Phytosociological survey in pineapple cultivated in northern Minas Gerais

Hercules Gustavo dos Santos SARMENTO1*, Thiago Mendes RODRIGUES2, Ignacio ASPIAZÚ2, Carlos Eduardo CORSATO2

1 Plant Production Graduation Program, Federal University of Ceará (UFC), Fortaleza, Ceará, Brazil.
2 Department of Agricultural Sciences, State University of Montes Claros (Unimontes), Montes Claros, Minas Gerais, Brazil.

* E-mail: herculesgustavo@hotmail.com

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.

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 ºC 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; BRIGHTENTI 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):
  \[ F = \frac{n^o \text{ of squares which contain the species}}{\text{total number of squares obtained (total area)}} \]

- 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):
  \[ RIVI = \frac{100 \times \text{importance value index of the species}}{\text{total importance value index of all the species}} \]

- Similarity 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.
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, Amarynthaceae, 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), Cyodon dactylon (0.50), Dactyloctenium aegyptium (0.25) and Aamaranthus hybridus (0.21). Regarding the density, which is the amount of plants per area unit, Cynodon dactylon (5.80), Cyperus iria (5.17), 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 Cyodon dactylon (2.42) prevailed (Table 3).

The species that presented the highest frequency in the fall-winter period were Euphorbia heterophylla (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), Cyodon dactylon (4.50), Boerhavia diffusa (3.83) and Portulaca oleracea (3.17) predominated (Table 4).

In the spring-summer period, stood out in DM accumulation the species Cyodon 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 heterophylla (57.42 g), Portulaca oleracea (54.65 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), Cyodon dactylon (51.99), Euphorbia heterophylla (45.46) and

### Table 1. List of weeds by family, genus and species found in the spring-summer period.

| Family (Família) | Genus (Gênero) | Scientific name | Common name |
|------------------|----------------|----------------|-------------|
| Poaceae          | Cynodon       | Cyodon dactylon | Bermuda grass |
| Euphorbiaceae    | Euphorbia     | Euphorbia heterophylla | Egyptian grass |
| Portulacaceae    | Portulaca     | Portulaca oleracea | Mexican fireplant |
| Cyperaceae       | Cyperus       | Boerhavia diffusa | Little hogweed |
| Solanaceae       | Solanum       | Solanum viarum | Tropical soda apple |
| Commelinaceae    | Commelina     | Commelina benghalensis | Bengal dayflower |
| Amananthaceae    | Amananthus    | Amananthus hybridus | Slim amaranth |

### Table 2. List of weeds by family, genus and species found in the fall-winter period.

| Family (Família) | Gênero (Gênero) | Nome científico | Nome comum |
|------------------|-----------------|-----------------|------------|
| Poaceae          | Cynodon         | Cyodon dactylon | Bermuda grass |
| Euphorbiaceae    | Euphorbia       | Euphorbia heterophylla | Mexican fireplant |
| Portulacaceae    | Portulaca       | Portulaca oleracea | Little hogweed |
| Cyperaceae       | Cyperus         | Boerhavia diffusa | Red spiderling |
| Amananthaceae    | Amananthus      | Amananthus 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.

| Species (Especies) | NSO | NIS | DM (g) | F   | Fr (%) | D (pl m²) | Dr (%) | A   | Ar (%) |
|--------------------|-----|-----|--------|-----|--------|-----------|--------|-----|--------|
| Cyodon 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       | 24  | 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    | 24  | 43  | 40.83  | 0.08| 3.92   | 5.67      | 25.37  | 1.5 | 47.99  |
| 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     | 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 (%) | 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   | 1.83 | 16.42  | 2.17       | 7.98   | 1.18   | 4.66   |
| Euphorbia hirta          | 14  | 27  | 57.42  | 0.58 | 16.56  | 1.93       | 15.17  | 7.57   | 15.17  |
| Ricinus communis         | 5   | 5   | 15.37  | 0.21 | 7.46   | 0.83       | 3.07   | 1.01   | 3.95   |
| 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  |

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 oleracea*.

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 dissemination.

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.

5. REFERENCES

BRANDÃO, M.; BRANDÃO, H.; LACA-BUENDIA, J. P. A mata ciliar do rio Sapucaí, município de Santa Rita do Sapucaí- MG: Fitosociologia. *Daphne*, Belo Horizonte, v. 8, n. 4, p. 36-48, 1998.

BRAUN-BLANQUET, J. *Fitossociologia: bases para El estudio de las comunidades vegetales*. Madrid: H. Blume, 1979, 820 p.

BRIHGENTI, A. M.; CASTRO, C.; GAZZIERO, D. L. P.; ADEGAS, F. S.; ELEMAR, V. Cadastramento fitossociológico de plantas daninhas na cultura de girassol. *Pesquisa Agropecuária Brasileira*, Brasília, v. 38, n. 5, p. 651-657, 2003. http://dx.doi.org/10.1590/S0100-204X2003000500014

CORRÊA, M. J. P.; ALVES, G. L.; ROCHA, L. G. F.; SILVA, M. R. M. Periodos de interferência de plantas daninhas na cultura do feijão-caupi. *Revista de Ciências Agroambientais*, Alta Floresta, v. 13, n. 2, p. 50-56, 2015

CUNHA, J. L. X. L.; FREITAS, F. C. L.; COELHO, M. E. H.; SILVA, M. G. O.; MESQUITA, H. C.; SILVA, K. S. Periodos de interferência de plantas daninhas na cultura do pimentão nos sistemas de plantio direto e convencional. *Revista Agrombiante On-line*, Boa Vista, v. 9, n. 2, p. 175-183, 2015

ERASMO, E. A. L.; PINHEIRO, L. L. A.; COSTA, N. V. Levantamento fitossociológico das comunidades de plantas infestantes em áreas de produção de arroz irrigado cultivado sob diferentes sistemas de manejo. *Planta Daninha*, Viçosa, v. 22, n. 2, p. 195-201, 2004. http://dx.doi.org/10.1590/S0100-83582004000200004

FELFILI, J. M.; VENTUROLI, F. Tópicos em análise de vegetação. *Comunicações Técnicas Florestais*, Brasília, v. 2, n. 2, p.1-25, 2000.

FRANCO, L. R. L.; MAIA, V. M.; LOPES, O. P.; FRANCO, W. T. N.; SANTOS, S. R. Crescimento, produção e qualidade do abacaxi efeito de diferentes tipos de lâminas de irrigação. *Revista Caatinga*, Mossoró, v. 27, n. 2, p. 132-140, 2014.

FREITAS, F. C. L.; MEDEIROS, V. F. L. P.; GRANGEIRO, L. C.; SILVA, M. G. O.; NASCIMENTO, P. G. M. L.; NUNES, G. H. Interferência de plantas daninhas na cultura do feijão-caupi. *Planta Daninha*, Viçosa, v. 27, n. 2, p. 241-247, 2009. http://dx.doi.org/10.1590/S0100-83582009000200005

GALVÃO, A. K. L.; SILVA, J. F.; ALBERTINO, S. M. F.; MONTEIRO, G. F. P.; CAVALCANTE, D. P. Levantamento fitossociológico em pastagens de várzea no Estado do Amazonas. *Planta Daninha*, Viçosa, v. 29, n. 1, p. 69-75, 2011. http://dx.doi.org/10.1590/S0100-835820110100010009

GOMES, G. L. G. C.; IBRAHIM, F. N.; MACEDO, G. L.; NOBREGA, L. P.; ALVES, E. Cadastramento fitossociológico de plantas daninhas na bananicultura. *Planta Daninha*, Viçosa, v. 28, n. 1, p. 61-68, 2010. http://dx.doi.org/10.1590/S0100-8358201000100008

LARA, J. F. R.; MACEDO, J. F.; BRANDÃO, M. Plantas daninhas em pastagens de várzea no estado de Minas Gerais. *Planta Daninha*, Viçosa, v. 21, n. 1, p. 11-20, 2003.

LOPEZ-OVEJERO, R. F.; SOARES, D. J.; OLIVEIRA, N. C.; KAWAGUCHI, I. T.; BERGER, R. G.; CARVALHO, S. J. P.; CHRISTOFFOLETI, P. J. Interferência e controle de milho em plantio direto com arroz irrigado cultivado sob diferentes sistemas de manejo. *Revista de Ciências Agroambientais*, Viçosa, v. 28, n. 1, p. 61-68, 2010. http://dx.doi.org/10.1590/S0100-8358201000100004

MORAES, L. P.; ALVES, E. Cadastramento fitossociológico de plantas daninhas da bananicultura. *Planta Daninha*, Viçosa, v. 29, n. 1, p. 69-75, 2011. http://dx.doi.org/10.1590/S0100-835820110100010009

MOSSORO, A. M.; CASTRO, C.; GAZZIERO, D. L. P.; ADEGAS, F. S.; ELEMAR, V. Cadastramento fitossociológico de plantas daninhas da bananicultura. *Planta Daninha*, Viçosa, v. 28, n. 1, p. 61-68, 2010. http://dx.doi.org/10.1590/S0100-8358201000100008
MOURA, E. G.; MOURA, N. G.; MARQUES, E. E.; PINHEIRO, K. M.; COSTA, J. R. S. S.; AGUIAR, A. C. F. Evaluating chemical and physical quality indicators for a structurally fragile tropical soil. *Soil Use and Management*, Oxford, v. 25, p. 368-375, 2009. http://dx.doi.org/10.1111/j.1475-2743.2009.00238.x

OLIVEIRA, A. R.; FREITAS, S. P. Levantamento fitossociológico de plantas daninhas em áreas de produção de cana-de-açúcar. *Planta Daninha*, Viçosa, v. 26, n. 1, p. 33-46, 2008. http://dx.doi.org/10.1590/S0100-83582008000100004

PEREIRA, F. C. M.; BARROSO, A. A. M.; ALBRECHT, A. J. P.; ALVES, P. L. C. A. Interferência de plantas daninhas: conceitos e exemplos na cultura do eucalipto. *Journal of Agronomic Sciences*, Umuaram, v. 3, n. especial, p. 236-255, 2014.

SILVA, A. A.; SILVA, J. F. Manejo integrado de plantas daninhas, Tópicos em manejos de plantas daninhas. Viçosa: Ed. UFV, 2007, p.72-81.

SORENSEN, T. A. Method of establishing group sequel amplitude in plant society based on similarity of species content. In: ODUM, E. P. *Ecologia*. 3.ed. México: Interamericana, 1972, p. 341-405.

TRISURAT, Y.; SHRESTHA, R. P.; KJELGREN, R. Plant species vulnerability to climate change in peninsular thailand. *Applied Geography*, Oxford, v. 31, n. 3, p. 1106-1114, 2011. https://doi.org/10.1016/j.apgeog.2011.02.007

TUFIN SANTOS, L. D.; SANTOS, I. C.; OLIVEIRA, C. H; SANTOS, M. V.; FERREIRA, F. A.; QUEIROZ, D. S. Levantamento fitossociológico em pastagens degradadas sob condições de várzea. *Planta Daninha*, Viçosa, v. 22, n. 3, p. 343-349, 2004. http://dx.doi.org/10.1590/S0100-83582004000300003