control of weeds due to a better area occupation and shading (SILVA et al., 2013). After studying the effect of banana plant densities "BRS Princess" on weeds suppression, Lanza et al. (2017) concluded that the results of their study point out advantages in relation to crop densities, increasing banana yield per equivalent area and, consequently, optimizing land use. These benefits also add to the ability to promote the suppression of common weeds in tropical regions.

In order to adopt the best weed management system in a crop, it is necessary to identify the

species present in the area and classify them in terms of aggressiveness and class, taking into account primarily the phytosociological parameters, which are essential for the decision making regarding weed management and control (GOMES et al., 2010; OLIVEIRA; FREITAS, 2008; SOUZA et al., 2003), aiming at efficiency and economy.

The first stage of proper plant management in a crop involves the identification of the species present in the area, as well as those which are of greater importance, for that matter, are frequency, density and abundance. For this, phytosociological studies are carried out comparing the populations of weeds at a given time. Programmed repetitions of phytosociological studies may indicate trends in variation of the importance of one or more populations, and such variations may be associated with the agricultural practices adopted (SARMENTO et al., 2015), such as weed management, spacing, planting times, and cultural practices.

The objective of this work was to evaluate the occurrence of weeds in *E. precatoria* and plantain tree (*Musa* sp.*)*, D'angola cultivar, in monoculture and intercropping systems in different planting arrangements.

MATERIALS AND METHODS

The study was carried out at the experimental field of Embrapa Acre, located in the municipality of Rio Branco, Acre, Brazil, at 10º01'30" S, 67º42'18" W, and at an altitude of 160 m. The regional climate is classified as Awi (hot and humid), according to Köppen, with maximum temperatures of 30.9°C and minimum of 20.8°C, an average of 1648.9 mm of annual rainfall and relative humidity of 83%. The survey was carried out on March 2014 in an experimental intercropping system of plantain tree, D'angola cv. (*Musa* sp., AAB - Terra subgroup) and single assai palm (*Euterpe precatoria*) in different planting arrangements.

The local soil is classified as dystrophic Red-Yellow Argisol, medium textured and well-drained, with the following physical-chemical characteristics in the 0-20 cm depth layer: pH (H_2O) = 4.52; Ca = 1.4 $cmol_c\ dm^{-3}$; Mg = 0.79 $cmol_c\ dm^{-3}$; K = 0.32 $cmol_c\ dm^{-3}$; Al + H = 4.43 $cmol_c\ dm^{-3}$; P (surplus) = 9.91 mg L^{-1}; base saturation = 36.18%; sand = 315.42 g kg^{-1}; silt = 319.88 g kg^{-1}; clay = 364.70 g kg^{-1}.

The experiment was performed using a randomized complete block design with six treatments and four replications, covering a total area of 5200 m². The treatments consisted of crop systems, arranged as follows: Area 1 - *E. precatoria* monoculture in 4 x 3 m; Area 2 - Banana tree

monoculture in 3 x 3 m; Area 3 – Banana tree in 3 x 2 m intercropped with *E. precatoria* in 3 x 4 m; Area 4 - Banana tree in 3 x 3 m intercropped with *E. precatoria* in 3 x 4 m; Area 5 - Banana tree in 4 x 2 x 2 m intercropped with *E. precatoria* in 6 x 3 m; Area 6 - Banana tree in 4 x 2 x 2 m intercropped with *E. precatoria* in 4 x 2 x 3 m.

The soil preparation was performed in a conventional manner, with one plowing and two harrowing operations. The planting holes, with dimensions of 0.4 x 0.4 x 0.4 m, were dug using a digger coupled to the tractor, 30 days before planting. To prepare the planting holes, 5 kg of chicken manure, 600g of 10-10-10 (NPK) fertilizer, 800g of dolomitic limestone and 50g of micronutrients (FTE BR 12) were applied.

In March 2013, the banana trees were planted using seedlings composed of pieces of rhizomes, with a mass of approximately 400g (± 50g), previously treated with carbofuran syrup, to prevent the attack of *Cosmopolites sordidus* Germar. The *E. precatoria* seedlings were planted in November 2013, when the banana trees had an average height of 1.6 m, pseudo-stem perimeter at a height of 0.3 m from the soil of 0.4 m and 17 active leaves.

Topdressing fertilization was performed according to the technical recommendation for each crop, based on soil analysis. The banana plants were grown in a "mother, daughter and granddaughter" system, and the desiccation and defoliation were carried out when necessary. Weed management was initially performed using manual hoeing and later, with coastal brush cutter, every 30 days in the rainy season and 45-60 days in the dry season. Cultivation was conducted without irrigation.

To map out the weeds, a 0.25 per m^2 (0.5 x 0.5 m) cast square was used and thrown lengthways three times, and thus it was placed to the right, at the center and to the left end of each plot. During the weed community sampling, the banana trees were in full production, with an average height of 3.20 m, and the *E. precatoria* palms had an average height of 0.50 m, measured from the soil up to the youngest expanded leaf.

After defining the sampling point of each square, which was performed by three trained evaluators through visual evaluation, the percentage of soil cover by weeds was estimated (Table 1).

Subsequently, the weed community was identified in relation to family, species and common name through comparisons to photos or descriptions of existing named specimens in the specialized literature (KISSMANN; GROTH, 1997; LORENZI, 2008). Then, the plants of each

species were quantified separately, cut at ground level and stored in paper bags for drying in a forced air circulation oven at 60°C until a constant mass was reached. Afterwards, the material was weighed using an analytical balance (0.01 g) and the dry mass of each sample was converted into kg ha^{-1}.

Table 1 – Scale of visual assessment of soil cover by weeds. Rio Branco-AC, 2014.

Grade	Soil cover (%)	Level of cover
1	1.0	Lack of plants
2	1.0 – 3.5	Low incidence
3	3.5 – 7.0	Reasonable incidence
4	7.0 – 12.5	Average incidence
5	12.5 – 20.0	Averagely high incidence
6	20.0 – 30.0	High incidence
7	30.0 – 50.0	Very high incidence
8	50.0 – 90.0	Extremely high incidence
9	100.0	Total cover

Extracted and adapted from Deuber (1992).

Determination and counting of the species at each sampling point allowed the calculation of the following phytosociological variables: absolute density (D), relative density (Dr), absolute abundance (A), relative abundance (Ar), absolute frequency (F), relative frequency (Fr), importance value index (IVI), and relative importance (Ir), according to the procedure described by Carvalho & Pitelli, 1992; Gomes et al., 2010; Silva et al., 2013.

The similarity index was calculated using the equation: IS = [2.A ÷ (B + C) × 100], where A = number of species common to both areas; B = number of species from environment "B"; C = number of species from environment "C" (GOMES et al., 2010). Is ranges from 0 to 100%, reaching the maximum level when all species are common to both areas and the minimum level when there are none in common.

Aerial dry matter mass (MSPA) and soil cover grades (NCS) were transformed by $\log_x$ and, subsequently subjected to analysis of variance by the F test. Means were compared by the Tukey's test ($p \leq 0.05$).

RESULTS AND DISCUSSION

In the surveys carried out on *E. precatoria* and plantain monocultures, as well as in the intercropping areas with these fruits in different planting arrangements, 50 species, belonging to 17 families were identified (Table 2).

The families with the highest number of species were Poaceae (13), Cyperaceae (9) and Asteraceae (6), making up a total of 56% of the species identified. Of these species, 22% were common to all evaluated areas, regardless of the cropping system.

Regarding the classes, only areas 2 and 4 had a higher number of dicotyledonous species, with 55.17% and 59.26%, respectively (Table 2). In some phytosociological surveys carried out on banana cropping, it was observed that dicotyledonous species prevail in the culture (GOMES et al., 2010; LIMA et al., 2012).

However, the weed community can be altered according to the farming systems management and spacings (BELALCÁZAR CARJAVAL et al., 1991; ERASMO et al., 2004), a factor that probably allowed a balance in the other areas, with 50% monocotyledons and 50% of dicotyledons. In the *E. precatoria* palm monoculture (area 1), the diversity and weed quantity was superior to the other areas, with 2333 individuals distributed among 34 species (Table 3).

It can be observed that *Digitaria sanguinalis* and *Mollugo verticillata* species were predominant, with an absolute frequency of 0.8; density of 413.0 and 205.3 plants per m^2; absolute abundance of 123.9 and 61.6; relative frequency of 9.2%; relative abundance of 35.9 and 17.9%; relative density of 53.1 and 26.4%; relative importance of 32.7 and 17.8%, and; importance value index of 98.2 and 53.4, respectively (Table 3). In cassava growing areas, Albuquerque et al. (2014) found that *Digitaria sanguinalis* was the main species, showing higher density and abundance values, similar to the crops observed in the present study.

Wider spacings and the low height of *E. precatoria* palms when the survey was performed favored a higher lighting level on the weeds in the monoculture, increasing the number of individuals of *Digitaria sanguinalis*. This species performs C4 photosynthesis, which under conditions of high light intensity may represent a strong competitive advantage in relation to C3 plants, due to a greater carboxylation efficiency (LARCHER, 2004), standing out in the evaluated phytosociological parameters. The high reproductive capacity of this species may also have influenced the relative density (53.11%), as it can produce up to 150,000 seeds per clump (LORENZI, 2008).

Table 2 – Identification of weed communities in different cropping systems, according to family, species and common name. Rio Branco-AC, 2014.

Family/Species	Common name	Cropping systems					
		1	2	3	4	5	6
Amaranthaceae							
Alternanthera tenella	basil	x			x		
Asteraceae							
Ageratum conyzoides	billygoat weed		x				
Corchorus olitorius	jute mallow	x	x	x		x	x
Emilia coccinea	tasselflower	x					
Emilia fosbergii	florida tasselflower					x	
Praxelis pauciflora	praxelis	x	x	x	x	x	x
Vernonia polyanthes	ironweed			x	x		
Commelinaceae							
Commelina benghalensis	benghal dayflower	x			x	x	x
Murdannia nudiflora	dayflower	x	x	x		x	x
Convolvulaceae							
Ipomoea triloba	littlebell		x				x
Cyperaceae							
Cyperus sp.	sedge	x					
Cyperus difusus	diffused flatsedge						x
Cyperus esculentus	yellow nutsedge	x	x	x	x	x	x
Cyperus flavus	yellow flatsedge						x
Cyperus iria	ricefield flatsedge	x	x	x	x	x	x
Fimbristylis dichotoma	forked fimbry	x	x	x	x	x	x
Kyllinga brevifolia	shortleaf spikesedge		x	x		x	
Kyllinga odorata	fragrant spikesedge	x	x	x	x	x	x
Rhychospora nervosa	beakrush	x		x			
Euphorbiaceae							
Acalypha arvensis	field copperleaf	x	x	x	x	x	
Fabaceae							
Pueraria phaseoloides	tropical kudzu	x	x		x		
Chamaecrista rotundifolia	roundleaf sensitive pea						x
Desmodium adscendens	zarzabacoa galana	x	x				
Desmodium barbatum	zarzabacoa peluda				x		
Loganiaceae							
Spigelia anthelmia	west Indian pinkroot	x	x	x	x	x	x
Malvaceae							
Malva spp.	mallow	x					
Anoda cristata	crested anoda	x					
Urena lobata	caesarweed		x				

Continue…

Table 2 – Identification of weed communities in different cropping systems, according to family, species and common name. Rio Branco-AC, 2014.

Family/Species	Common name	Cropping systems					
		1	2	3	4	5	6
Molluginaceae							
Mollugo verticillata	green carpetweed	x	x	x	x	x	x
Phyllanthaceae							
Phyllanthus niruri	gale of the wind	x	x	x	x	x	x
Phyllanthus tenellus	mascarene island leaf-flower	x		x	x		x
Piperaceae							
Pothomorphe umbellata	monkey's hand			x			
Plantaginaceae							
Lindernia dubia	yellowseed false pimpernel	x	x	x	x		
Stemodia verticillata	whorled twintip		x				
Poaceae							
Brachiaria brizantha	palisade grass	x	x		x		
Brachiaria decumbens	spreading liverseed grass	x			x		
Digitaria bicornis	asian crabgrass	x					
Digitaria horizontalis	jamaican crabgrass	x			x		
Digitaria sanguinalis	hairy crabgrass	x	x	x	x	x	x
Eleusine indica	indian goosegrass	x	x	x		x	x
Leptochloa filiformis	mucronate sprangeltop	x	x	x	x	x	
Panicum maximum	guineagrass	x					
Paspalum conjugatum	hilograss	x			x	x	x
Paspalum maritimum	coastal sand paspalum	x	x	x	x	x	x
Paspalum notatum	bahiagrass	x	x	x	x		x
Paspalum paniculatum	arrocillo		x	x		x	
Sporobolus indicus	smut grass		x	x			x
Portulacaceae							
Talinum paniculatum	jewels of opar				x	x	
Rubiaceae							
Spermacoce latifolia	oval-leaf false buttonweed	x	x	x	x	x	x
Urticaceae							
Cecropia pachystachya	yarumo		x	x	x		

Table 3 – Values of the number of squares (NQ), number of individuals (NI), absolute frequency (Fa), absolute density (Da), absolute abundance (Ab), relative frequency (Fr), relative abundance (Ar), relative density (Dr), relative importance (Ir) and importance value index (IVI) in area 1. Rio Branco-AC, 2014.

Species	NI	NQ	Fa	Da (p m^2)	Ab	Fr (%)	Ar (%)	Dr (%)	Ir (%)	IVI
Acalypha arvensis	1	1	0.1	0.3	1.0	0.9	0.3	0.0	0.4	1.3
Alternanthera tenella	4	2	0.2	1.3	2.0	1.8	0.6	0.2	0.9	2.6
Anoda cristata	1	1	0.1	0.3	1.0	0.9	0.3	0.0	0.4	1.3
Brachiaria brizantha	4	4	0.3	1.3	1.0	3.7	0.3	0.2	1.4	4.1
Brachiaria decumbens	1	1	0.1	0.3	1.0	0.9	0.3	0.0	0.4	1.3
Commelina benghalensis	2	2	0.2	0.7	1.0	1.8	0.3	0.1	0.7	2.2
Corchorus olitorius	11	5	0.4	3.7	2.2	4.6	0.6	0.5	1.9	5.7
Cyperus esculentus	5	3	0.3	1.7	1.7	2.8	0.5	0.2	1.2	3.5
Cyperus iria	3	2	0.2	1.0	1.5	1.8	0.4	0.1	0.8	2.4
Cyperus spp.	1	1	0.1	0.3	1.0	0.9	0.3	0.0	0.4	1.3
Desmodium adscendens	1	1	0.1	0.3	1.0	0.9	0.3	0.0	0.4	1.3
Digitaria bicornis	9	1	0.1	3.0	9.0	0.9	2.6	0.4	1.3	3.9
Digitaria horizontalis	7	2	0.2	2.3	3.5	1.8	1.0	0.3	1.1	3.2
Digitaria sanguinalis	1239	10	0.8	413.0	123.9	9.2	35.9	53.1	32.7	98.2
Eleusine indica	20	3	0.3	6.7	6.7	2.8	1.9	0.9	1.8	5.5
Emilia coccinea	11	2	0.2	3.7	5.5	1.8	1.6	0.5	1.3	3.9
Fimbristylis dichotoma	18	5	0.4	6.0	3.6	4.6	1.0	0.8	2.1	6.4
Kyllinga odorata	35	2	0.2	11.7	17.5	1.8	5.1	1.5	2.8	8.4
Leptochloa filiformis	16	3	0.3	5.3	5.3	2.8	1.5	0.7	1.7	5.0
Lindernia dubia	57	5	0.4	19.0	11.4	4.6	3.3	2.4	3.4	10.3
Malva spp.	4	2	0.2	1.3	2.0	1.8	0.6	0.2	0.9	2.6
Mollugo verticillata	616	10	0.8	205.3	61.6	9.2	17.9	26.4	17.8	53.4
Murdannia nudiflora	94	7	0.6	31.3	13.4	6.4	3.9	4.0	4.8	14.3
Panicum maximum	4	2	0.2	1.3	2.0	1.8	0.6	0.2	0.9	2.6
Paspalum conjugatum	46	2	0.2	15.3	23.0	1.8	6.7	2.0	3.5	10.5
Paspalum maritimum	46	5	0.4	15.3	9.2	4.6	2.7	2.0	3.1	9.2
Paspalum notatum	1	1	0.1	0.3	1.0	0.9	0.3	0.0	0.4	1.3
Phyllanthus niruri	15	5	0.4	5.0	3.0	4.6	0.9	0.6	2.0	6.1
Phyllanthus tenellus	4	2	0.2	1.3	2.0	1.8	0.6	0.2	0.9	2.6
Praxelis pauciflora	19	5	0.4	6.3	3.8	4.6	1.1	0.8	2.2	6.5
Pueraria phaseoloides	9	4	0,3	3,0	2,3	3,7	0,7	0.4	1.6	4.7
Rhychospora nervosa	17	1	0.1	5.7	17.0	0.9	4.9	0.7	2.2	6.6
Spermacoce latifolia	7	5	0.4	2.3	1.4	4.6	0.4	0.3	1.8	5.3
Spigelia anthelmia	5	2	0.2	1.7	2.5	1.8	0.7	0.2	0.9	2.8
Total	2333	-	9.1	777.7	344.9	100	100	100	100	-

In the banana tree monoculture (area 2), 770 individuals were identified and grouped into 14 families and 28 species (Tables 2 and 4).

The species with the highest absolute and relative frequencies in descending order were *Mollugo verticillata, Kyllinga odorata, Paspalum maritimum,* and *Digitaria sanguinalis*. Among these species showing a high frequency, two belong to Poaceae family, which can be explained by the greater efficiency of the soil production factors. In a study carried out by Silva et al. (2013) with the objective of evaluating the occurrence of weeds in intercropped coffee and macadamia nuts, a higher occurrence of weeds of the family Poaceae.

In relation to the other parameters, *Paspalum maritimum, Mollugo verticillata* and *Paspalum paniculatum* displayed higher absolute density values, 60.3, 55.7 and 53.3 plants per m^2; absolute abundance rates of 30.2, 23.9 and 53.3; relative abundance rates of 15.5, 12.3 and 27.5%; relative density of 23.5, 21.7 and 20.8%; relative importance of 15.6, 14.3 and 17.4%, and; value index of importance of 46.7, 43.0 and 52.1; respectively. The tolerance to shaded and intense environments shown by some species of the genus *Paspalum* is confirmed in some studies, as it was observed in *Paspalum reginelli, P. dilatatum, P. notatum* (BARRO et al., 2010; SCHREINER, 1987), which may explain the predominance of these weeds.

In the 3 x 2 m banana intercropped with 3 x 4 m *E. precatoria* (area 3), *Mollugo verticillata* showed an absolute frequency of 0.7, followed by *Paspalum maritimum* and *Spigelia anthelmia* with a rate of 0.6, and these were also the species displaying the highest relative frequency (Table 5).

Mollugo verticillata also obtained higher values for absolute density, with 126 plants per m^2; absolute abundance of 47.3; relative abundance of 29%; relative density of 57.4%; relative importance of 32.7%, and importance value index of 98.2. In Brazil, these species are characterized by infesting annual and perennial crops (LORENZI, 2008).

Table 6 also shows the survey carried out on weed found in the 3 x 3 m banana intercropped with 3 x 4 m *E. precatoria* palm (area 4), as well as the phytosociological parameters.

In descending order, the seven most frequent species in absolute and relative forms were: *Mollugo verticillata* with 0.9 and 13.4%, *Spigelia anthelmia* and *Praxelis pauciflora* with 0.5 and 7.3%, *Spermacoce latifolia, Cyperus esculentus, Kyllinga odorata,* and *Paspalum maritimum* with 0.4 and 6.1%, respectively. However, *Mollugo verticillata* showed the highest absolute density

(209 plants per m^2), absolute abundance (57), relative abundance (43.3%), relative density (71.7%), relative importance (42.8%), and importance value index (128.4).

Table 4 - Values of the number of individuals (NI), number of squares (NQ), absolute frequency (Fa), absolute density (Da), absolute abundance (Ab), relative frequency (Fr), relative abundance (Ar), relative density (Dr), relative importance (Ir) and the importance value index (IVI) in area 2. Rio Branco-AC, 2014.

Species	NI	NQ	Fa	Da (p m^2)	Ab	Fr (%)	Ar (%)	Dr (%)	Ir (%)	IVI
Acalypha arvensis	2	2	0.2	0.7	1.0	2.6	0.5	0.3	1.1	3.3
Agetarum conyzoides	7	2	0.2	2.3	3.5	2.6	1.8	0.9	1.8	5.3
Brachiaria brizantha	5	2	0.2	1.7	2.5	2.6	1.3	0.6	1.5	4.5
Cecropia pachystachya	4	2	0.2	1.3	2.0	2.6	1.0	0.5	1.4	4.1
Corchorus olitorius	1	1	0.1	0.3	1.0	1.3	0.5	0.1	0.6	1.9
Cyperus esculentus	5	2	0.2	1.7	2.5	2.6	1.3	0.6	1.5	4.5
Cyperus iria	20	2	0.2	6.7	10.0	2.6	5.2	2.6	3.4	10.3
Desmodium adscendens	2	1	0.1	0.7	2.0	1.3	1.0	0.3	0.9	2.6
Digitaria sanguinalis	40	5	0.4	13.3	8.0	6.4	4.1	5.2	5.2	15.7
Eleusine indica	1	1	0.1	0.3	1.0	1.3	0.5	0.1	0.6	1.9
Fimbristylis dichotoma	15	3	0.3	5.0	5.0	3.8	2.6	1.9	2.8	8.4
Ipomoea triloba	2	2	0.2	0.7	1.0	2.6	0.5	0.3	1.1	3.3
Kyllinga brevifolia	4	1	0.1	1.3	4.0	1.3	2.1	0.5	1.3	3.9
Kyllinga odorata	72	7	0.6	24.0	10.3	9.0	5.3	9.4	7.9	23.6
Leptochloa filiformis	14	3	0.3	4.7	4.7	3.8	2.4	1.8	2.7	8.1
Lindernia dubia	8	4	0.3	2.7	2.0	5.1	1.0	1.0	2.4	7.2
Mollugo verticillata	167	7	0.6	55.7	23.9	9.0	12.3	21.7	14.3	43.0
Murdannia nudiflora	4	2	0.2	1.3	2.0	2.6	1.0	0.5	1.4	4.1
Paspalum maritimum	181	6	0.5	60.3	30.2	7.7	15.5	23.5	15.6	46.7
Paspalum notatum	8	2	0.2	2.7	4.0	2.6	2.1	1.0	1.9	5.7
Paspalum paniculatum	160	3	0.3	53.3	53.3	3.8	27.5	20.8	17.4	52.1
Phyllanthus niruri	10	4	0.3	3.3	2.5	5.1	1.3	1.3	2.6	7.7
Praxelis pauciflora	10	3	0.3	3.3	3.3	3.8	1.7	1.3	2.3	6.9
Pueraria phaseoloides	1	1	0.1	0.3	1.0	1.3	0.5	0.1	0.6	1.9
Spermacoce latifolia	10	3	0.3	3.3	3.3	3.8	1.7	1.3	2.3	6.9
Spigelia anthelmia	8	3	0.3	2.7	2.7	3.8	1.4	1.0	2.1	6.3
Sporobolus indicus	2	1	0.1	0.7	2.0	1.3	1.0	0.3	0.9	2.6
Stemodia verticillata	4	1	0.1	1.3	4.0	1.3	2.1	0.5	1.3	3.9
Urena lobata	3	2	0.2	1.0	1.5	2.6	0.8	0.4	1.2	3.7
Total	770	-	6.5	256.7	194.1	100	100	100	100	-

Table 5 - Values of the number of individuals (NI), number of squares (NQ), absolute frequency (Fa), absolute density (Da), absolute abundance (Ab), relative frequency (Fr), relative abundance (Ar), relative density (Dr), relative importance (Ir) and the importance value index (IVI) in area 3. Rio Branco-AC, 2014.

Species	NI	NQ	Fa	Da (p m^2)	Ab	Fr (%)	Ar (%)	Dr (%)	Ir (%)	IVI
Acalypha arvensis	1	1	0.1	0.3	1.0	1.5	0.6	0.2	0.7	2.2
Cecropia pachystachya	2	1	0.1	0.7	2.0	1.5	1.2	0.3	1.0	3.0
Corchorus olitorius	1	1	0.1	0.3	1.0	1.5	0.6	0.2	0.7	2.2
Cyperus esculentus	1	1	0.1	0.3	1.0	1.5	0.6	0.2	0.7	2.2
Cyperus iria	3	1	0.1	1.0	3.0	1.5	1.8	0.5	1.3	3.8
Digitaria sanguinalis	39	4	0.3	13.0	9.8	5.9	6.0	5.9	5.9	17.8
Eleusine indica	2	2	0.2	0.7	1.0	2.9	0.6	0.3	1.3	3.9
Fimbristylis dichotoma	19	3	0.3	6.3	6.3	4.4	3.9	2.9	3.7	11.2
Kyllinga brevifolia	11	2	0.2	3.7	5.5	2.9	3.4	1.7	2.7	8.0
Kyllinga odorata	25	4	0.3	8.3	6.3	5.9	3.8	3.8	4.5	13.5
Leptochloa filiformis	3	1	0.1	1.0	3.0	1.5	1.8	0.5	1.3	3.8
Lindernia dubia	4	1	0.1	1.3	4.0	1.5	2.5	0.6	1.5	4.5
Mollugo verticillata	378	8	0.7	126.0	47.3	11.8	29.0	57.4	32.7	98.2
Murdannia nudiflora	3	2	0.2	1.0	1.5	2.9	0.9	0.5	1.4	4.3
Paspalum maritimum	24	7	0.6	8.0	3.4	10.3	2.1	3.6	5.3	16.0
Paspalum notatum	6	4	0.3	2.0	1.5	5.9	0.9	0.9	2.6	7.7
Paspalum paniculatum	57	2	0.2	19.0	28.5	2.9	17.5	8.7	9.7	29.1
Phyllanthus niruri	3	3	0.3	1.0	1.0	4.4	0.6	0.5	1.8	5.5
Phyllanthus tenellus	1	1	0.1	0.3	1.0	1.5	0.6	0.2	0.7	2.2
Pothomorphe umbellata	7	2	0.2	2.3	3.5	2.9	2.1	1.1	2.1	6.2
Praxeliz pauciflora	5	1	0.1	1.7	5.0	1.5	3.1	0.8	1.8	5.3
Rhychospora nervosa	43	2	0.2	14.3	21.5	2.9	13.2	6.5	7.6	22.7
Spermacoce latifolia	10	5	0.4	3.3	2.0	7.4	1.2	1.5	3.4	10.1
Spigelia anthelmia	8	7	0.6	2.7	1.1	10.3	0.7	1.2	4.1	12.2
Sporobulus indicus	1	1	0.1	0.3	1.0	1.5	0.6	0.2	0.7	2.2
Vernonia polyanthes	1	1	0.1	0.3	1.0	1.5	0.6	0.2	0.7	2.2
Total	658	-	5.7	219.3	163.2	100	100	100	100	-

Cyperus esculentus and *Kyllinga odorata* (Cyperaceae) species are mainly herbaceous perennials, and their propagation occurs by seeds or rhizomes and subterranean tubers. A prolonged permanence of tubers in the soil makes it difficult to control these weeds, resulting in costly consequences and causing damage to the agricultural sector. The shade provided by the banana

canopy promotes a reduction in the number of sprouts, tubers and dry matter production (KEELEY; THULLEN, 1978), which may be responsible for the low density of these plants in the area.

Table 6 - Values of the number of individuals (NI), number of squares (NQ), absolute frequency (Fa), absolute density (Da), absolute abundance (Ab), relative frequency (Fr), relative abundance (Ar), relative density (Dr), relative importance (Ir) and the importance value index (IVI) in area 4. Rio Branco-AC, 2014.

Species	NI	NQ	Fa	Da (p m^2)	Ab	Fr (%)	Ar (%)	Dr (%)	Ir (%)	IVI
Acalypha arvensis	2	2	0.2	0.7	1.0	2.4	0.8	0.2	1.1	3.4
Alternanthera tenella	1	1	0.1	0.3	1.0	1.2	0.8	0.1	0.7	2.1
Brachiaria brizantha	5	1	0.1	1.7	5.0	1.2	3.8	0.6	1.9	5.6
Brachiaria decumbens	1	1	0.1	0.3	1.0	1.2	0.8	0.1	0.7	2.1
Cecropia pachystachya	5	2	0.2	1.7	2.5	2.4	1.9	0.6	1.6	4.9
Commelina benghalensis	2	2	0.2	0.7	1.0	2.4	0.8	0.2	1.1	3.4
Cyperus esculentus	7	5	0.4	2.3	1.4	6.1	1.1	0.8	2.7	8.0
Cyperus iria	9	3	0.3	3.0	3.0	3.7	2.3	1.0	2.3	7.0
Desmodium barbatum	1	1	0.1	0.3	1.0	1.2	0.8	0.1	0.7	2.1
Digitaria horizontalis	7	3	0.3	2.3	2.3	3.7	1.8	0.8	2.1	6.2
Digitaria sanguinalis	19	3	0.3	6.3	6.3	3.7	4.8	2.2	3.5	10.6
Fimbristylis dichotoma	3	3	0.3	1.0	1.0	3.7	0.8	0.3	1.6	4.8
Kyllinga odorata	19	5	0.4	6.3	3.8	6.1	2.9	2.2	3.7	11.2
Leptochloa filiformis	40	4	0.3	13.3	10.0	4.9	7.6	4.6	5.7	17.1
Lindernia dubia	4	2	0.2	1.3	2.0	2.4	1.5	0.5	1.5	4.4
Mollugo verticillata	627	11	0.9	209.0	57.0	13.4	43.3	71.7	42.8	128.4
Paspalum conjugatum	1	1	0.1	0.3	1.0	1.2	0.8	0.1	0.7	2.1
Paspalum maritimum	40	5	0.4	13.3	8.0	6.1	6.1	4.6	5.6	16.7
Paspalum notatum	1	1	0.1	0.3	1.0	1.2	0.8	0.1	0.7	2.1
Phyllanthus niruri	9	2	0.2	3.0	4.5	2.4	3.4	1.0	2.3	6.9
Phyllanthus tenellus	8	2	0.2	2.7	4.0	2.4	3.0	0.9	2.1	6.4
Praxeliz pauciflora	39	6	0.5	13.0	6.5	7.3	4.9	4.5	5.6	16.7
Pueraria phaseoloides	2	2	0.2	0.7	1.0	2.4	0.8	0.2	1.1	3.4
Spermacoce latifolia	6	5	0.4	2.0	1.2	6.1	0.9	0.7	2.6	7.7
Spigelia anthelmia	12	6	0.5	4.0	2.0	7.3	1.5	1.4	3.4	10.2
Talinum paniculatum	4	2	0.2	1.3	2.0	2.4	1.5	0.5	1.5	4.4
Vernonia polyanthes	1	1	0.1	0.3	1.0	1.2	0.8	0.1	0.7	2.1
Total	875	-	6.8	291.7	131.6	100	100	100	100	-

Although *Spermacoce latifolia* (oval-leaf false buttonweed) displayed high absolute and relative frequencies and tolerated a certain degree of shading, it was not one of the main weeds in

area 4, with an absolute density of 2.0 plants m^2, possibly due to an improvement in the fertility levels (LORENZI, 2008).

The use of banana plant remains is an important means of control, since it reduces weed density through light reduction or suppression, affecting weed germination and development when residues remain on the soil (OLIVEIRA; SOUZA, 2003). Consequently, the use of post-emergent herbicides can be rationalized, since some species are tolerant and require higher doses or herbicide combinations for control, such as *Spermacoce latifolia* and *Commelina benghalensis.*

The weed species with the highest absolute and relative frequencies in 4 x 2 x 2 m banana intercropped with 6 x 3 m *E. precatoria* (area 5) were *Paspalum maritimum, Spigelia anthelmia, Digitaria sanguinalis, Cyperus iria, Paspalum conjugatum, Fimbristylis dichotoma,* and *Praxelis pauciflora* (Table 7).

It was observed that *Digitaria sanguinalis* had a higher phytosociological parameter for absolute density (55.0 plants per m^2), absolute abundance (33.0%), relative abundance (24.1%), relative density (29.6%), relative importance (20.2%) and importance value index (60.6). Lima et al. (2012) and Gomes et al. (2010) demonstrated that this species is one of the main weeds found amid banana crops.

Table 8 shows that *Mollugo verticillata, Fimbristylis dichotoma, Kylinga odorata* and *Phyllanthus niruri* were the most frequent species in area 6 (4 x 2 x 2 m banana intercropped with 4 x 2 x 3 m *E. precatoria* palm), presenting higher absolute and relative frequencies.

In relation to the number of plants per m^2, *Mollugo verticillata* and *Paspalum notatum* showed an absolute density of 60.3 and 24.0 plants per m^2, relative density of 39.6% and 15.8%, respectively, above the other results. Regarding absolute and relative abundance, relative importance and importance value index, one can observe that *Digitaria sanguinalis*, as well as *Mollugo verticillata* and *Paspalum notatum* stand out in this crop area.

Several phytosociological surveys carried out on banana crops and agroforestry intercroppings have identified many weed species belonging to different families (LIMA et al., 2012; GOMES et al., 2010; SILVA et al., 2013), which may be influenced by farming practices, soil management systems, location and time of survey, planting densities, among other factors.

Table 7 – Values of the number of individuals (NI), number of squares (NQ), absolute frequency (Fa), absolute density (Da), absolute abundance (Ab), relative frequency (Fr), relative abundance (Ar), relative density (Dr), relative importance (Ir) and the importance value index (IVI) in area 5. Rio Branco-AC, 2014.

Species	NI	NQ	Fa	Da (p m^2)	Ab	Fr (%)	Ar (%)	Dr (%)	Ir (%)	IVI
Acalypha arvensis	1	1	0.1	0.3	1.0	1.4	0.7	0.2	0.8	2.3
Commelina benghalensis	2	1	0.1	0.7	2.0	1.4	1.5	0.4	1.1	3.2
Corchorus olitorius	2	1	0.1	0.7	2.0	1.4	1.5	0.4	1.1	3.2
Cyperus esculentus	2	2	0.2	0.7	1.0	2.7	0.7	0.4	1.3	3.8
Cyperus iria	27	5	0.4	9.0	5.4	6.8	3.9	4.8	5.2	15.6
Digitaria sanguinalis	165	5	0.4	55.0	33.0	6.8	24.1	29.6	20.2	60.6
Eleusine indica	37	2	0.2	12.3	18.5	2.7	13.5	6.6	7.6	22.9
Emilia fosbergii	1	1	0.1	0.3	1.0	1.4	0.7	0.2	0.8	2.3
Fimbristylis dichotoma	10	5	0.4	3.3	2.0	6.8	1.5	1.8	3.4	10.1
Kyllinga brevifolia	9	3	0.3	3.0	3.0	4.1	2.2	1.6	2.6	7.9
Kyllinga odorata	11	4	0.3	3.7	2.8	5.5	2.0	2.0	3.2	9.5
Leptochloa filiformis	55	4	0.3	18.3	13.8	5.5	10.1	9.9	8.5	25.4
Mollugo verticillata	60	4	0.3	20.0	15.0	5.5	11.0	10.8	9.1	27.2
Murdannia nudiflora	7	4	0.3	2.3	1.8	5.5	1.3	1.3	2.7	8.0
Paspalum conjugatum	25	5	0.4	8.3	5.0	6.8	3.7	4.5	5.0	15.0
Paspalum maritimum	38	7	0.6	12.7	5.4	9.6	4.0	6.8	6.8	20.4
Paspalum paniculatum	2	1	0.1	0.7	2.0	1.4	1.5	0.4	1.1	3.2
Phyllanthus niruri	8	3	0.3	2.7	2.7	4.1	2.0	1.4	2.5	7.5
Praxeliz pauciflora	44	5	0.4	14.7	8.8	6.8	6.4	7.9	7.1	21.2
Spermacoce latifolia	3	3	0.3	1.0	1.0	4.1	0.7	0.5	1.8	5.4
Spigelia anthelmia	46	6	0.5	15.3	7.7	8.2	5.6	8.3	7.4	22.1
Talinum paniculatum	2	1	0.1	0.7	2.0	1.4	1.5	0.4	1.1	3.2
Total	557	-	6.1	185.7	136.7	100	100	100	100	-

Table 8 - Values of the number of individuals (NI), number of squares (NQ), absolute frequency (Fa), absolute density (Da), absolute abundance (Ab), relative frequency (Fr), relative abundance (Ar), relative density (Dr), relative importance (Ir) and the importance value index (IVI) in area 6. Rio Branco-AC, 2014.

Species	NI	NQ	Fa	Da (p m^2)	Ab	Fr (%)	Ar (%)	Dr (%)	Ir (%)	IVI
Mollugo verticillata	181	8	0.7	60.3	22.6	14.0	15.4	39.6	23.0	69.0
Paspalum notatum	72	3	0.3	24.0	24.0	5.3	16.3	15.8	12.4	37.3
Digitaria sanguinalis	35	1	0.1	11.7	35.0	1.8	23.8	7.7	11.1	33.2
Paspalum maritimum	34	4	0.3	11.3	8.5	7.0	5.8	7.4	6.7	20.2
Fimbristylis dichotoma	31	5	0.4	10.3	6.2	8.8	4.2	6.8	6.6	19.8
Kyllinga odorata	23	5	0.4	7.7	4.6	8.8	3.1	5.0	5.6	16.9
Cyperus iria	20	3	0.3	6.7	6.7	5.3	4.5	4.4	4.7	14.2
Cyperus difusus	11	1	0.1	3.7	11.0	1.8	7.5	2.4	3.9	11.6
Praxeliz pauciflora	11	3	0.3	3.7	3.7	5.3	2.5	2.4	3.4	10.2
Phyllanthus niruri	8	5	0.4	2.7	1.6	8.8	1.1	1.8	3.9	11.6
Commelina benghalensis	7	1	0.1	2.3	7.0	1.8	4.8	1.5	2.7	8.0
Cyperus esculentus	5	4	0.3	1.7	1.3	7.0	0.8	1.1	3.0	9.0
Murdannia nudiflora	4	2	0.2	1.3	2.0	3.5	1.4	0.9	1.9	5.7
Paspalum conjugatum	4	1	0.1	1.3	4.0	1.8	2.7	0.9	1.8	5.3
Spermacoce latifolia	3	3	0.3	1.0	1.0	5.3	0.7	0.7	2.2	6.6
Phyllanthus tenellus	1	1	0.1	0.3	1.0	1.8	0.7	0.2	0.9	2.7
Chamaecrista rotundifolia	1	1	0.1	0.3	1.0	1.8	0.7	0.2	0.9	2.7
Spigelia anthelmia	1	1	0.1	0.3	1.0	1.8	0.7	0.2	0.9	2.7
Eleusine indica	1	1	0.1	0.3	1.0	1.8	0.7	0.2	0.9	2.7
Corchorus olitorius	1	1	0.1	0.3	1.0	1.8	0.7	0.2	0.9	2.7
Ipomoea triloba	1	1	0.1	0.3	1.0	1.8	0.7	0.2	0.9	2.7
Sporobulus indicus	1	1	0.1	0.3	1.0	1.8	0.7	0.2	0.9	2.7
Cyperus flavus	1	1	0.1	0.3	1.0	1.8	0.7	0.2	0.9	2.7
Total	457	-	4.8	152.3	147.1	100	100	100	100	-

In general, *Mollugo verticillata* stood out in all the assessed areas as the main weed in three areas (4, 5 and 6) regarding the phytosociological parameters (Tables 6, 7 and 8). The importance of this species in both intercropping and monoculture systems can be explained by its adaptation to carbon metabolism occurring in an intermediate form (C_3-C_4), with C_3 e C_4 acids as the primary products of photosynthesis, the intermediate photorespiration and perivascular sheath containing chloroplasts, enabling a successful development in a shaded or sunny environment.

The *E. precatoria* palm monoculture favored a better weed development, resulting in a greater amount of dry matter, reaching a value of 2676.8 kg ha^{-1} and, as a consequence, the percentage of soil cover was also higher, achieving 8.3 points on the grade scale (Tables 1 and 9).

Table 9 – Dry matter of the aerial part (MSPA) and grades related to the visual evaluation of the soil cover (NCS) in the *E. precatoria* palm intercropping with banana and monocultures. Rio Branco-AC, 2014.

Treatments	MSPA (kg ha^{-1})	NCS (%)
E. precatoria palm monoculture (3 x 4 m)	2676.80a	8.37a
Banana monoculture (3 x 3 m)	555.87b	4.45b
Banana (3 x 2 m) with *E. precatoria* palm (3 x 4 m)	379.13b	2.57b
Banana (3x 3 m) with *E. precatoria* palm (3 x 4 m)	353.80b	3.63b
Banana (4 x 2 x 2 m) with *E. precatoria* palm (6 x 3 m)	272.33b	2.39b
Banana (4 x 2 x 2 m) with *E. precatoria* palm (4 x 2 x 3 m)	331.80b	2.39b
CV (%)	10.69	14.96

Thus, the soil cover values ranged between 90 and 100% with the presence of weeds above the extremely high incidence, in which monocotyledon species were favored by the high solar radiation, a consequence of the spacing and low height of the *E. precatoria* palms at the moment of the survey (LARCHER, 2004).

In areas with banana trees, both in monoculture and in an intercropping system with *E. precatoria* palm in different planting arrangements, there was no statistical difference in the production of dry mass and visual evaluation scores (Tables 1 and 9). The grades ranged from 2.39 to 4.45 (1 to 12.5% of the soil cover), indicating that the shading imposed by banana leaves promoted an efficient reduction in the soil cover levels, and was also responsible for the decrease of species diversity and for the reduction in the dry mass of the aerial part of the weeds. Such

influence on the weed community occurred due to the low-intensity light in relation to the *E. precatoria* palm monoculture.

The similarity index indicated similarities in the weed communities found in *E. precatoria* palm and banana monocultures, as well as in intercropping systems with different planting arrangements, which achieved a value above 60% (Table 10).

Table 10 – Similarity index values (IS%) obtained from the survey carried out on the floristic communities of different areas under banana intercropping with *E. precatoria* palm and monocultures in different planting densities.

IS%	Area 1	Area 2	Area 3	Area 4	Area 5
Area 2	67.74				
Area 3	65.57	80.00			
Area 4	76.67	70.37	71.70		
Area 5	64.29	72.00	73.47	66.67	
Area 6	63.16	66.67	64.00	61.22	75.56

The major similarities were found between the species of area 2 and area 3 (80.0%), area 1 and area 4 (76.67%), area 5 and area 6 (75.56%), which can be explained in part by the management practices adopted, the proximity between areas and the same type of soil (CARVALHO; PITELLI, 1992).

Comparing the banana monoculture (area 2) with the intercropping system in different planting densities, it was observed that there was less similarity between the species in area 6, with a similarity index of 66.67%, due to the greater density of *E. precatoria* palms and banana trees. Likewise, Souza et al. (2003) found a lower similarity index when comparing peach-palm and cupuaçu monocultures with an agroforestry system of these crops in the Amazonian environmental conditions. Contrasting with the present study, Gomes et al. (2010) observed a low similarity between weed species when comparing drained floodplain and banana dry farming areas (35.70%).

CONCLUSIONS

In general, *Mollugo verticillata* is one of the main species found in *E. precatoria* palm and banana monocultures and in intercropping systems with different planting arrangements.

The *E. precatoria* palm monoculture shows a greater diversity of weed species and individuals, dry mass of the aerial part and provides a considerable soil cover.

Areas with banana monoculture or under a banana intercropping with *E. precatoria* palm in different planting arrangements display the same amount of dry matter of the aerial part and similar soil cover levels.

REFERENCES

ALBUQUERQUE, J. A. A.; EVANGELISTA, M. O.; MATES, A. P. K.; ALVES, J. M. A.; OLIVEIRA, N. T.; SEDIYAMA, T.; SILVA, A. A. 2014. Occurrence of weeds in *Cassava savana* plantations in Roraima. **Planta Daninha,** Viçosa, MG, v. 32, n. 1, p. 91-98.

BARRO, R. S.; VARELLA, A. C.; BANGEL, F. V.; SAIBRO, J. C.; MEDEIROS, R. B.; RADIN, B. 2010. Screening native C4 pasture genotypes for shade tolerance in Southern Brazil. In: AUSTRALIAN SOCIETY OF AGRONOMY CONFERENCE, 15., Lincoln, Nova Zelândia. **Proceedings...** Lincoln: Australian Society of Agronomy, 2010. Available in: <http://www.regional.org.au/au/asa/2010/crop-production/intercrops/6969_varellaac. htm>. Access em: 6 july 2015.

BELALCÁZAR CARVAJAL, S.; SALAZAR M., C. A.; CAYÓN S., G.; LOZADA Z. J. E.; CASTILLO, L. E.; VALENCIA M., J. A. 1991. Manejo de Plantaciones. In: **El cultivo del plátano en el tropico.** Colômbia: INIBAP/ICA/CDCT/ CIID. p. 149-242. (Manual de Asistencia tecnica, 50).

CARVALHO, S. L.; PITELLI, R. A. 1992. Comportamento e análise fitossociológica das principais espécies de plantas daninhas de pastagens da região de Selvia (MS). **Planta Daninha,** Viçosa, MG, v.10, p. 25-32.

DEUBER, R. 1992. **Ciência das plantas daninhas: fundamentos.** Jaboticabal: FUNEP, 431 p.

ERASMO, E. A. L.; PINHEIRO, L. L. A.; COSTA, N. V. 2004. Levantamento fitossociológico das comunidades de plantas infestantes em áreas de produção de arroz irrigado cultivado sob diferentes sistemas de manejo. **Planta Daninha,** Viçosa, MG, v. 22, n. 2, p. 195-201.

GOMES, G. L. G. C.; IBRAHIM, F. N.; MACEDO, G. L.; NOBREGA, L. P.; ALVES, E. 2010. Cadastramento fitossociológico de plantas daninhas na bananicultura. **Planta Daninha,** Viçosa, MG, v. 28, n. 1, p. 61-68.

IBGE, 2019. Instituto Brasileiro de Geografia e Estatística. **Lavouras permanentes.** Available in: http://www.ibge.gov.br/home/estatistica/ economia/pam/default_perm_xls.shtm. Access in: 17 Abril, 2019.

KEELEY, P. E.; THULLEN, R. J. 1978. Light requirements of yellow nutsedge (*Cyperus esculentus*) and light interception by crops. **Weed Science,** New York, p. 10-16.

KISSMANN, K. G.; GROTH, D. 1997. **Plantas infestantes e nocivas.** São Paulo: BASF Brasileira, v. 2, 798 p.

LANZA, T.R.; MACHADO, A.F.L.; MARTELLETO, L.A.P. 2017. Effect of planting densities of "BRS Princess" banana tree in the suppression of weeds. **Planta daninha**, Viçosa, v.35, e017162958.

LARCHER, W. 2004. **Ecofisiologia vegetal.** São Carlos, SP: RiMa. 531 p.

LIMA, L. K. S.; BARBOSA, A. J. S.; SILVA, R. T. L. da; ARAÚJO, R. da C. 2012. Distribuição fitossociológica da comunidade de plantas espontâneas na bananicultura. **Revista Verde,** Mossoró, v. 7, n. 4, p. 59-68.

LORENZI, H. 2008. 4 ed. **Plantas daninhas do Brasil:** terrestres, aquáticas, parasíticas e tóxicas. Nova Odessa: Instituto Plantarum.

MOURA FILHO, E. R.; MACEDO, L. P. M.; SILVA, A. R. S. 2015. Levantamento fitossociológico de plantas daninhas em cultivo de banana irrigada. **Holos**, v. 2, p. 92-97.

OLIVEIRA, A. R.; FREITAS, S. P. 2008. Levantamento fitossociológico de plantas daninhas em áreas de produção de cana-de-açúcar. **Planta Daninha,** Viçosa, MG, v. 26, n. 1, p. 33-46.

OLIVEIRA, C. A. P. de; SOUZA, C. M. de. 2003. Influência da cobertura morta na umidade, incidência de plantas daninhas e de broca-do-rizoma (*Cosmopolites sordidus*) em um pomar de bananeiras (*Musa* spp.). **Revista Brasileira de Fruticultura,** Jaboticabal, v. 25, n. 2, p. 345-347.

OUMA, G.; JERUTO, P. 2010. Sustainable horticultural crop production through intercropping: The case of fruits and vegetable crops: A review. **Agriculture and Biology Journal of North America**, vol. 1, p. 1098-1105.

SARMENTO, H. G. S.; CAMPOS FILHO, J. M.; ASPIAZÚ, I.; RODRIGUES, T. M.; FERREIRA, E. A. 2015. Levantamento fitossociológico de plantas daninhas em áreas de bananicultura no Vale do Rio Gorutuba, norte de Minas Gerais. **Revista Agro@mbiente On-line**, Boa Vista-RR, v. 9, n. 3, p. 308-316.

SCHREINER, H. G. 1987 Tolerância de quatro gramíneas forrageiras a diferentes graus de sombreamento. **Boletim de Pesquisa Florestal,** Colombo, n. 15, p.61-72, Dez. Available in: < http://www.cnpf.embrapa.br/pesquisa/safs/bolet15a.pdf>. Access in: 6 July. 2015.

SILVA, V. de C.; PERDONÁ, M. J.; SORATTO, R. P.; NEGRISOLI, E. 2013. Ocorrência de plantas daninhas em cultivo consorciado de café e nogueira-macadâmia. **Pesquisa Agropecuária Tropical,** Goiânia, v. 43, n. 4, p. 441-449.

SOUZA, L. S. A.; SILVA, J. F.; SOUZA, M. D. B. 2003. Composição florística de plantas daninhas em agrossistemas de cupuaçuzeiro (*Theobroma grandiflorum*) e pupunheira (*Bactris gasipaes*). **Planta Daninha,** Viçosa, MG, v. 21, n. 2, p. 249-255.

VIEIRA, T. A.; ROSA, L. dos S.; VASCONCELOS, P. C. S.; SANTOS, M. M. dos S.; MODESTO, R. da S. 2007. Sistemas agroflorestais em áreas de agricultores familiares em Igarapé-Açu, Pará: caracterização florística, implantação e manejo. **Acta Amazonica,** Manaus, v. 37, n. 4, p. 549-558.

Received in: December 30, 2016
Accepted in: April, 24, 2019