WEED COMMUNITY AND GROWTH UNDER THE CANOPY OF TREES ADAPTED TO THE BRAZILIAN SEMI-ARID REGION[1]

Comunidade e Crescimento de Plantas Daninhas sob a Copa de Árvores Adaptadas ao Semi-Árido Brasileiro

SILVA, P.S.L.[2], SILVA, P.I.B.[3], SILVA, K.M.B.[4], OLIVEIRA, O.F.[5], JALES, J.D.D.[6] and MEDEIROS, J.L.B.[7]

ABSTRACT - The objectives of this work were to evaluate the floristic composition and dry biomass of weeds under the canopy of seven perennial species adapted to the Semi-Arid region of Brazil, and correlate these characteristics with growth traits of the perennial species. The following perennial species were evaluated in two experiments (E1 and E2): mesquite (*Prosopis juliflora*), jucá (*Caesalpinia ferrea*), white popinac (*Leucaena leucocephala*), mofumbo (*Combretum leprosum*), neem (*Azadirachata indica*), sabiá (*Mimosa caesalpiniaefolia*) and tamarind (*Tamarindus indica*). In E1, the seven species were evaluated in a random block design with four replicates and nine plants per plot. In E2, evaluation comprised four species (mesquite, jucá, white popinac, and tamarind) in a random block design with eight replicates and nine plants per plot. A circle with an area of 1.77 m^2 was established around the trunk of each plant, two years after they were transplanted to the permanent location. The weeds collected within this circle were cut even with the ground, classified and weighed. At this time, plant height, and crown and stem diameters were evaluated in all trees of each plot. In E1 there were no differences between tree species as to weed frequency under their canopies; however, weed growth was smaller under the canopy of sabiá trees. Mesquite and sabiá had the greatest plant height and crown diameter means, but only sabiá had the greatest stem diameter. In E2, the perennial species were not different with regard to weed frequency and growth under their canopies, but mesquite had the greatest growth, as measured by plant height (with significant results for jucá as well) and crown and stem diameter.

Keywords: Caatinga, floristic composition.

*RESUMO - Os objetivos deste trabalho foram avaliar a composição florística e a biomassa de plantas daninhas sob a copa de sete espécies perenes adaptadas à região semi-árida do Brasil, e correlacionar essas características com características do crescimento das espécies perenes. As seguintes espécies perenes foram avaliadas em dois experimentos (E1 e E2): algaroba (**Prosopis juliflora**), jucá (**Caesalpinia ferrea**), leucena (**Leucena leucocephala**), mofumbo (**Combretum leprosum**), nim (**Azadirachta indica**), sabiá (**Mimosa caesalpiniaefolia**) e tamarindo (**Tamarindus indica**). Em E1, as sete espécies foram avaliadas em blocos ao acaso com quatro repetições e nove plantas por parcela. Em E2, a avaliação compreendeu quatro espécies (algaroba, jucá, leucena e tamarindo) no delineamento de blocos ao acaso com oito repetições e nove plantas por parcela. Um círculo com área de 1,77 m^2 foi estabelecido ao redor do caule de cada planta, dois anos após o transplantio dela para o local definitivo. As plantas daninhas coletadas no interior desse círculo foram cortadas rente ao solo, classificadas e pesadas. Nessa ocasião, foram avaliados os diâmetros do caule e da copa e a altura de todas as árvores de cada parcela. Em E1, não existiram diferenças entre espécies*

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[1] Recebido para publicação em 6.11.2009 e na forma revisada em 12.3.2010.

[2] Universidade Federal do Semi-Árido (UFERSA), Caixa Postal 137, 59600-970, Mossoró-RN, CNPq fellow, <paulosergio@ufersa.edu.br> (corresponding author); [3] Universidade Federal de Viçosa (doctorate program student), <pauloigor@alunos.ufersa.edu.br>; [4] Professor, Biological Sciences Dep., Universidade do Estado do Rio Grande do Norte – UERN, 59610-090, <kmbsbarbosa@yahoo.com.br>; [5] UFERSA (retired professor), <odaci@uol.com.br>; [6] Student, UFERSA, Caixa Postal 137, 59600-970, Mossoró-RN, CNPq fellow, <jdantasjales@yahoo.com.br>, [7] Student, UERN,< laerciomedeiros82@hotmail.com>.

arbóreas quanto à freqüência de plantas daninhas sob suas copas. Contudo, o crescimento das plantas daninhas foi menor sob a copa da sabiá. Algaroba e sabiá apresentaram os maiores diâmetro da copa e altura da planta, mas apenas sabiá apresentou o maior diâmetro do caule. Em E2, as espécies perenes não diferiram quanto à freqüência e crescimento das plantas daninhas sob suas copas, mas a algaroba apresentou o maior crescimento, medido pelos diâmetros da copa e do caule e altura da planta.

Palavras-chave: Caatinga, composição florística.

INTRODUCTION

The semi-arid region of Northeastern Brazil covers an estimated area of 6 to 9 x 105 km^2, which represents nearly 10% of the Brazilian territory (Brasil, 2001). The ratio between trees adapted to the Brazilian Semi-Arid Region and the herbaceous vegetation under their respective canopies is an important study subject because of at least three aspects. First, if the trees represent the crop being exploited for the production of timber, fruits, or other purposes, the adjacent herbaceous vegetation assumes the role of weeds. When not controlled, weeds reduce the growth of perennial plants, negatively influencing stem diameter and height (Toledo et al., 2000), nutrient content (Ronchi et al., 2003) and yield (Carvalho et al., 1993) of crops.

Second, the information obtained about the ratio between trees and the herbaceous community that grows under their canopy can be useful for the identification of species with weed control potential (Piña-Rodrigues & Lopes, 2001). A species associated with a smaller number or growth of weeds could be potentially useful for the control of these plants. The use of agroforestry systems in which pruning from trees is used to mulch the companion crops is an important area of research in the tropics. Plant species differ in their response to phytotoxic plant residues *Gliricidia sepium* mulch had no allelopathic effect on maize or beans but significantly decreased the population of some weed species (Obando, 1987). Mulches from *G. sepium* and *S. siamea* reduced weed density and weed biomass, while *Leucaena leucocephala* was less effective in reducing weed biomass and weed density (Kamara et al., 2000).

Finally, a third justification for studies such as the one herein reported is motivated by its connections to ecology and livestock farming. Trees of different species exert different effects on the herbaceous canopy present under the crown, in terms of composition and biomass (Harmand et al., 2003). An evaluation of the floristic composition of weeds in cultivations of tree species, either individually or in agroforestry systems, showed differences in the coefficient of similarity of weeds between the agrosystems (Souza et al., 2003). Herbaceous community growth, either under or outside the tree canopy, depends on the tree species under consideration (Menezes & Salcedo, 1999).

The objectives of this work were to evaluate the floristic composition and biomass of weeds under the canopy of seven perennial species adapted to the Semi-Arid region of Brazil, and correlate these characteristics with growth traits of the perennial species.

MATERIAL AND METHODS

Two experiments were conducted at the "Rafael Fernandes" Experimental Farm (latitude 5^o 11'S, longitude 37^o 20'W and altitude 18 m). The experimental area was fallow (without agricultural use) for at least ten years. The mean maximum temperature in the region is between 32.1 and 34.5 ºC and the minimum is between 21.3 and 23.7 ºC, with June and July as the coolest months. In view of the low latitude, the mean temperature does not present great annual variations. Since the region is located between the 500 and 700 mm isohyets, the climate, according to W. Köppen's classification, is ranked as type BSwh', that is, very hot with a summer rainy season that extends through the fall. The mean annual evapotranspiration is around 2000 mm and the mean insolation is 236 hours/month, with the driest months also being the months with the least insolation.

The relative humidity is between 60.5 and 79.1 % and the mean monthly wind speed ranges between 2.6 and 5.6 m s^{-1} (Carmo Filho & Oliveira, 1989).

The following species were evaluated: mesquite (*Prosopis juliflora*), jucá (*Caesalpinia ferrea*), white popinac (*Leucaena leucocephala*), mofumbo (*Combretum leprosum*), neem (*Azadirachata indica*), sabiá (*Mimosa caesalpiniaefolia*) and tamarind (*Tamarindus indica*). In experiment-1, the seven species were evaluated in a random block design with four replicates and nine plants per plot. In experiment-2, evaluations comprised four species (mesquite, jucá, white popinac, and tamarind) in a random block design with eight replicates and nine plants per plot.

Seed-propagated species were planted in January, 2003. The seeds were sown in black plastic bags, 32 cm tall and 25 cm in diameter, perforated in their bottom third. The bags were filled with substrate consisting of 1/3 manure and 2/3 soil. The soil was classified as a Red-Yellow Argisol, according to the Brazilian Soil Classification System (Embrapa, 1999) and as a Ferric Lixisol, according to the Soil Map of the World (Fao 1988). The soil analysis indicated: pH = 6.8; Ca = 1.80 $cmol_c^{-1}$ dm^{-3}; Mg = 0.40 $cmol_c$ dm^{-3}; K = 0.10 $cmol_c$ dm^{-3}; Na = 0.01 $cmol_c$ dm^{-3}; Al = 0.00 $cmol_c$ dm^{-3}; P = 25 mg dm^{-3}; Org. Matt. = 1.90 g kg^{-1}. The manure analysis gave: pH (water) = 8.1; Ca = 4.0 $cmol_c$ dm^{-3}; Mg = 5.5 $cmol_c$ dm^{-3}; K = 1.72 $cmol_c$ dm^{-3}; Na = 1.84 $cmol_c$ dm^{-3}; Al = 0.00 $cmol_c$ dm^{-3}; P = 76.7 mg dm^{-3}.

Transplanting was performed in March, 2003, to a soil of the same type previously referred. The seedlings were transplanted to pits measuring 60 x 60 x 60 cm. A circle with an area of 1.77 m^2 was established around the trunk of each plant, two years after they were transplanted to the permanent location, in the beginning of the rainy period. The weeds collected within this circle were cut even with the ground, classified, weighed, and taken to a forced air circulation oven adjusted to a temperature of 70 °C until constant weight was achieved. At this time, plant height, and crown and stem diameters were evaluated in all plants of each plot. The mean diameter values for the crown or stem, measured in two perpendicular directions, were considered the crown and stem diameters, respectively. Stem diameter was measured at 10 cm above the ground with a digital caliper rule.

Calculations were made for index of occurrence, defined as the ratio between the number of trees under which a given weed species was found and the total number of trees in the experiment area, and for the frequency of weed occurrence, defined as the ratio between the number of weed plants in a given plot and the total number of weed species found in the experiment area.

The data for the evaluated characteristics were analyzed by the analysis of variance method. The ratio of number of species that occurred in each tree to total number of species that occurred in the experiment area were transformed to $\arcsin\sqrt{p}$ before analysis of variance, since it is a well-known fact that proportions tend to follow a binomial, rather than a normal distribution (Zar, 1999). The coefficient of linear correlation between tree species characteristics and weed characteristics was also estimated. The statistical analyses were performed using software developed by Universidade Federal de Viçosa (Ribeiro Júnior, 2001).

RESULTS AND DISCUSSION

Although the experiments conducted were different, the fact that they were grown in neighboring areas and during the same season, planted and managed in a similar manner, suggests some comparisons (Table 1). Forty-five weed species occurred in experiment-1, while only 37 were found in experiment-2. Some weed species that occurred in experiment-2 did not occur in experiment-1 (and vice versa). In both experiments, some species occurred much more frequently than others. The species *Adenocalymma* sp. was the most frequent in both experiments, but the least frequent species were different in each experiment: *Pavonia cancellata* Cav. and *Stylosanthes viscose* Sw. were the least frequent in experiment-1, while *Boerhavia diffusa* L. and *Cenchrus echinatus* L. were the least frequent in experiment-2.

Table 1 - Index of occurrence (ratio between the number of trees under which the weed species was found and the total number of trees in the experiment area) of weed species under the canopy of seven tree species in two experiments

Nº order	Weeds	Experiment 1	Experiment 2	Nº order	Weeds	Experiment 1	Experiment 2
		Index of occurrence				Index of occurrence	
1	*Adenocalymma* sp.	63.72	87.25	24	*Jacquemontia serrata* Meisn	0.00	7.17
2	*Alternanthera tenella* Colla	58.85	1.20	25	*Macroptilium lathyroides* (L.) Urban	46.90	52.19
3	*Aniseia gracillima* Choisy	17.26	5.18	26	*Macroptilium martii* (Benth) Maréchal et Baudet	10.18	0.00
4	*Aristida setifolia* H.B.K.	0.00	5.18	27	*Manihot glaziovii* Muell. Arg.	2.65	1.99
5	*Boerhavia diffusa* L.	3.10	0.40	28	*Merremia aegyptia* (L.) Urban	19.91	0.00
6	*Cenchrus echinatus* L.	1.77	0.40	29	*Neojobertia candolleana* (Mart. Ex DC) Bur. Ex K. Sch.	8.85	3.59
7	*Centrosema pascuorum* Mart. Ex Benth.	39.82	3.98	30	*Panicum maximum* Jacq.	10.62	1.20
8	*Chaetocalyx* sp.	28.76	29.48	31	*Pavonia cancellata* Cav.	0.44	5.98
9	*Chamaecrista* sp.	41.59	27.89	32	*Piptadenia moniliformis*	1.33	3.19
10	*Chamaecrista* sp.	12.39	1.59	33	*Richardia grandiflora* (Cham. Et Schlecht.)	0.88	0.00
11	*Corchorus hirtus* L.	0.00	0.80	34	*Schranckia leptocarpa* D.C.	34.96	11.16
12	*Croton glanoulosus* Muell. Arg.	1.77	0.00	35	*Senna obtusifolia* (L.) H.S. Irwin et R.C. Barneby	12.39	0.00
13	*Croton obatus* L.	1.33	0.00	36	*Sida* sp.	1.77	0.80
14	*Desmodium glabrum* (Mill.) D.C.	8.41	2.79	37	*Sida rhombifolia* (L.)	9.29	0.00
15	*Digitaria sanguinalis* (L.) Scop.	3.54	0.40	38	*Spermacoce verticillata* L.	6.19	64.94
16	*Diodia teres*	23.01	14.34	39	*Stylosanthes viscose* Sw.	0.44	4.78
17	*Evolvulus ovatus* M.L. Fernalo	27.43	54.58	40	*Triunfetta longicoma* St. Hil.	2.21	21.91
18	*Froelichia humboldtiana* (Roem. et Schult.) Seub	14.60	19.92	41	*Turnera sp.*	5.31	3.98
19	*Hybanthus ipecacuantia* Vent.	3.54	8.37	42	*Turnera ulmifolia* L.	18.58	7.97
20	*Hyptis suaveolens* L.	0.00	3.59	43	*Urochloa mosabicensis* (Hackel.) Dardy	2.65	1.20
21	*Ipomoea asarifolia* Roem et Schult	15.49	0.00	44	*Waltheria indica* L.	7.52	13.55
22	*Ipomoea bahiensis* Willd. Ex Roem. Et Schult.	27.43	18.73	45	*Zornia gemella* (Willd.) Vo g.	3.98	0.80
23	*Jacquemontia densiflora* (Meisn.) Hall. F.	2.65	12.35	-	-	-	

There were variations in the number and type of species verified in the same block of experiment-1 (Table 2). For example, 20 species occurred in plots involving mofumbo and mesquite in the first block, but species type matching was only 70%. That is, of all 20 species, only 14 occurred simultaneously in both of the plots mentioned. On the other hand, only 12 species occurred in the plot involving tamarind, and 25 species were found in the plot containing neem in that block. Similar observations can be made for the other blocks. On average, the smallest number of species was found in block 3 (16 species), and the highest occurred in block 4 (almost 20 species). Similar observations can be made for the data in experiment-2 (Table 3).

There were no differences between tree species for weed frequency under their canopies in experiment-1, but weed growth was smaller under the canopy of sabiá trees (Table 4). Mesquite and sabiá had the greatest plant height and crown diameter means, but only sabiá had the greatest stem diameter (Table 4). Apparently no relation existed between tree and weed characteristics. For example, mesquite and sabiá showed the same plant height and crown diameter, but were different with regard to weed growth under the canopy, as measured by dry matter. Mesquite and tamarind, which were quite different for crown diameter, did not differ in relation to weed growth. It was not evaluated the biomass of the weeds species individually. For this reason, it was not possible to determine the influence of tree species on specific growth of each type of weed.

In experiment-2, the perennial species were not different with regard to weed frequency and growth under their canopies, but mesquite had the greatest growth, as measured by plant height (with significant results for jucá as well) and crown and stem diameter (Table 5).

In addition to the harmful tree shading effect on the weeds that grow under the canopy, some trees also exert allelopathic effect on them (Saario et al., 2002). On the other hand, trees can be beneficial to the weeds by improving the chemical, physical, and biological properties of the soil under the canopy (Buresh & Tian, 1998). Nutrient supply would increase by "capturing" nutrients from the soil layers below the root system of weeds. These nutrients become available for the weed species in the form of litter from tree branches and leaves. The increased supply of nutrients would also occur by a reduction in leaching and by the biological fixation of nitrogen. The availability of nutrients would increase via increased nutrient cycling and the conversion of nutrients to more labile forms. Greater soil water availability can be maintained under the trees due to rainwater interception and redistribution, reduction in evapotranspiration, and greater infiltration. Improvements can also be achieved in soil density and porosity, as well as in water distribution and infiltration into the soil. The decomposition of soil organic matter and plant residues is controlled by the soil biota, particularly by the macrofauna (Tian et al., 1992). The application of tree residues increases the populations of earthworms, termites, and ants (Tian et al., 1993).

With regard to the number and species of weeds that grow under a certain tree species,

Table 2 - Weed distribution in the experiment-1 area (the number next to the name of each tree represents the number of species in each plot, while numbers below the name of each species correspond to the numbers of species listed in Table 1)

Blocks			
1	2	3	4
Sabiá (18)	Jucá (19)	Neem (17)	Mesquite (22)
1, 2, 7, 9, 10, 14, 16, 19, 22, 25, 26, 28, 29, 30, 34, 35, 37, 42	1, 2, 7, 8, 9, 10, 14, 15, 16, 18, 21, 22, 25, 26, 28, 29, 34, 37, 42	1, 2, 6, 7, 8, 9, 16, 17, 20, 22, 25, 28, 30, 34, 37, 41, 42	1, 2, 3, 7, 8, 9, 16, 17, 18, 21, 22, 23, 25, 29, 30, 33, 34, 37, 38, 42, 43, 44
White popinac (19)	Mesquite (19)	Mesquite (19)	Neem (20)
1, 2, 3, 7, 8, 9, 10, 14, 21, 22, 25, 26, 28, 29, 30, 34, 41, 42, 44	1, 2, 8, 9, 10, 13, 14, 16, 20, 21, 22, 25, 28, 30, 34, 37, 38, 42, 43	1, 2, 6, 7, 8, 9, 10, 14, 16, 17, 21, 22, 25, 28, 30, 34, 36, 37, 42	1, 2, 7, 9, 10, 14, 16, 17, 18, 21, 22, 25, 28, 30, 33, 34, 37, 38, 40, 44
Mofumbo (20)	Tamarind (17)	Sabiá (15)	Mofumbo (20)
1, 2, 5, 6, 7, 9, 10, 13, 14, 16, 21, 22, 25, 28, 29, 30, 34, 36, 41, 42	1, 2, 6, 8, 9, 10, 15, 21, 22, 25, 28, 29, 34, 35, 36, 42, 43	1, 2, 5, 8, 9, 10, 12, 14, 16, 17, 22, 25, 28, 34, 38	1, 2, 3, 5, 7, 8, 9, 14, 16, 17, 18, 19, 25, 29, 34, 37, 38, 40, 42
Tamarind (12)	White popinac (17)	Mofumbo (13)	White popinac (19)
1, 2, 7, 9, 12, 21, 25, 26, 28, 34, 35, 42	1, 2, 7, 8, 9, 13, 14, 17, 21, 22, 25, 28, 34, 35, 36, 41, 42	1, 2, 7, 8, 9, 12, 15, 22, 25, 28, 34, 35, 42	1, 2, 7, 8, 9, 16, 17, 18, 20, 21, 22, 23, 25, 28, 29, 34, 38, 42, 44
Mesquite (20)	Sabiá (15)	White popinac (17)	Sabiá (23)
1, 2, 6, 7, 8, 9, 10, 15, 21, 22, 25, 26, 27, 28, 30, 34, 41, 42, 43, 44	1, 2, 7, 8, 9, 15, 19, 21, 22, 25, 26, 27, 30, 42, 43	1, 2, 3, 7, 8, 9, 10, 15, 16, 17, 22, 26, 29, 30, 41, 42, 44	1, 2, 3, 7, 8, 9, 14, 16, 17, 20, 22, 23, 25, 29, 34, 35, 38, 40, 41, 42, 43, 44, 45
Neem (25)	Mofumbo (20)	Jucá (18)	Tamarind (16)
1, 2, 5, 7, 8, 9, 10, 14, 15, 16, 17, 18, 20, 21, 22, 25, 26, 27, 28, 30, 34, 41, 42, 43, 44	1, 2, 3, 5, 7, 8, 9, 14, 16, 17, 19, 21, 22, 25, 26, 29, 34, 37, 41, 44	1, 2, 3, 7, 8, 9, 10, 16, 17, 18, 22, 25, 26, 29, 37, 39, 41, 44	1, 3, 7, 8, 9, 10, 16, 17, 18, 19, 22, 25, 29, 31, 37, 45
Jucá (15)	Neem (18)	Tamarind (13)	Jucá (17)
1, 2, 3, 7, 9, 14, 16, 17, 18, 22, 25, 29, 34, 41, 44	1, 2, 3, 7, 8, 9, 10, 15, 16, 17, 18, 19, 22, 27, 32, 34, 37, 45	2, 3, 7, 8, 9, 16, 17, 18, 20, 22, 27, 30, 39	2, 3, 7, 8, 9, 16, 17, 18, 22, 23, 27, 29, 32, 38, 40, 42, 45

Table 3 - Weed distribution in the experiment-2 area (the number next to the name of each tree represents the number of species in each plot, while numbers below the name of each species correspond to the numbers of species listed in Table 1)

B[1/]	Tamarind (17)	B	Mesquite (19)	B	Jucá (13)	B	Mesquite (15)
1	1, 3, 7, 8, 9, 14, 16, 17, 18, 22, 23, 25, 31, 33, 34, 38, 42	3	1, 8, 9, 16, 17, 18, 19, 20, 23, 25, 30, 31, 33, 38, 40, 41, 42, 43, 44	5	1, 8, 9, 16, 17, 18, 19, 25, 31, 33, 38, 40, 44	7	1, 4, 8, 9, 15, 17, 18, 22, 24, 25, 31, 38, 40, 42, 44
	White popinac (21)		White popinac (19)		Mesquite (17)		Jucá (15)
	1, 2, 3, 7, 8, 9, 10, 14, 16, 17, 18, 20, 22, 23, 25, 34, 38, 39, 41, 42, 44		1, 8, 9, 10, 16, 17, 18, 19, 20, 22, 23, 25, 31, 34, 38, 39, 40, 42, 44		1, 2, 8, 9, 16, 17, 18, 23, 24, 25, 29, 31, 38, 40, 41, 43, 44		1, 4, 6, 8, 9, 17, 19, 22, 23, 24, 25, 34, 38, 40, 44
	Jucá (18)		Tamarind (11)		Tamarind (16)		White popinac(12)
	1, 3, 7, 8, 9, 14, 16, 17, 18, 22, 23, 25, 27, 36, 38, 40, 42, 45		1, 8, 9, 17, 18, 22, 23, 25, 34, 38, 44		1, 4, 8, 9, 16, 17, 18, 20, 22, 24, 25, 29, 38, 40, 42, 44		1, 4, 8, 9, 10, 17, 18, 24, 25, 32, 38, 40
	Mesquite (17)		Jucá (15)		White popinac (14)		Tamarind (4)
	1, 3, 9, 11, 16, 17, 20, 22, 23, 25, 29, 31, 34, 36, 38, 40, 42		1, 3, 5, 8, 9, 16, 17, 18, 19, 22, 25, 32, 34, 38, 44		1, 4, 8, 14, 16, 17, 19, 20, 25, 27, 29, 38, 39, 44		1, 16, 22, 24
2	Tamarind (18)	4	Mesquite (12)	6	Jucá (16)	8	Jucá (15)
	1, 3, 7, 8, 9, 10, 14, 16, 17, 18, 22, 23, 25, 34, 38, 40, 42, 44		1, 8, 9, 16, 17, 18, 19, 23, 25, 38, 40, 44		1, 7, 8, 9, 16, 17, 18, 19, 22, 25, 29, 38, 40, 41, 42, 44		1, 4, 8, 9, 16, 17, 18, 22, 23, 24, 25, 29, 40, 42, 44
	Mesquite (17)		White popinac (13)		Mesquite (12)		Mesquite (15)
	1, 2, 7, 8, 9, 16, 17, 18, 19, 22, 23, 25, 34, 38, 40, 42, 44		1, 8, 9, 16, 17, 19, 22, 25, 27, 29, 34, 38, 40		1, 4, 8, 9, 16, 17, 18, 25, 30, 38, 40, 44		1, 4, 8, 16, 17, 18, 19, 22, 23, 25, 32, 34, 38, 39, 40
	Jucá (15)		Tamarind (13)		White popinac (14)		Tamarind (8)
	1, 7, 8, 9, 16, 17, 18, 22, 23, 25, 26, 33, 34, 38, 44		1, 8, 9, 17, 22, 23, 25, 31, 32, 34, 38, 39, 44		1, 4, 8, 16, 17, 18, 22, 24, 25, 29, 32, 34, 38, 44		1, 16, 17, 18, 22, 22, 25, 38
	White popinac (18)		Jucá (13)		Tamarind (11)		White popinac(10)
	1, 3, 7, 8, 9, 16, 17, 18, 19, 22, 23, 25, 33, 38, 40, 41, 42, 45		1, 3, 8, 11, 17, 18, 19, 25, 27, 31, 32, 38, 44		1, 4, 8, 9, 17, 19, 24, 32, 38, 39, 43		1, 4, 8, 17, 18, 24, 29, 31, 38, 39

[1/] Block.

interspecific and intraspecific interactions may occur that influence the composition and growth of weeds as a whole, which, in turn, should depend on other environmental factors (Britton et al., 2003). Such interactions can facilitate or discourage the development of certain weed species.

The same factors that affect weed growth under the canopy of trees may influence the floristic composition of those species under the canopy, which would explain the variability in the distribution of weed species observed in the experiments upon which the present work was based (Tables 3 and 4).

Despite the apparent lack of correlation between tree crown diameter and the growth of weeds under them (Tables 4 and 5), the linear correlation coefficient between these two traits was negative in experiment-1 (Table 6). Discrepancies between analysis of variance and regression analysis are well-known, i.e., the first type of analysis may fail to indicate differences between treatments, while the regression analysis is indicating that an equation should be fitted. This suggests that discrepancies may occur between analysis of variance and correlation analysis, such as those found in the present work. The means comparison test compared the diameter means between two species, whereas the linear correlation coefficient calculation considered the values for crown diameter and dry matter of the above-ground part of weeds associated with all tree species evaluated. Besides, in addition to canopy diameter, stem diameter and plant height, other characteristics related to the canopy must be involved, such as branch distribution, number of leaves per plant, leaf area, root system, etc. *Senna siamea*, in spite of having an “open” canopy, in relation to two other tree species, showed a strong depressive effect on its herbaceous understory, probably due to its greater mass of fine roots (Harmand et al., 2003). In spite of the potential importance of crop plant architecture for weed control, especially with respect to shading effects, evaluations of luminosity under the canopy of trees were not made in the present work. Finally, the allelopathy must not be forgotten. Different tree species could influence weed growth differently under the canopy by means of allelopathy. In this respect, the allelopathic potential of sabiá on seeds of *Tabebuia alba* (Piña-Rodrigues & Lopes, 2001), white popinac on weeds (Prates et al., 2003), and perhaps of other species evaluated in the present study is worth mentioning.

There was a positive correlation between the frequencies of weed species and growth characteristics in experiment-2, as well as in

Table 4 - Frequency (number of weed species/total number of weed species in the experiment area) and dry matter in the above-ground part of weeds, plant height, stem and crown diameters of plant species adapted to the Brazilian Semi-Arid in experiment-1[1/]

Trees	Weeds		Trees		
	Frequency (%)	Dry matter ($g\ m^{-2}$)	Plant height (m)	Crown diameter (m)	Stem diameter (mm)
Mesquite	48.8 a	365.0 a	3.93 a	4.92 a	80.7 ab
Jucá	42.1 a	395.9 a	3.16 ab	2.68 b	51.9 cd
White popinac	45.1 a	338.5 ab	3.05 ab	2.76 b	76.2 bc
Mofumbo	44.5 a	366.4 a	2.75 b	3.44 b	65.1 bc
Neem	48.8 a	406.9 a	3.74 ab	2.66 b	85.3 ab
Sabiá	41.8 a	185.4 b	3.88 a	5.22 a	104.9 a
Tamarind	35.4 a	427.7 a	1.56 c	1.47 c	35.6 d
CV, %	8.3	18.9	13.8	13.8	17.0

[1/] Means followed by the same letter are not different at 5% probability by Tukey test.

Table 5 - Frequency (number of weed species/total of weed species in the experiment area) and dry matter in the above-ground part of weeds, plant height, root collar and crown diameters of four plant species adapted to the Brazilian Semi-Arid Region[1/]

Trees	Weeds		Trees		
	Frequency (%)	Dry matter ($g\ m^{-2}$)	Plant height (m)	Crown diameter (m)	Stem diameter (mm)
Mesquite	41.9 a	639.9 a	2.91 a	3.16 a	52.2 a
Jucá	40.5 a	535.2 a	3.11 a	2.62 b	41.9 b
White popinac	41.0 a	540.6 a	2.30 b	1.65 c	43.0 b
Tamarind	33.1 a	566.4 a	1.11 c	1.06 d	19.1 c
CV, %	11.9	13.5	15.1	18.5	14.4

[1/] Means followed by the same letter are not different at 5% probability by Tukey test.

Table 6 - Coefficient of linear correlation between characteristics of trees and weeds under the canopy of the trees, in two experiments

Species (trees)	Experiment-1		Experiment-2	
	Weeds		Weeds	
	Frequency	Dry matter in the above-ground part	Frequency	Dry matter in the above-ground part
Plant height	0.34^{ns}	-0.36^{ns}	0.48^{*}	0.03^{ns}
Stem diameter	0.39^{*}	-0.58^{*}	0.54^{*}	0.09^{ns}
Crown diameter	0.34^{ns}	-0.55^{*}	0.47^{*}	0.29^{ns}

$^{ns,\ *}$ = non-significant and significant at 5% probability, by the t test, respectively.

one case in experiment-1 (Table 6). Although the linear correlation coefficient not always indicates a cause-and-effect relationship between two variables, perhaps the beneficial effect that trees may have on the soil properties, favoring greater weed richness, could explain this type of correlation.

It can be concluded that in experiment-1 there were no differences between tree species as to weed frequency under their canopies; however, weed growth was smaller under the canopy of sabiá trees. Mesquite and sabiá had the greatest plant height and crown diameter means, but only sabiá had the greatest stem diameter. In experiment-2, the perennial species were not different with regard to weed frequency and growth under their canopies, but mesquite had the greatest growth, as measured by plant height (with significant results for jucá as well) and crown and stem diameter.

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