Nativa, Sinop, v.5, n.4, p.231-236, jul./ago. 2017.
Pesquisas Agrárias e Ambientais
DOI: 10.5935/2318-7670.v05n04a01
http://www.ufmt.br/nativa

ISSN: 2318-7670

Phytosociological survey in pineapple cultivated in northern Minas Gerais

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Received in september/2016; Accepted in may/2017.

ABSTRACT: This study aimed to identify some of the main weed species in the pineapple crop grown in northern Minas Gerais state, Brazil. The phytosociological survey was carried out in two seasons, spring-summer and fall-winter, in a pineapple cultivation area of Unimontes, using the square inventory method (0.25 x 0.25 m). The samples were identified and quantified by families, genera and species, evaluating: frequency, relative frequency, density, relative density, abundance, relative abundance, importance value index, relative importance value index and similarity index. In the spring-summer period, ten species were identified, distributed in nine genera and eight families, highlighting the Euphorbiaceae and Poaceae families, with two species each. The species with the highest importance value indexes were *Cyperus iria* (77.29), *Cynodon dactylon* (51.99) and *Euphorbia heterophylla* (45.46). In the fall-winter period, six families, seven genera and nine species were identified, since three of the Euphorbiaceae family, with more species. The species that showed greater importance value indexes in the fall-winter period were *Amaranthus hybridus* (48.64), *Cyperus hiris* (48.11) and *Euphorbia hirta* (45.06). The similarity index was 84.21%, with 11 species in common, demonstrating a high homogeneity between the two evaluated periods.

Keywords: pineapple crop, phytosociology, weeds, phytosociological variables.

Levantamento fitossociológico na cultura do abacaxi cultivado no norte de Minas Gerais

RESUMO: Objetivou-se identificar algumas das principais espécies de plantas daninhas em área cultivada com abacaxi no norte de Minas Gerais. O levantamento fitossociológico foi desenvolvido em duas épocas do ano, primavera-verão e outono-inverno, em área de plantio de abacaxi da Unimontes, utilizando o método do quadrado inventário (0,25 x 0,25 m). As amostras foram identificadas e quantificadas por famílias, gêneros e espécies, avaliando-se: frequência, frequência relativa, densidade, densidade relativa, abundância, abundância relativa, índice de valor de importância, índice de valor de importância relativa e índice de similaridade. No período de primavera-verão foram identificadas dez espécies, distribuídas em nove gêneros e oito famílias, destacando-se as famílias Euphorbiaceae e Poaceae, com duas espécies cada. As espécies com maiores índices de valor de importância foram *Cyperus iria* (77,29), *Cynodon dactylon* (51,99) e *Euphorbia heterophylla* (45,46). No período de outono-inverno foram identificadas seis famílias, sete gêneros e nove espécies, visto que três dessas da família Euphorbiaceae, com maior número de espécies. As espécies que alcançaram maiores índices de valor de importância no período de outono-inverno foram *Amaranthus hybridus* (48,64), *Cyperus iria* (48,11) e *Euphorbia hirta* (45,06). O índice de similaridade foi 84,21%, com 11 espécies em comum, demonstrando alta homogeneidade entre os dois períodos avaliados.

Palavras-chave: abacaxicultura, fitossociologia, plantas daninhas, variáveis fitossociológicas.

1. INTRODUCTION

The pineapple (*Ananas comosus* (L.) Merrill) is a plant originated in a tropical climate and broadly distributed throughout the country, and because its fruit is very appreciated mainly for *in natura* consumption, it shows a great potential for irrigated agriculture in northern Minas Gerais. The crop fits very well to the climate conditions of the region, being an excellent alternative for being appreciated by consumers and showing a good economic performance (FRANCO et al., 2014).

Losses due to competition between weeds and crops may reach 90% (CORRÊA et al., 2015; CUNHA et al., 2015; LÓPEZ-OVEJERO et al., 2016). In addition to the quantitative and qualitative reduction of production of all types of agricultural products, weeds cause an increase in crop production costs and indirect harvest losses.

The pineapple presents very slow vegetative development, small size and superficial root system, which aggravates weed interference, mainly in the first six months after planting. On

the other hand, weeds usually show rapid growth and efficiency in the absorption of water and nutrients (MAIA et al., 2012; PEREIRA et al., 2014). Thus, it is necessary to devise strategies for weed control in order to minimize competition damages, since control without adequate planning can become expensive, inefficient and harmful to the environment.

During the pineapple production cycle, climatic conditions of each season of the year, temperature, luminosity, together with the management of fertilization and irrigation provided, can influence the population, competition and variability of weed species in the area. This can influence control strategies during certain periods of the year (FREITAS et al., 2009; MOURA et al., 2009; TRISURAT et al., 2011).

Phytosociological studies compare weed populations at a given time. Scheduled repetitions of these studies may indicate trends of variation in the importance of one or more populations, and these variations may be associated with the adopted agricultural practices. Therefore, the structural analysis or the phytosociological survey of a particular crop is very important so that one can have reliable variables about the floristic of the weeds of a certain area (OLIVEIRA; FREITAS, 2008; MARQUES et al., 2010).

Based on the above considerations, the objective of this work was to carry out the phytosociological survey of weeds infesting in area cultivated with pineapple in the north of Minas Gerais state, Brazil.

2. MATERIAL AND METHODS

The phytosociological survey was carried out in two seasons of the year 2012, fall-winter, in the month of May, and spring-summer, in November, in an area that was cultivated with two-year-old 'Pérola' pineapple, at the State University of Montes Claros (UNIMONTES), Campus Janaúba, MG. The area where the experiment was carried out had the geographical coordinates 43°26‟92”,8 W, 15°82‟89”,6 S and altitude of approximately 540 m. The average rainfall of the region is approximately 760 mm, average annual temperature of 24 ºC, insolation of 2,700 annual hours and average relative humidity of 65%.

The relief is considered as flat and the crop was drip-irrigated. Weed control was performed by weedings every 30 days in the spring-summer period and every 45 days in the fall-winter period.

The survey was carried out using the inventory square method (0.25 m side), which was randomly released 24 times in the area in zigzag walking (BRAUN-BLANQUET, 1979; ERASMO et al., 2004). Samples from each square were identified and quantified by families, genera and species, being then packed in paper bags to be sent to the laboratory, where they were weighed and taken to a forced circulation oven and maintained at 60 °C until reaching a constant mass, to be weighed again to obtain the dry mass.

The identification and counting of the species allowed to calculate the following phytosociological variables: frequency, relative frequency, density, relative density, abundance, relative abundance, importance value index and relative importance index (BRAUN-BLANQUET, 1979; BRANDÃO et al., 1998; LARA et al., 2003; BRIGHENTI et al., 2003; TUFFI SANTOS et al., 2004), and determination of the similarity index (SI) (SORENSEN, 1972).

Calculations were based on the following formulas:

- Frequency (F):

$$F = \frac{\text{nº of squares which contain the species}}{\text{total number of squares obtained (total area)}}$$

- Relative frequency (Fr):

$$Fr = \frac{100 \times \text{species frequency}}{\text{total frequency of all species}}$$

- Density (D):

$$D = \frac{\text{total number of individuals per species}}{\text{total number of squares obtained (total area)}}$$

- Relative density (Dr):

$$Dr = \frac{100 \times \text{density of the species}}{\text{total density of all species}}$$

- Abundance (A):

$$A = \frac{\text{total number of individuals per species}}{\text{total number of squares containing the species}}$$

- Relative abundance (Ar):

$$Ar = \frac{100 \times \text{abundance of the species}}{\text{total abundance of all species}}$$

- Importance Value Index (IVI):

$$IVI = \text{relative frequency} + \text{relative density} + \text{relative abundance}$$

- Relative Importance Value Index (RIVI):

$$RIVI = \frac{100 \times \text{importance value index of the species}}{\text{total importance value index of all the species}}$$

- Similiarity Index (SI):

$$SI = \left(\frac{2a}{b+c}\right) \times 100$$

in which a is the number of species common to both areas, b and c are the total number of species in the two compared areas. The SI, which is an estimate of the degree of similarity in species composition, varies from 0 to 100%, being maximum when all species are common to both areas and minimum when there are no species in common.

3. RESULTS

In the spring-summer period, ten species were identified, distributed in nine genera and eight families (Table 1). The most representative family in terms of number of species were Euphorbiaceae and Poaceae, with a total of two individuals.

Table 1. List of weeds by family, genus and species found in the spring-summer period.
Tabela 1. Relação de plantas daninhas por família, gênero e espécies encontradas no período de primavera-verão.

Family	Genus	Species	
		Scientific name	Common name
Poaceae	*Cynodon*	*Cynodon dactylon*	Bermuda grass
	Dactyloctenium	*Dactyloctenium aegyptium*	Egyptian grass
Euphorbiaceae	*Euphorbia*	*Euphorbia hirta*	Pillpod sandmat
		Euphorbia heterophylla	Mexican fireplant
Portulacaceae	*Portulaca*	*Portulaca oleracea*	Little hogweed
Nyctaginaceae	*Boerhavia*	*Boerhavia diffusa*	Red spiderling
Cyperaceae	*Cyperus*	*Cyperus iria*	Ricefield flatsedge
Solanaceae	*Solanum*	*Solanum viarum*	Tropical soda apple
Commelinaceae	*Commelina*	*Commelina benghalensis*	Benghal dayflower
Amaranthaceae	*Amaranthus*	*Amaranthus hybridus*	Slim amaranth

The families Portulacaceae, Nyctaginaceae, Cyperaceae, Solanaceae, Commelinaceae and Amaranthaceae presented one species each.

Six families, seven genera and nine species were identified in the fall-winter period (Table 2), in which the family with the highest number of species was Euphorbiaceae (three), followed by Poaceae (two) and the other Portulacaceae, Nyctaginaceae, Cyperaceae, Amaranthaceae, with one species.

In the spring-summer period, the species with the highest frequency values, representing the distribution by area, were *Euphorbia heterophylla* (0.58), *Cynodon dactylon* (0.50), *Dactyloctenium aegyptium* (0.25) and *Amaranthus hybridus* (0.21). Regarding the density, which is the amount of plants per species per area unit, *Cyperus iria* (5.67), *Cynodon dactylon* (4.83), *Euphorbia heterophylla* (3.17), *Portulaca oleracea* (2.83) and *Amaranthus hybridus* (1.17) presented the highest values. As for the abundance, which indicates the concentration of the species in the area, *Commelina benghalensis* (17), *Portulaca oleracea* (5.67), *Dactyloctenium aegyptium* (2.83) and *Cynodon dactylon* (2.42) prevailed (Table 3).

The species that presented the highest frequency in the fall-winter period were *Euphorbia hirta* (0.58), *Amaranthus hybridus* (0.58), *Euphorbia heterophylla* (0.46) and *Portulaca oleracea* (0.25) (Table 4). The highest densities appeared for *Amaranthus hybridus* (5.17), *Cyperus iria* (4.83), *Boerhavia diffusa* (3.83) and *Portulaca oleracea* (3.17). As for abundance, *Cyperus iria* (5,80), *Cynodon dactylon* (4.50), *Boerhavia diffusa* (3.83) and *Portulaca oleracea* (3.17) predominated (Tabela 4).

Int the spring-summer period, stood out in DM accumulation the species *Cynodon dactylon* (113.61 g), *Cyperus iria* (40.83 g), *Dactyloctenium aegyptium* (19.65 g) and *Portulaca oleracea* (12.42 g). During the fall-winter period, stood out *Euphorbia hirta* (57.42 g), *Portulaca oleracea* (54.63 g), *Amaranthus hybridus* (38.94 g) and *Boerhavia diffusa* (26.6 g).

In the spring-summer period stood out, in terms of importance value index (IVI), the species *Cyperus iria* (77.29), *Cynodon dactylon* (51.99), *Euphorbia heterophylla* (45.46) and

Table 2. List of weeds by family, genus and species found in the fall-winter period.
Tabela 2. Relação de plantas daninhas por família, gênero e espécies encontradas no período de outono-inverno.

Família	Gênero	Espécies	
		Nome cientifico	Nome comum
Poaceae	*Cynodon*	*Cynodon dactylon*	Bermuda grass
	Dactyloctenium	*Dactyloctenium aegyptium*	Egyptian grass
Euphorbiaceae	*Euphorbia*	*Euphorbia hirta*	Pillpod sandmat
		Euphorbia heterophylla	Mexican fireplant
	Ricinus	*Ricinus communis*	Castor bean
Portulacaceae	*Portulaca*	*Portulaca oleracea*	Little hogweed
Nyctaginaceae	*Boerhavia*	*Boerhavia diffusa*	Red spiderling
Cyperaceae	*Cyperus*	*Cyperus iria*	Ricefield flatsedge
Amaranthaceae	*Amaranthus*	*Amaranthus hybridus*	Slim amaranth

Table 3. Number of squares with occurrence (NSO), number of individuals per species (NIS), dry matter (DM), frequency (F), relative frequency (Fr), density (D), relative density (Dr) and relative abundance (Ar) of weeds in the spring-summer period.
Tabela 3. Número de quadrados com ocorrência (NQO), número de indivíduos por espécie (NIE), matéria seca (MS), frequência (F), frequência relativa (Fr), densidade (D), densidade relativa (Dr), abundância (A) e abundância relativa (Ar) das plantas daninhas no primavera-verão.

Species	NSO	NIS	DM (g)	F	Fr (%)	D (pl m^{-2})	Dr (%)	A	Ar (%)
Cynodon dactylon	12	29	113.6	0.50	23.53	4.83	21.64	2.42	6.82
Dactyloctenium aegyptium	6	17	19.65	0.25	11.76	0.25	12.6	2.83	8
Amaranthus hybridus	5	7	10.80	0.21	9.8	1.17	5.22	1.36	3.95
Boerhavia diffusa	2	3	0.48	0.08	3.92	0.5	2.24	1.25	4.23
Cyperus iria	2	43	40.83	0.08	3.92	5.67	25.37	1.5	47.99
Commelina benghalensis	2	2	0.08	0.08	3.92	0.33	1.49	17	2.82
Euphorbia heterophylla	14	19	5.72	0.58	27.45	3.17	14.18	1	3.83
Euphorbia hirta	4	5	1.83	0.17	7.84	0.83	3.73	1.4	3.53
Solanum viarum	1	1	2.39	0.04	1.96	0.17	0.75	1	2.82
Portulaca oleracea	3	17	12.42	0.13	5.88	2.83	12.69	5.67	16
Total	51	134	207.9	2.0	100	22.33	100	35.42	100

Table 4. Number of squares with occurrence (NSO), number of individuals per species (NIS), dry matter (DM), frequency (F), relative frequency (Fr), density (D), relative density (Dr) and relative abundance (Ar) of weeds in the fall-winter period.
Tabela 4. Número de quadrados com ocorrência (NQO), número de indivíduos por espécie (NIE), matéria seca (MS), frequência (F), frequência relativa (Fr), densidade (D), densidade relativa (Dr), abundância (A) e abundância relativa (Ar) das plantas daninhas no outono-inverno.

Species	NSO	NIS	DM (g)	F	Fr (%)	D (pl m^{-2})	Dr (%)	A	Ar (%)
Cynodon dactylon	2	9	24.1	0.08	2.99	1.5	5.26	4.5	17.35
Dactyloctenium aegyptium	4	7	19.65	0.17	5.97	1.17	4.29	1.75	6.90
Amaranthus hybridus	14	31	38.94	0.58	20.9	5.17	19.02	2.21	8.73
Boerhavia diffusa	6	23	26.6	0.25	8.96	3.83	14.11	3.83	15.11
Cyperus iria	5	29	11.42	0.21	7.46	4.83	17.79	5.80	22.86
Euphorbia heterophylla	11	13	1.83	0.46	16.42	2.17	7.98	1.18	4.66
Euphorbia hirta	14	27	57.42	0.58	20.9	4.5	16.56	1.93	7.60
Ricinus communis	5	5	15.37	0.21	7.46	0.83	3.07	1.00	3.94
Portulaca oleracea	6	19	54.63	0.25	8.96	3.17	11.66	3.17	12.48
Total	67	163	249.9	2.79	100	27.17	100	25.37	100

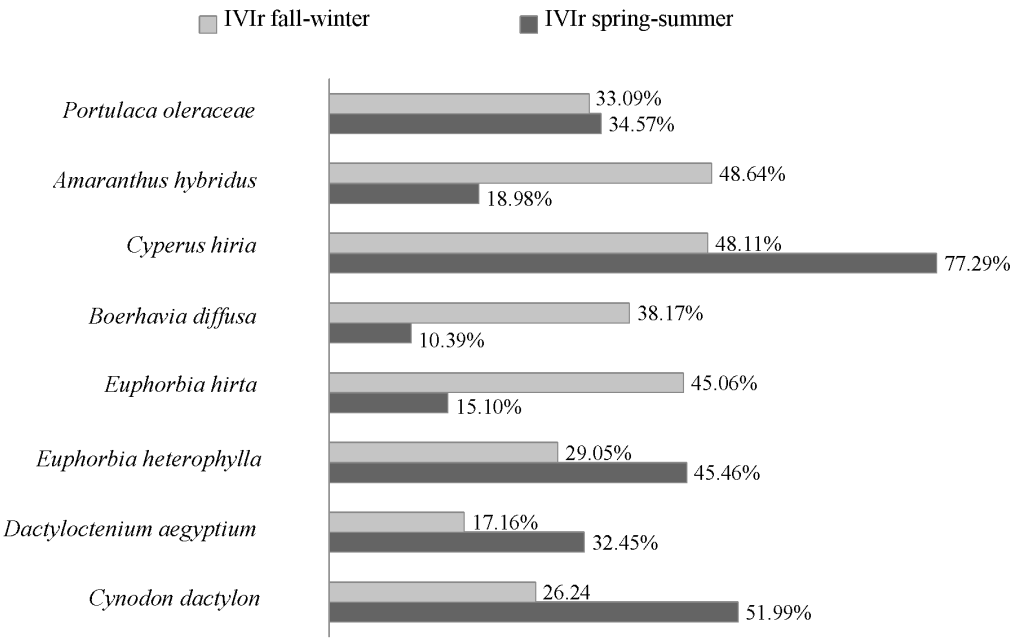

Figure 1. Relative Importance Value Index (IVIr) of the weed species of the area in the spring-summer and fall-winter periods.
Figura 1. Índice de Valor de Importância Relativa (IVIr) das espécies de plantas daninhas da área nos períodos primavera-verão.

Portulaca oleracea (34.57) (Figure 1). The main species in the fall-winter period were *Amaranthus hybridus* (48.64), *Cyperus iria* (48.11), *Euphorbia hirta* (45.06) and *Boerhavia diffusa* (38.17) (Figure 1).

5. DISCUSSION

Among the families most found in the two periods of the year the importance of the family Poaceae is observed, which was among the most important in both periods. This result corroborates those of Gomes et al. (2010), who worked with banana fields in dryland and floodplain areas in the municipality of Registro-SP; Galvão et al. (2011), in lowland pastures of the municipality of Autazes-AM; and Oliveira; Freitas (2008), in sugarcane fields in the spring-summer and fall-winter periods in the municipality of Campos dos Goytacazes-RJ. Even in different crops, which cause different micro climates in their areas, and in climatologically contrasting regions, the Poaceae stood out, demonstrating the importance of the family and its competitive capacity.

A similarity of species in both quantity and variety is observed in both periods, in absolute and relative indices (frequency, density and abundance) (Tables 3 and 4). This happens because it is the same area, with the same seed bank and cultural practices, only with hoeings, and weed capacity to germinate at all times of the year.

The two periods presented close averages of density, 2.23 plants m^{-2} in the spring-summer, and 3 plants m^{-2} in fall-winter. Being this close, the averages contradicted the hypothesis that in the rainy season there could be greater density due to the favorable climatic conditions. This can be explained by the fact that there is irrigation in the area, so the water availability was not a differential. In addition, in the fall-winter period, the weeds were hoed less frequently, with an interval of 45 days, fifteen days more than in spring-summer.

The accumulation of dry matter (DM) by plants may be associated with mineral nutrition, which demonstrates the importance of weeds in competition for nutrients. These are costly and can still directly interfere with fruit quality.

The total number of species in spring-summer (ten) was higher than the fall-winter period (nine). Even with only one different species, the result was the same as that obtained by Oliveira; Freitas (2008), who verified that the number of species in the spring-summer period is higher when compared

to the autumn-winter period. On the other hand, the number of individuals was higher in the fall-winter period, 163 against 134 in the spring-summer period. This can be explained by the cultural practices that also favor weeds, such as fertilization and manual hoeing, which, when carried out in areas with the presence of weeds that are capable of asexual dissemination, can have an opposite effect and cause dissemination rather than effective control. Species such as *Cynodon dactylon* and *Cyperus iria* have the ability to reproduce by vegetative structures and may have been favored by hoeing. At each collection season, some species stand out due to several factors, among them, species characteristics, climate, seed bank, crop development and the control period.

The high importance value index (Figure 1) indicates that these species should have priority in the management, mainly due to the high capacity of seed production of the species and ability of asexual perpetuation as *C. iria* and *Portulaca oleraceae.*

Among the species that presented the highest relative importance index (IVIr) only *C. iria* is present in the two periods of the year, as observed by Oliveira; Freitas (2008) in a study of the phytosociological analysis in areas cultivated with sugarcane.

Analyzing Figure 1, the species *C.iria*, *C. dactylon*, *Euphorbia heterophylla* and *P. oleracea* show higher indexes, differing from the other species in the spring-summer period. In the fall-winter period, the prominent species were *C. iria*, *Amaranthus hybridus*, *Euphorbia hirta* and *Boerhavia diffusa*. The IVIr is an indication that these species should receive top priority in weed control order, tracing control strategies focused on their characteristics. According to Silva; Silva (2007), for the success of any technique, weed control should be applied based on the detailed knowledge of weed biology and ecology.

The similarity index (IS) allows knowing the similar weeds which exist in the regions in the two periods. IS was 84.21%, with 11 species in common, demonstrating high homogeneity between the two periods. According to Felfili; Venturoli (2000), the SI is high when greater than 50%. This similarity can be explained by the fact that the collections were carried out in the same area, and since it is an irrigated area, it offers adequate conditions in the autumn-winter, as the limiting factor in this period is water, and the cultural practices carried out by manual hoeing, which favored the main weeds by the asexual disemination.

4. CONCLUSIONS

In the spring-summer period, the Euphorbiaceae and Poaceae families stood out, with two individuals per species. In the autumn-winter period, the Euphorbiaceae family, with three species, was the most important.

In spite of the high similarity index value, the relative importance value index varied between the seasons, which justifies the adequate knowledge of the floristic composition of weeds in both periods and, in practice, implies in different management strategies of these plants in the two seasons.

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