SCIENTIA NATURALIS
Scientia Naturalis, v. 7, n. 1, p. 25-36, 2025
Home page: http://revistas.ufac.br/revista/index.php/SciNat
DOI: https://doi.org/10.29327/269504.7.1-3
ISSN 2596-1640

Phytosociology of spontaneous plants in organic cultivation of Amazonian spinach

Márcio Chaves da Silva[1*], Regina Lúcia Félix Ferreira[2], Bárbara Barbosa Mota[1], Adalberto Hipólito de Sousa[2], Márcia Chaves da Silva[1], Camila Ferreira Martins Freire[1], Ryan da Cunha Feitosa[1]

[1]Discente do Programa de pós-graduação em Produção Vegetal, Rio Branco, Acre, Brasil. [2]Professor da Universidade Federal do Acre, Centro de Ciências Biológicas e da Natureza, Rio Branco, Acre, Brasil.
*marciochaves10silva@gmail.com

Recebido em: 01/03/2024 **Aceito em: 15/01/2025** **Publicado em: 10/05/2025**

DOI: https://doi.org/10.29327/269504.7.1-3

ABSTRACT

The objective of this work was to carry out a phytosociological study on the community of spontaneous plants in organic spinach cultivation in the Amazon. The study was carried out at the Federal University of Acre, from May to July 2023. The cultivation of Amazon spinach was installed in a randomized block design, with five treatments and four replications. The treatments were alternative soil coverings, including: chestnut husk, rice husk, jambeiro foliage, grass straw and bare soil. The evaluation of weeds was carried out during the Amazon spinach harvest, after 45 days of cultivation. To sample weeds, the square method was used, with a sample measuring 0.5 m x 0.5 m (0.25 m^2), launched twenty times (5 m^2). Weed species were quantified and identified, followed by the calculations: density, relative density, frequency, relative frequency, abundance, relative abundance, relative dry mass, importance value index and relative importance. 18 weed species were identified in the weed community, belonging to 13 botanical families, with greater species diversity in the Malvaceae family. The most important species in cultivation were *Digitaria horizontalis*, *Phyllanthus amarus*, *Amaranthus blitum* and *Acalypha alopecuroidea*.
Keywords: *Alternanthera sessilis* (L.) R.Br. ex DC. Weedy plants. Organic agriculture.

Fitossociologia de plantas espontâneas em cultivo orgânico de espinafre da Amazônia

RESUMO

O objetivo deste trabalho foi realizar um estudo fitossociológico na comunidade de plantas espontâneas em cultivo orgânico de espinafre da Amazônia. O estudo foi realizado na Universidade Federal do Acre, no período de maio a julho de 2023. O cultivo de espinafre da Amazônia foi instalado em delineamento de blocos casualizados, com cinco tratamentos e quatro repetições. Os tratamentos foram coberturas alternativas do solo, sendo: casca de castanha, casca de arroz, folhagem de jambeiro, palha de capim e solo sem cobertura. A avaliação das plantas daninhas foi realizada na colheita do espinafre da Amazônia, aos 45 dias de cultivo. Para amostragem das daninhas foi utilizada o método do quadrado, com amostra de 0,5 m x 0,5 m (0,25 m^2), lançada vinte vezes (5 m^2). As espécies de plantas daninhas foram quantificadas e identificadas, seguido dos cálculos: densidade, densidade relativa, frequência, frequência relativa, abundância, abundância relativa, massa seca relativa, índice de valor de importância e importância relativa. Foram identificadas na comunidade de plantas infestantes 18 espécies de plantas daninhas, pertencentes a 13 famílias botânicas, com maior diversidade de espécies na família Malvaceae. As espécies de maior importância no cultivo foram *Digitaria horizontalis*, *Phyllanthus amarus*, *Amaranthus blitum* e *Acalypha alopecuroidea.*
Palavras-chave: *Alternanthera sessilis* (L.) R.Br. ex DC. Plantas infestantes. Agricultura orgânica.

INTRODUCTION

Amazonian spinach (*Alternanthera sessilis* (L.) R.Br. ex DC.) is a leafy vegetable classified as an unconventional food plant, it is generally present spontaneously in humid soils, a little-known species and when cultivated, it is in small quantities for family farmers (KINUPP; LORENZI, 2014). This plant has food and pharmacological potential, mainly because its composition contains a high protein content, a diversity of vitamins, minerals, fiber, as well as antioxidants and other compounds beneficial to health (RADHAKRISHNAN et al., 2015; IKRAM et al., 2022).

The plant is a perennial herb with a tropical climate, from the Amarantaceae family, with a probable center of origin in Brazil, and is popularly known as monkey's ear, Amazon spinach and Brazilian spinach (KINUPP; LORENZI, 2014). The species is classified as a leafy vegetable with rapid development, propagated mainly by cuttings and tender stems, with greater leaf growth in a shady environment, also adapting to cultivation in full sun, with characteristically rounded, wrinkled leaves, small, white flowers (KINUPP; LORENZI, 2014; ALLAM et al., 2022).

The cultivation of non-conventional food plants, which include a wide diversity of species, such as Amazonian spinach, being carried out mainly by small family-based farmers, where soil management is mostly organic, which is characterized by the use of agroecological practices, such as incorporation of organic matter, use of plant residue-based soil covers, use of living covers, species diversity, physical soil techniques, use of biofertilizers and other conservation practices (LEAL et al., 2018; ARAÚJO; FERREIRA, 2019). This type of management allows for a greater presence of spontaneous plant communities and establishes complex interactions with crops of interest.

In organic vegetable crops, the soils are generally fertile, presenting a large amount of organic matter, excellent nutritional properties, constant irrigation, as well as a shaded environment, thus favoring the emergence and establishment of spontaneous plants, which, by presenting ecological characteristics that facilitate its propagation, as a rapid development cycle, large numbers of reproductive propagules, in addition to diverse reproduction structures, quickly colonize environments (ARAÚJO NETO; FERREIRA, 2019).

The establishment of spontaneous plants in vegetable growing areas, especially in vegetable species that do not close the canopy quickly, may have negatively affected their development, as weeds compete for resources with the crop of interest, necessary for its development, resources such as nutrients, water, light, and thus, when these species are

not controlled, productive compromise can occur, a decrease in production and deforming the desired characteristics of the products, causing economic losses (ULJOL et al., 2018; AMORIM; MESQUITA, 2019; SOUZA et al., 2023).

The greater diversity of spontaneous plants in organic vegetable crops, especially due to the management system adopted, results in a complex interaction between weeds and the crop of interest (MEDES; SILVA, 2022). Therefore, for adequate crop management, greater knowledge of weedy plants is necessary, which includes their identification, distribution, diversity and ecology, so that, based on this knowledge, we can propose measures for control, suppression and management, aiming for greater efficiency and productivity in crops, without the use of chemicals, such as herbicides.

The phytosociological survey carried out on populations of spontaneous plants provides characterization of individuals and their distribution in the community, making it possible to establish the identification of species, number of individuals and observe their distribution based on determined parameters, such as calculations of frequency, density, abundance and importance value index, among others, which, after analyzing and understanding the ecology and its distribution, enables the application of practices to control weeds (PITELLI, 2000; AMORIM; MESQUITA, 2019).

The phytosociological analysis of the community of spontaneous plants is of fundamental importance, as it provides information that helps to understand the floristic composition and distribution of species in the areas evaluated (PITELLI, 2000). Based on the information acquired in the surveys and their appropriate interpretation, it is possible to support the application of weed management techniques, with a greater possibility of obtaining positive results, as each species and its interaction with the community can be specific (ALBUQUERQUE et al., 2017).

To carry out adequate management of spontaneous plants in organic cultivation systems, it is necessary to know the ecology and specificity of the weed plant community, especially for the establishment of appropriate management practices. Thus, the objective of this work was to carry out a phytosociological study on the community of spontaneous plants in organic spinach cultivation in the Amazon.

MATERIAL AND METHODS

The study was carried out in the experimental garden of the Federal University of Acre, located in the municipality of Rio Branco, Acre, Brazil, at latitude 09º 57'11" S and

longitude 67º52'16" W, altitude of 163 m, during the period from may to july 2023. The region's climate is hot and humid, type Am, according to the Köppen classification, with average temperatures of 24.7 °C, relative humidity of 80.2% and accumulated precipitation of 267.2 mm during the experiment (INMET, 2023).

The soil in the spontaneous plants collection environment is classified as Typical Dystrophic Red-Yellow Clay (Santos et al., 2013), sandy clay loam texture, with pH (H_2O) = 6.08; and nutrient content: P = 28.79 mg.dm^{-3}; K = 0.56 cmolc.dm^{-3}; Ca = 9.34 cmolc.dm^{-3}; Mg = 3.36 cmolc.dm^{-3}; Al = 0 cmolc.dm^{-3} and H+Al = 1.76 cmolc.dm^{-3}; M.O. = 41.61 g.dm^{-3}; base saturation = 88.30%; SB = 13.26 cmolc.dm^{-3} and CTC= 15.02 cmolc.dm^{-3}.

Phytosociological assessments were carried out in the community of spontaneous plants in the organic cultivation of spinach in the Amazon. The experiment was carried out in a randomized block design, with four blocks and five soil covers. Four alternative soil covers and control treatments were used, namely: jambo leaves, grass straw, rice husk, chestnut shell and bare soil.

The Amazon spinach plants remained in coexistence with the spontaneous plants throughout the cultivation period, with no cleaning carried out, only the application of soil covers. The assessment of the weed plant community was carried out at the spinach harvest, occurring after 45 days of cultivation and planting of the seedlings. In sampling, a 0.5 m x 0.5 m (0.25 m^2) sample was used, thrown twenty times (5 m^2) in the area and the spontaneous plants were collected.

The spontaneous plants collected were separated, the individuals were counted and the botanical families and their species were identified (LORENZI, 2014; MOREIRA; BRAGANÇA, 2010a; MOREIRA; BRAGANÇA, 2010b). The weed material was packed in Kraft paper bags and taken to dry in a forced air circulation oven at a temperature of 65 °C, until they reached a constant mass, to obtain the dry mass of the aerial part.

After counting the species, the phytosociological variables for the weeds were calculated, following the methodology of Pitelli and Bianco (2013). The following were calculated: density (D), relative density (Rd), frequency (F), relative frequency (Rf), abundance (Ab), relative abundance (Rab), relative dry mass (Rdm), importance value index (Ivi) and relative importance (Ri).

To calculate the variables, the following formulas were used:

$$(D)\ Density\ (plants.\ m^2) = \frac{Total\ number\ of\ individuals\ per\ species}{Total\ collection\ area}$$

$$(Rd)\ Relative\ density\ (\%) = \frac{Species\ density}{Total\ density\ of\ all\ species}\ x\ 100$$

$$(F)\ Frequency = \frac{Number\ of\ plots\ where\ the\ species\ was\ found}{total\ number\ of\ plots\ sampled}$$

$$(Rf)\ Relative\ frequency\ (\%) = \frac{Species\ frequency}{Total\ frequency\ of\ all\ species}\ x\ 100$$

$$(Ab)\ Abundance = \frac{total\ number\ of\ individuals\ per\ species}{total\ number\ of\ plots\ containing\ each\ species}$$

$$(Rab)\ Relative\ abundance\ (\%) = \frac{Abundance\ of\ the\ species}{Total\ abundance\ of\ all\ species}\ x\ 100$$

$$(Rdm)\ Relative\ dry\ mass\ (\%) = \frac{Dry\ mass\ of\ the\ species}{Total\ dry\ mass\ of\ all\ species}\ x\ 100$$

$$(Ivi)\ Importance\ Value\ Index = Rd + Rf + Rab$$

$$(Ri)\ Relative\ importance = \frac{Ivi\ of\ the\ species}{Total\ Ivi\ of\ all\ species}\ x\ 100$$

In addition to calculating phytosociological variables, species were classified by class, botanical family, scientific name and popular name. The data obtained were tabulated and discussed using descriptive analysis.

RESULTS AND DISCUSSION

The weed plant community in the organic spinach cultivation area in the Amazon was composed of 18 species, distributed in 13 botanical families, of which 83.30% were dicotyledons and 16.70% were monocotyledons (Table 1). The Malvaceae family presented the greatest diversity of member species, with three, representing 16.67% of spontaneous species, followed by the families Euphorbiaceae, Portulacaceae and Poaceae, with two species each, which represents a diversity of 11.11% in each family. of weeds (Figure 1).

The diversity of spontaneous plant species found in Amazonian spinach cultivation is common in vegetable plantations. Organic cultivation systems in vegetable crops are characterized by having a high diversity of spontaneous plant species, with interaction and negative influence on cultivated plants, mainly due to the fact that weeds have a facilitated ecology and diversified propagation, enabling rapid colonization and long-term longevity. for propagules, these being great competitive advantages (TESTANI et al., 2019; SOUZA et al., 2023).

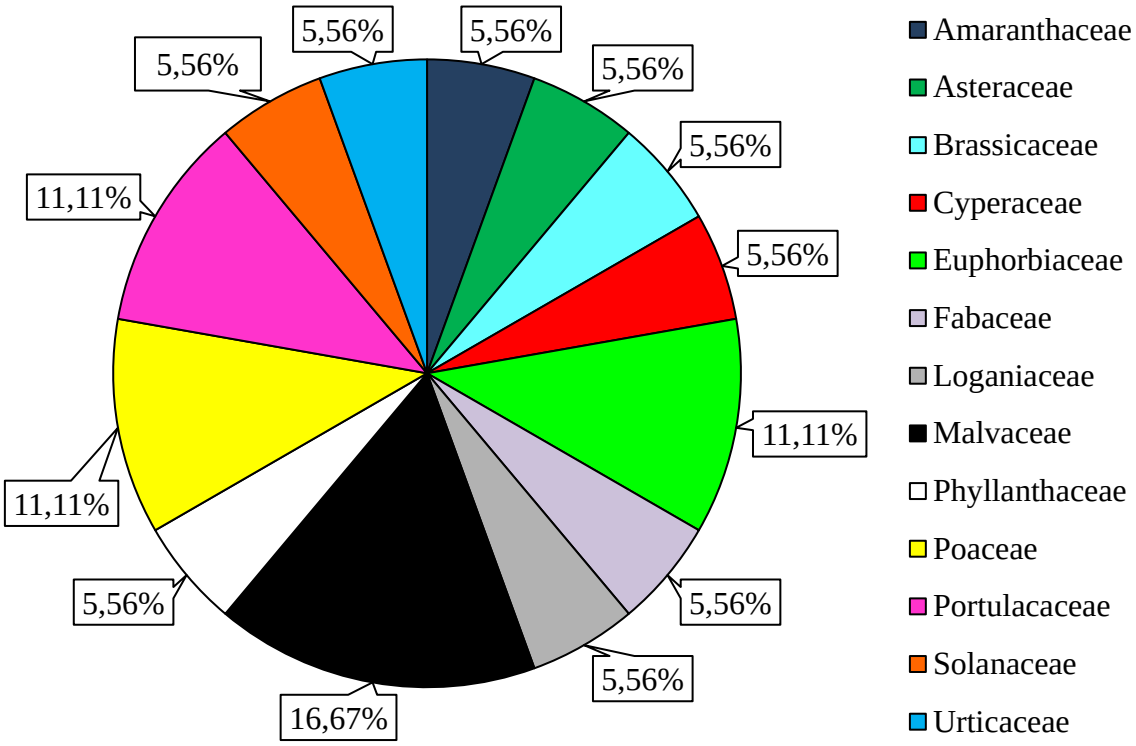
Table 1 - Families, classes, botanical species and popular name of spontaneous plants in organic Amazon spinach cultivation in alternative soil covers.

Family	**Species**	**Common name**	**Class**
Amaranthaceae	*Amaranthus blitum* L.	Caruru	Dicotyledon
Asteraceae	*Pectis elongata* Kunth	Small lemon balm	
Brassicaceae	*Cleome aculeata* L.	Mussambê	
Euphorbiaceae	*Euphorbia hirta* L.	Santa Luzia Herb	
	Acalypha alopecuroidea Jacq.	Cat's tail	
Fabaceae	*Senna obtusifolia* (L.) H. S. Irwin & Barneby	Kills pasture	
Loganiaceae	*Spigelia anthelmia* L.	Roundworm herb	
Malvaceae	*Sidastrum micranthum* (A.St.-Hil.) Fryxell	Black mauve	
	Sida acuta Burm.f.	Broom clock	
	Abelmoschus esculentus (L.) Moench.	Okra	
Phyllanthaceae	*Phyllanthus amarus*	Break stone	
Portulacaceae	*Portulaca oleracea* L.	Purslane	
	Talinum paniculatum (Jacq.) Gaertn.	Major gomes	
Solanaceae	*Fisalis Angulata* L.	Camapu	
Urticaceae	*Urtica dioica* L.	Nettle	
Cyperaceae	*Cyperus difformis* L.	Nutsedge	Monocotyledon
Poaceae	*Urochloa decumbens* R. D. Webster	Brachiaria	
	Digitaria horizontalis Willd.	Crabgrass	

The most prominent families in the cultivation area were Malvaceae, with 16.67% of the species, Poaceae, Portulacaceae and Euphorbiaceae, covering 11.11% of the spontaneous plant species found, respectively (Figure 1). The families found in this study are often found in other agricultural areas with organic cultivation, thus being included in the main groups of spontaneous plants present in vegetable cultivation, such as in the

cultivation of chives (AMORIM; MESQUITA, 2019), intercropping of cabbage and okra (SACKSER et al., 2021) and carrot (SOUZA et al., 2023).

Figure 1 - Percentage of botanical families found in an organic spinach cultivation area in the Amazon under alternative soil covers.



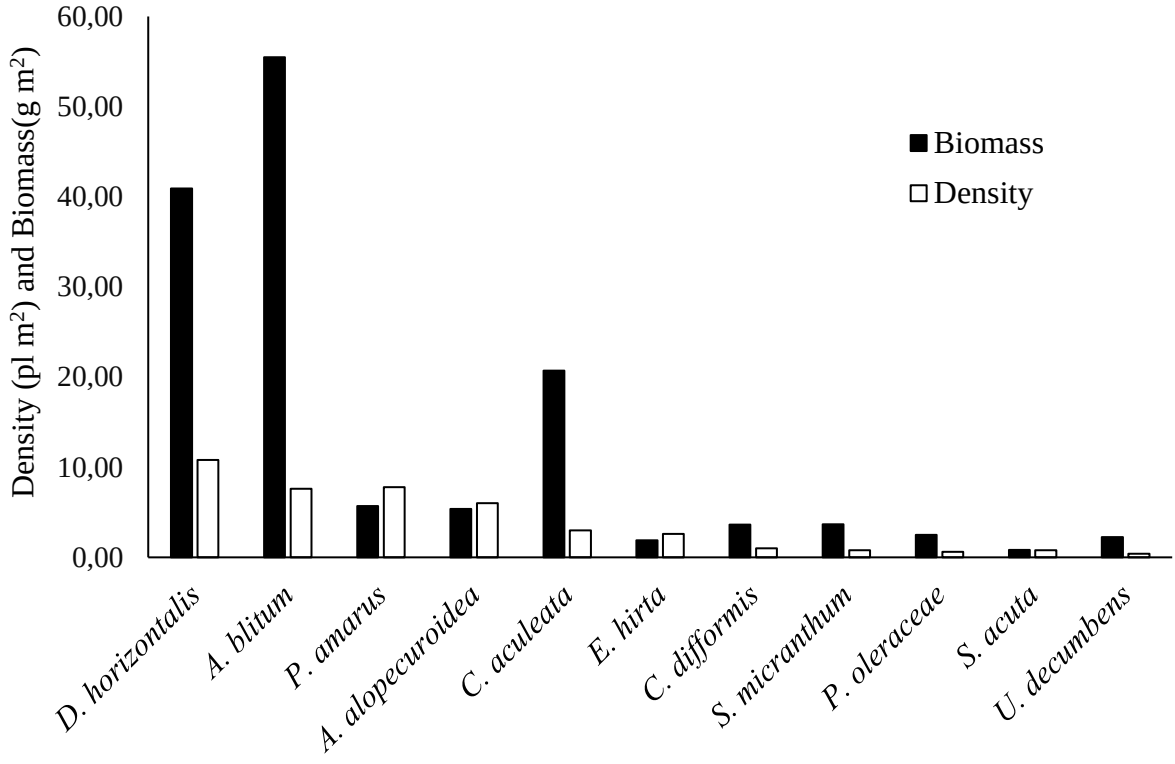
The highest percentage of species in the botanical families highlighted in this study can be explained in part by their ecology, history of use and management of the cultivation site, in addition to the biology of the species, which have a large quantity of diaspore production, which facilitates their dissemination and consolidation in environments. The biology of some spontaneous plants makes them resist the harsh environments and achieve greater success in their propagation. Many of these characteristics that facilitate their colonization are the adaptive mechanisms, such as producing stolons, which cutting does not eliminate the plant, for example of nutsedge (*Cyperus difformis* L.) (ARAÚJO NETO; FERREIRA, 2019; BARROSO; MURATA, 2021).

The classification of species into classes helps to understand their biology, such as their seed dispersal. Plants classified as dicotyledons were predominant in the organic cultivation of spinach in the Amazon, as well as other surveys carried out in cultivations of vegetable species, which may be an example of their ecology of facilitated multiplication,

as in the species found in lettuce cultivation (SILVA et al., 2018), chives (AMORIM et al., 2019), barley and zucchini (TESTANI et al., 2019) and carrots (SOUZA et al., 2023).

The species with the highest densities at the cultivation site were mattress grass (*D. horizontalis* - 10.80 pl m^{-2}), stone crusher (*P. amarus* - 7.80 pl m^{-2}), pigweed (*A. blitum* - 7.60 pl m^{-2}) and the cat's tail (*A. alopecuroidea* - 6.00 pl m^{-2}). However, higher biomasses were found in caruru (*A. blitum* - 55.49 g m^{-2}), mattress grass (*D. horizontalis* - 40.91 g m^{-2}), mussambê (*C. aculeata* - 20.72 g m^{-2}) and stone breakers (*P. amarus* - 5.68 g m^{-2}) (Figure 2).

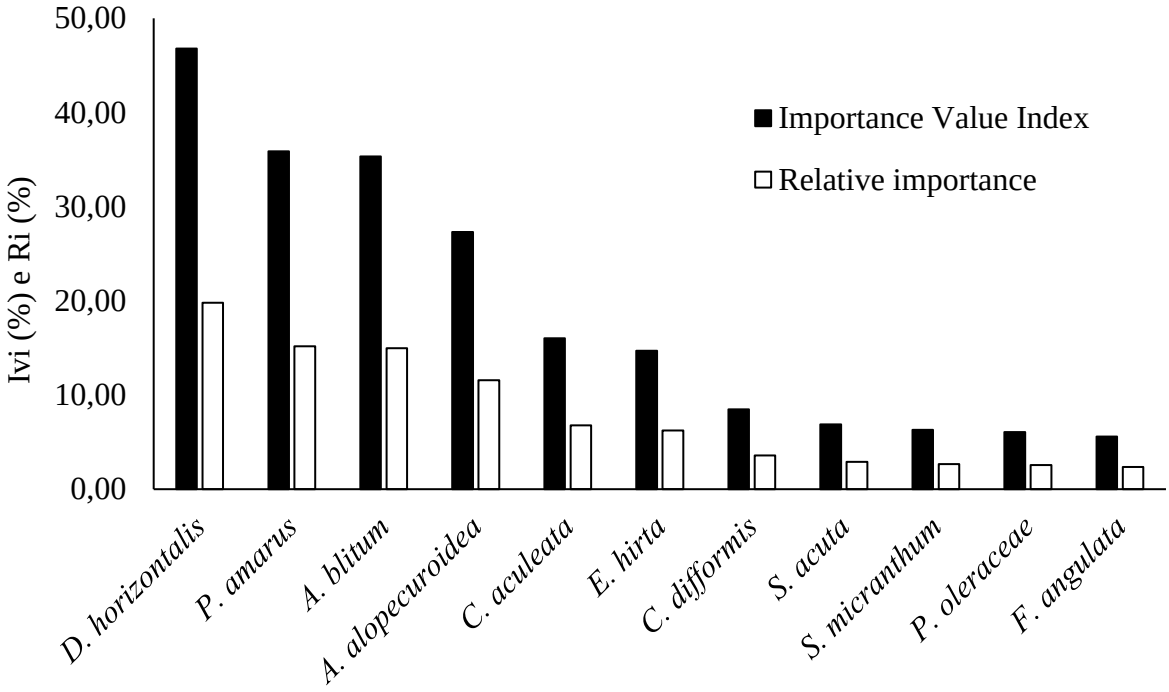
Figure 2 - Plant density (plants m^{-2}) and biomass yield of the main spontaneous plants in organic Amazon spinach cultivation in alternative soil covers.



The species mentioned with the highest plant densities and biomass in the organic cultivation of spinach in the Amazon, present in their biology ease of propagation, as they have dissemination and germination structures for a wide range of environments. Furthermore, it should be noted that some of these species can be propagated vegetatively or seminal. Furthermore, the species with greater biomass and density in the cultivation area (*D. horizontalis* and *A. blitum*) are common in vegetable crops, and their main characteristic is the production of a large quantity of propagules, forming a large and long-lived seed bank (MOREIRA; BRAGANÇA, 2010a; GIORIA et al., 2023).

The importance value index and relative importance index show the same behavior for the species, although the Ivi groups the variables (Rd, Rf and Rdm), it is important to observe this index to understand the importance that each species occupies in the community, and thus the possibility to explore available resources. The species *D. horizontalis, P. amarus, A. blitum* and *A. alopecuroidea* remain the most important within the community of weeds in spinach cultivation in the Amazon, representing a total importance of 61.49% (Figure 3).

Figure 3 - Importance value index (IVI - %) and relative importance (IR - %) of the main spontaneous plants in organic Amazon spinach cultivation in alternative soil covers.



The invasive species found in this study were verified in other studies, causing interference in the productivity of vegetable crops, such as carrot cultivation, in which the species *D. horizontalis* contributed significantly to lower productivity (REGINALDO et al., 2021; SOUZA et al., 2023), as well as the species *A. blitum*, which has the phenological characteristic of rapid reproduction of a large quantity of seeds, which form a seed bank that can remain viable for a long period of time, just like the other representatives of this genus, observed in several crops, such as peppers (ULJOL et al., 2018), chives (AMORIM; MESQUITA, 2019) and carrots (SOUZA et al., 2023).

The highest densities and relative frequencies were found in the species *D. horizontalis, P. amarus, A. blitum* and *A. alopecuroidea*, respectively, representing a total

density of 73.52% and frequency of 58.02% in the spontaneous community (Table 2). Observing the characteristics of reproduction and establishment of the mentioned species, the conditions of soil preparation through disturbance, with incorporation of organic matter obtained from an external source on the site, irrigation and availability of light, favored the greater density of these plants in spinach cultivation. of the Amazon (MOREIRA; BRAGANÇA, 2010a; BARROSO; MURATA, 2021).

Table 2 - Relative density (Dr - %), relative frequency (Fr - %), relative abundance (AbR - %) and relative dry mass (MsR - %) of the main weeds in organic Amazon spinach cultivation in alternative soil covers.

Species	**Rd (%)**	**Rf (%)**	**Rab (%)**	**Rdm (%)**
D. horizontalis	24,66	18,52	9,92	27,16
P. amarus	17,81	14,81	8,96	3,77
A. blitum	17,35	14,81	8,73	36,84
A. alopecuroidea	13,70	9,88	10,34	3,56
C. aculeata	6,85	6,17	8,27	13,76
E. hirta	5,94	6,17	7,17	1,25
C. difformis	2,28	4,94	3,45	2,42
S. acuta	1,83	3,70	3,68	0,54
S. micranthum	1,83	2,47	5,51	2,44
P. oleraceae	1,37	3,70	2,76	1,65
F. angulata	1,37	1,23	8,27	0,74

For the relative abundance of invasive species, higher values were verified for the same species observed in density and relative frequency, however, changing the order of importance in this parameter, it was observed that the abundance verifies the species considering the total number of individuals and only the plots that are observed its presence. The species were most important in *A. alopecuroidea, D. horizontalis, P. amarus and A. blitum*, respectively, totaling a total abundance in the community of 37.95% (Table 2).

Relative biomass presents the percentage of dry mass of each species of invasive plants in the study area, with the species *A. blitum* (36.84%), *D. horizontalis* (27.16%) and *C. aculeata* (13.76%). %) standing out in the study with the largest masses, representing a total percentage of 77.76% of the dry mass of spontaneous plants in the study area (Table

2). The species *A. blitum* and *D. horizontalis* stood out with the highest percentages of mass, an expected result, considering their plant density. However, the species *C. aculeata* stands out, as it presented a low density of individuals, however high biomass, characteristic of individuals of the species, which present rapid growth and colonization of space, as suggested by its biology described by Moreira and Bragança (2010).

Spontaneous plants can cause several problems in the cultivation of vegetables and vegetables in general, especially when adequate management is not carried out, as they can interfere with production during the crucial period of competition (BUTLER et al., 2016). The phytosociological survey is a tool in which we can learn about the species of spontaneous plants in the place of cultivation and even in the region. Furthermore, we offer solutions to control and eliminate, in order to carry out economical management and reduce costs with this instrument. To do this, you need to know the plants that give you the most trouble, as well as their reproduction capabilities, growth habits, and competition tactics.

Effective weed management must mitigate the negative interference of weeds in the crop by maintaining a functional and balanced weed community. Therefore, to carry out adequate management of these species, it is essential to know the phytosociology of the species in different cultivation environments and locations, in order to establish efficient methods and mechanisms of action (ARAÚJO NETO; FERREIRA, 2019).

CONCLUSION

The Malvaceae family has the largest number of species in organic Amazon spinach cultivation.

The most important species in cultivation were *Digitaria horizontalis*, *Phyllanthus amarus*, *Amaranthus blitum* and *Acalypha alopecuroidea*.

REFERENCES

ALAM, M. A.; RAHMAT, N. A.; MIJIN, S.; RAHMAN, M. S.; HASAN, M. M. Influence of palm oil mill effluent (POME) on growth and yield performance of Brazilian spinach (Alternanthera sissoo). **Journal of Agrobiotechnology**, v. 13, n. 1, p. 40-49, 2022.

AMORIM, D. dos S.; MESQUITA, M. L. R. Floristic composition, phytosociology and weed diversity in chives (Allium schoenoprasum L.). **Revista Brasileira de Ciências Agrárias**, v. 14, n. 3, p. 1-7, 2019.

ARAÚJO NETO, S. E.; FERREIRA, R. L. F. **Agricultura ecológica tropical**. Rio Branco, AC: Clube de Autores, 2019. 169 p.

BARROSO, A. A. M.; MURATA, A. T. **Matologia: estudos sobre plantas daninhas**. Jaboticabal: Fábrica da Palavra, 2021. 547 p.

BUTLER, D. M.; BATES, G. E.; INWOOD, S. E. E. Tillage System and Cover Crop Management Impacts on Soil Quality and Vegetable Crop Performance in Organically Managed Production in Tennessee. **American Society for Horticultural Science**, v. 51, n. 8, p. 1038-1044, 2016.

GIORIA, M.; HULME, P. E.; RICHARDSON, D. M.; PYSEK, P. Why Are Invasive Plants Successful? **Annual Review of Plant Biology**, v. 74, p. 635-670, 2023.

IKRAM, E. H. K.; NASIR, W. D. N. W. M.; IKRAM, N. K. K. Antioxidant activity and total phenolics content of Brazilian spinach (Alternanthera sissoo) and spinach cultivar in Malaysia. **Malaysian Journal of Medicine and Health Sciences**, v. 18, n. 8, p. 221-229, 2022.

INSTITUTO NACIONAL DE METEOROLOGIA DO BRASIL (INMET). **Banco de dados meteorológicos. 2023**. Disponível em: https://portal.inmet.gov.br/. Acesso em: 4 set. 2023.

KINUPP, V. F.; LORENZI, H. **Plantas alimentícias não convencionais (PANC) no Brasil: guia de identificação, aspectos nutricionais e receitas ilustradas**. São Paulo: Plantarum, 2014. 768 p.

LEAL, M. L.; ALVES, R. P.; HANAZAKI, N. Knowledge, use, and disuse of unconventional food plants. **Journal of ethnobiology and ethnomedicine**, v. 14, n. 1, p. 1-9, 2018.

LORENZI, H. **Manual de identificação e controle de plantas daninhas: plantio direto e convencional**. 7. ed. Nova Odessa: Instituto Plantarum, 2014.

MOREIRA, H. J. C.; BRAGANÇA, H. B. N. **Manual de identificação de plantas infestantes: arroz**. Campinas: FMC Agricultural Products, 2010a.

MOREIRA, H. J. C.; BRAGANÇA, H. B. N. **Manual de identificação de plantas infestantes: cultivos de verão**. Campinas: FMC Agricultural Products, 2010b.

PITELLI, R. A. Estudos fitossociológicos em comunidades infestantes de agroecossistemas. **Jornal Conserb**, v. 1, n. 2, p. 1-7, 2000.

PITELLI, R. A.; BIANCO, S. Avaliações de índices fitossociológicos em comunidades infestantes de agroecossistemas. In: SILVA, J. F.; MARTINS, D. (Ed.). **Manual de aulas práticas de plantas daninhas**. Jaboticabal, SP: Funep, 2013. p. 1-7.

RADHAKRISHNAN, S.; SARAVANA BHAVAN, P.; SEENIVASAN, C.; MURALISANKAR, T.; SHANTHI, R. Effects of native medicinal herbs (Alternanthera sessilis, E clipta alba and C issus quadrangularis) on growth performance, digestive enzymes and biochemical constituents of the monsoon river prawn M acrobrachium malcolmsonii. **Aquaculture Nutrition**, v. 21, n. 4, p. 496-506, 2015.

SACKSER, G. A. B.; BARBOSA, J. A.; ECHER, M. M.; ALVES, T. N. Phytosociological survey of weeds in cultivation of leaf cabbage intercropped with okra in an organic production system. **Research, Society and Development**, v. 10, n. 2, p. e2910212071, 2021.

SILVA, C. T., FERREIRA, E. A., PEREIRA, G. A. M., FIALHO, C. T., RIBEIRO, V. H. V., & DO SANTOS, J. B. Phytosociology in organic system of lettuce production. **Horticultura Argentina**, v. 37, n. 92, p. 42-60, 2018.

SOUZA, L. G., FERREIRA, R. L. F., DE ARAÚJO NETO, S. E., UCHÔA, T. L., DA SILVA, N. M., PINTO, G. P., & DE MOURA FRANCISCO, W. Fitossociologia de plantas espontâneas em cultivo orgânico de cenoura. **Scientia Naturalis**, v. 5, n. 1, p. 262-271, 2023.

TESTANI. E.; CIACCIA, C.; CAMPANELLI, G.; LETEO, F.; SALVATI, L.; CANALI, S. Mulch-Based No-Tillage Effects on Weed Community and Management in an Organic Vegetable System. **Agronomy**, v. 9, n. 10, p. 1-17, 2019.

ULJOL, L. H. O.; BIANCO, S.; FILHO, A. B. C.; CARVALHO, L. B. Weed interference on productivity of bell pepper crops. **Planta Daninha**, v. 36, p. 1-12, 2018.