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Phytosociological survey ofspontaneous plant communitiesina conventional corn crop area in the region of Carajás,Pará, Brazil

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Abstract. The presence of spontaneous plants in agricultural cultivation areas can result in damage to the crop of interest due to competition for natural resources and allelopathy, requiring systematic monitoring for an adequate cultivationmanagement. In this way, the objective was to identify the spontaneous plant communitiesspecies in an area of a one-year fallow conventional corn crop in the southeastern of Pará state, in the Brazilian amazon. A phytosociological survey of the plants in the experimental area of the Technological Center of Family Agriculture (CETAF) was carried out, by applying the inventory square method with 1.0 m^2, randomly launched twenty times in an area corresponding to 1.1 hectare. The phytosociological parameters analyzed were frequency, relative frequency, density, relative density, abundance, relative abundance and importance value index (IRI). It was found 19 species of spontaneous plants distributed in 11 botanical families, being,Euphorbiaceae (4), Asteraceae (3),Amaranthaceae (2) and

Poaceae (2) the most representative in numbers of species sampled. The most important species were *Sorghum arundinaceum* (IRI = 55.70),*Commelinabenghalensis* (IRI = 47.78) and *Synedrellanodiflora* (IRI = 42.39). A high diversity of spontaneous plants was verified, emphasizing the need for phytosociological surveys for the definition of integrated control practices in face of the type of cultivation system adopted.
Keywords: Floristic composition, Taxonomy, Importance value index.

Introduction

Spontaneous plants are considered those vegetable species that arise naturally in the agro-ecosystem to occupy available ecological niches (SOUZA; REZENDE, 2006) and there is still no knowledge if they are causing interference in the crop of economic interest (SUGASTI; JUNQUEIRA; SABOYA, 2012).

However, there are several forms of interference in plant development of the crop of interest, such as through allelopathy, with toxic, stimulating or innocuous allelochemicals for other plant species (DEUBER, 2003) or by competition, either by removing or reducing one or more factors necessary for the growth and development of both species, such as light, water, nutrients and physical space (LORENZI et al., 2014, SANTOS et al., 2019; GAZZIERO et al., 2019).

Since the weed communities can vary their composition and structure depending on the type and intensity of cultivation practices (KRENCHINSKI et al., 2015), for the establishment of an efficient integrated weed management program, with indication of one or more control methods, the identification of the species that occur in agricultural areas is essential (FONTES; SHIRATSUCHI, 2005), even though when considered the financial and environmental costs of using pesticides (KRENCHINSKIet al., 2015).

In this way, the objective of this study was to identify the spontaneous plant species present in an area of a one-year fallow conventional corn crop in the southeastern of Pará state, in the Brazilian amazon.

Materials and Methods

Experimental Area

The local of study was in an experimental crop production area belonging to the Technological Center of Family Agriculture (CETAF), a supplementary agency of the Municipal Department of Rural Production of the municipality of Parauapebas, in the southeastern of Pará state, Brazil (06º 03' 30" S; 49º 55' 15" W), as shown in Figure 1.

Sampling method and botanic taxonomy

A floristic inventory was conducted using the inventory square method (BRAUN-BLANQUET. 1979) in an area corresponding to 1.1 hectare, with a history of three consecutive years of conventional corn planting (2015, 2016, 2017) and which had been fallow for about one year (2018).

In the field, a 1.0 x 1.0 m (1.0 m^2) sampling frame was randomly cast 20 times in the evaluated area. according to the methodology of Domingos and Laca-Buendia (2010), totaling a sampled area of 20m^2. The plant species in the area delimited by the frame were sectioned at ground level (Figure 2), transported to the laboratory, and taxonomically identified through specialized literature (CARDOSO et al., 2013;CRUZ et al., 2009).

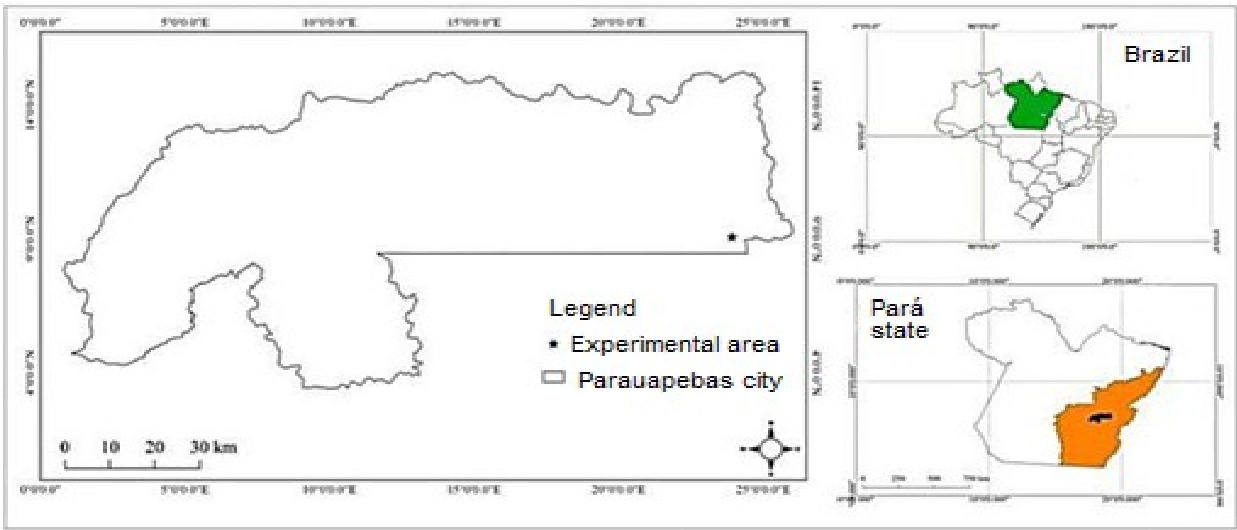

Figure 1.Location map of the study area in the municipality of Parauapebas, Pará state, Brazil.

Figure 2.Sampling of plants by the inventory square method.

From the data obtained it was possible to calculate density and relative density (CURTIS; MCINTOS, 1950),frequency (MARTINS, 1978). relative frequency, abundance, relative abundance and relative importance value index (MUELLER-DOMBOIS; ELLEMBERG, 1974; INOUE et al., 2013), according to the following expressions:

Frequency (F) = (number of launched frames that contain the specie)/(total number of frames launched in the area);

Relative Frequency (RF) = (Frequency of the specie × 100) / (total frequency);

Density (D) = (total number of individuals per species) / (total area sampled);

Relative Density (RD) = (density of the specie x 100) / (total density of all sampled species);

Abundance (A) = (total number of individuals of the specie) / (total number of squares that contain the given specie);

Relative Abundance (RA) = (abundance of the specie x 100) / (total abundance of all species);

Index of relative importance values(IRI)=(RF+RD+RA).

Results and discussion

In Table 1 are found the values of the index of importance value of the identified species and in Table 2, the botanical families, the respective common Brazilian names of the species found, their mechanisms of reproduction and life cycle.

The Importance Value Index (IRI), which weighs on the integration of partial variables, combining them into a simpler and unique expression, the relative importance of each species, so it has been considered the most suitable parameter for phytosociological inventories (LAMPRECH, 1964). In this sense, the most important species found, based on the value index of importance (IRI) higher than 40%, according to Fontes and Shiratsuchi (2005), were *Sorghum arundinaceum* (55.70%), *Commelinabenghalensis* (47.78%), *Synedrellanodiflora* (42.39%) and unidentified specie (42.14%). The reason that plant species was not identified refers to the juvenility of the botanical materials collected in the field, which did not present morphological structures that could characterize their distinction and grouping to a taxon, implying in the systematics of this component.

The parameters that most influenced the IRI of *S.arundinaceum*, *C.benghalensis* and the unidentified species were the RF and RD (Table 1), while for *S.nodiflora*, it was the RA (18.07%).

Although *C. benghalensis* presented the highest frequency, it was *S. arundinaceum* that showed the highest density (D) and relative density (Rd), being respectively, 59.10 plants m^{-2} and about 27.06% of total plants sampled, while *C.*

benghalensis showed D corresponding to 48.85 plants m^{-2} and Rdto 22.37%. These species together correspond to almost half of the total plants sampled in this floristic survey, corresponding to a total of 2,159 plants (49.43%). For abundance (A) and relative abundance (RA), the most representative species were, in descending order: *S.arundinaceum* (A = 62.17; RA = 17.72),*C.benghalensis* (A =48.85; RA = 13.92),*Synedrellanodiflora* (A = 63.42; RA = 18.07),*Celosia argentea* (A = 53.00; RA =15.10) and the unidentified specie (A = 43.37; RA = 12.36).

The *C. benghalensis* is an herbaceous, perennial species that grows throughout the country and installs itself in cultivated areas, abandoned lands, vegetable gardens, orchards, and gardens, with a preference for rich, dry or humid soils and good exposure to light MOREIRA; BRAGANÇA, 2011) and it is possible to emphasize that these plant species present perennial life cycle (Table 2), which enables these plants to remain propagating in the environment where they grow. Furthermore, *C. benghalensis* presents asexual and sexual reproductive mechanisms (MOREIRA; BRAGANÇA, 2011) and it has favored its propagation and permanence in agricultural environments, even with mechanical control of weeds by harrowing, in which the propagules, even when cut, regrow, and form a new plant.

Table 1. Values of frequency, relative frequency, density, relative density, abundance, relative abundance and relative importance value index of the spontaneous plant community present in anone-year fallow corn production area.

Specie	Q -	NT -	F -	RF %	D plant m^{-2}	RD %	A -	RA %	IRI %
Sorghum arundinaceum(Desv.) Stapf	19	1,182	0.95	10.92	59.10	27.06	62.21	17.72	55.70
*Commelinabenghalensis*L.	20	977	1.00	11.49	48.85	22.37	48.85	13.92	47.78
Synedrellanodiflora (L.) Gaertn.	12	761	0.60	6.90	38.05	17.42	63.42	18.07	42.39
Unidentifiedplant specie	19	824	0.95	10.92	41.20	18.86	43.37	12.36	42.14
Celosia argentea L.	1	53	0.05	0.57	2.65	1.21	53.00	15.10	16.89
*Phyllanthus tenellus*Roxb.	17	165	0.85	9.77	8.25	3.78	9.71	2.77	16.31
*Alternanthera tenella*Colla	16	146	0.80	9.20	7.30	3.34	9.13	2.60	15.14
Urochloadecumbens(Stapf) R. D. Webster	16	34	0.80	9.20	1.70	0.78	2.13	0.61	10.58
Spigeliaanthelmia L.	13	29	0.65	7.47	1.45	0.66	2.23	0.64	8.77
Ipomoea triloba L.	12	35	0.60	6.90	1.75	0.80	2.92	0.83	8.53
Sebastianiacorniculata(Vahl) Mull. Arg.	10	46	0.50	5.75	2.30	1.05	4.60	1.31	8.11
Aeschynomenedendiculata Rudd	6	41	0.30	3.45	2.05	0.94	6.83	1.95	6.33
*Emilia fosbergii*Nicolson	1	17	0.05	0.57	0.85	0.39	17.00	4.84	5.81
Ecliptaprostrata (L.) L.	2	26	0.10	1.15	1.30	0.60	13.00	3.70	5.45
Mesosphaerumsuaveolens (L.) Kuntze	5	23	0.25	2.87	1.15	0.53	4.60	1.31	4.71
Hemiscola aculeata (L.) Raf.	1	3	0.05	0.57	0.15	0.07	3.00	0.85	1.50
Jatropha mollissima(Pohl) Baill	2	2	0.10	1.15	0.10	0.05	1.00	0.28	1.48
Acalypha communis Müll. Arg.	1	2	0.05	0.57	0.10	0.05	2.00	0.57	1.19
Euphorbia heterophylla L.	1	2	0.05	0.57	0.10	0.05	2.00	0.57	1.19
Total		4,368	8.70	100.00	218.40	100.00	350.98	100.00	300.00

Q = number of frames with a given species, TN = total number of a given species, F = frequency, RF = relative frequency, D = density, RD = relative density, A = abundance, RA = relative abundance and IRI = index of relative importance values.

In the phytosociological survey, 11 botanical families and 18 plant species were identified, which showed greater representativeness, based on the number of species collected, the botanical families: Euphorbiaceae (4), Asteraceae (3), Amaranthaceae (2) and Poaceae (2), while for Cleomaceae, Commelinaceae, Convolvulaceae, Fabaceae-Faboideae, Lamiaceae, Loganiaceae and Phyllanthaceae were represented by one specie each one (Table 2).

The Asteraceae is considered one of the largest families of invasive plants, but despite the richness in number of species, there is no difficulty in identifying the family, because the identification is made by the inflorescence, called chapter, with tubular, hermaphrodite or monoecious flowers and the achene-type fruits, which are usually accompanied by tufts of hyaline hair and hooks, characteristics that allow dispersal by wind and animals (MOREIRA; BRAGANÇA, 2011).

The Euphorbiaceaeis represented throughout the country by numerous annual or perennial species whose sizes range from herbaceous to arboreal, many of them are invasive, heliophytes (LORENZI et al., 2014; MOREIRA; BRAGANÇA, 2011) and occur in crop areas, causing losses in the production levels (HELVIG et al., 2020; PIASECKI; RIZZARDI, 2019; SANTOS et al., 2020; GAZZIERO et al., 2019).

It is also notable the importance of studying the floristic composition in each biome for the comprehension of each ecosystem, for example, for the same region in the Brazilian Amazon, there are distinct environments, for example, the canga of the Carajás forest, where the flora has been studied and recently a probable new specie and three new occurrences are registered for the Euphorbiacea family in the region of Serra dos Carajás, Pará, Brazil, according to Costa, Secco, and Gurgel (2018).

In this study were found four species of Euphorbiaceae:*Acalypha communis*; *Euphorbia heterophylla*; *Jatropha mollissima*and *Sebastianiacorniculata*.

in the field, *E. heterophylla*can be identified in the field by the following characteristics: it has latex, very evident heterophily in the same plant, a cup-shaped nectary gland and for it presents inflorescence consisting of flowers of separate sexes (MOREIRA; BRAGANÇA, 2010).

Table 2.Description of spontaneous plant species found in the phytosociological survey in an area of one-year fallow conventional corn crop.

Botanical family	Specie	Brazilian common name	Reproduction mechanism	Life cycle
Amaranthaceae	*Alternanthera tenella*	Apaga-fogo	Sexual	Annual or perennial
Amaranthaceae	*Celosia argentea*	Crista-de-galo	Sexual	Annual
Asteraceae	*Ecliptaprostrata*	Erva-de-botão	Sexual	Annual
Asteraceae	*Emilia fosbergii*	Serralhinha	Sexual	Annual
Asteraceae	*Synedrellanodiflora*	Botão-de-ouro	Sexual	Annual
Cleomaceae	*Hemiscola aculeata*	Mussambê	Sexual	Annual
Commelinaceae	*Commelinabenghalensis*	Trapoeraba	Sexual and asexual	Perennial
Convolvulaceae	*Ipomoea triloba*	Corda-de-viola	Sexual	Annual
Euphorbiaceae	*Acalypha communis*	Parietália	Sexual	Annual
Euphorbiaceae	*Euphorbia heterophylla*	Leiteiro	Sexual	Annual
Euphorbiaceae	*Jatropha mollissima*	Pinhão-bravo	Sexual	Annual
Euphorbiaceae	*Sebastianiacorniculata*	Guanxuma-de-chifre	Sexual	Annual
Fabaceae-Faboideae	*Aeschynomenedendiculata*	Angiquinho	Sexual	Annual
Lamiaceae	*Mesosphaerumsuaveolens*	Salva-limão	Sexual	Annual
Loganiaceae	*Spigeliaanthelmia*	Pimenta-da-água	Sexual	Annual
Phyllanthaceae	*Phyllanthus tenellus*	Quebra-pedra	Sexual	Annual
Poaceae	*Sorghum arundinaceum*	Falso-massambará	Sexual	Annual or Perennial
Poaceae	*Urochloadecumbens*	Braquiária	Sexual and asexual	Perennial

Font: Adapted of Brighenti (2010), Moreira and Bragança (2010, 2011) and Lorenzi et al. (2014)

Even it is founded in minor frequency in the experimental area, an important aspect about *E. heterophylla* has been its control, is the occurrence of resistance to molecule of glyphosate (ADEGAS et al., 2020), extensively used in agricultural fields in Brazil. In this sense, changes in farming practices can provide great benefits to the agroecosystem, with positive effects on weed control (VARGAS et al., 2017), as the correct identification and the comprehension of the dynamics of weed communities in the agricultural environment, alerting and reinforcing the need to adopt the recommended good agricultural practices, in order to efficiently preserve the different tools for weed management, contributing to the sustainability of the Brazilian agriculture currently.

Conclusion

A high diversity of spontaneous plants was verified in the area, with 19 species distributed in 11 botanical families, with the highest participation of species for Euphorbiaceae and Asteraceae consecutively, emphasizing the need for floristic compositioninventoriesin agricultural areas for the definition of integrated control practices in face of the type of adopted cultivation system.

The species *Sorghum arundinaceum* (Desv.) Stapf and *Commelinabenghalensis* L. showed the highest values for plant density and relative importance value index compared to the others identified by the phytosociological survey.

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