PLANTA DANINHA

SOCIEDADE BRASILEIRA DA CIÊNCIA DAS PLANTAS DANINHAS

<http://www.sbcpd.org>

ISSN 0100-8358 (print)
1806-9681 (online)

Article

Weed Interference in Okra Crop in the Organic System During the Dry Season

Interferência de Plantas Daninhas na Cultura do Quiabo Orgânico Durante a Estação "Seca"

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ABSTRACT - In organic systems during the dry season, competition of weeds with okra increases the critical period of interference of these species and yield losses. The objective of this research was to determine the critical period of weed interference in organic okra during the dry season in São Luís - MA. The experiment was conducted from October/2014 to January/2015 in randomized blocks, with four replicates. The treatments were the periods of 07, 14, 21, 28, 35, 42 days after the transplanting of the crop with control and coexistence of the infesting community. The species with the highest importance value index were *Cynodon dactylon*, *Eleusine indica*, *Amaranthus spinosus* and *Commelina benghalensis*. The CPWI was 04 to 53 days after transplanting and yield losses were 69.5%. The organic okra cropping system during the season dry should be free of weeds until the beginning of the harvest to avoid high yield loss.

Keywords: *Abelmoschus esculentus* (L.) Moench., competition, water deficit, weed community.

RESUMO - Em sistema orgânico durante a estação "seca", a competição das plantas daninhas com a cultura do quiabo aumenta o período crítico de interferência dessas espécies e as perdas de rendimento. Assim, objetivou-se neste trabalho determinar o período crítico de interferência das plantas daninhas no cultivo de quiabo orgânico durante a estação "seca", em São Luís - MA. O experimento foi conduzido de outubro/2014 a janeiro/2015 em blocos ao acaso com quatro repetições. Os tratamentos foram os períodos de 7, 14, 21, 28, 35, 42 dias após o transplantio da cultura com controle e convivência da comunidade infestante. As espécies com maior índice de valor de importância foram ***Cynodon dactylon***, ***Eleusine indica***, ***Amaranthus spinosus*** *e* ***Commelina benghalensis***. *O PCPI foi de 4 a 53 dias após o transplantio, e as perdas de rendimentos foram de 69,5%. A cultura do quiabo em sistema orgânico durante a estação "seca" deve ser livre de plantas daninhas até o início da colheita, a fim de evitar elevadas perdas de rendimento.*

Palavras-chave: *Abelmoschus esculentus* (L.) Moench., competição, déficit hídrico, comunidade infestante.

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Received: December 12, 2018
Approved: February 25, 2019

Planta Daninha 2020; v38:e020217201

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) is an important vegetable for family farmers in the humid tropics because of its heat tolerance, easy cultivation and economic return. It is a vegetable whose essential and

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Doi: 10.1590/S0100-83582020380100014

nonessential amino acids are comparable to those of soybean, which makes it important in the human diet (Law-Ogbomo et al., 2013). The fruits are consumed immature and can be used in salads, soups and stews, fresh or dried, fried or cooked. They have mucilaginous consistency after cooking, therefore they are added to different recipes, such as stews and sauces, to increase consistency (Gemede et al., 2015).

In Brazil, okra is grown in several regions, especially in the Southeast and Northeast, where it is much appreciated. In the state of Maranhão, it is the fourth most cultivated vegetable by farmers on São Luís Island, with an average yield of 2,932 kg ha^{-1} (Maranhão, 2017). Okra is mainly grown by local farmers in the conventional system; however, it can be a promising activity in an organic system because the use of mineral fertilization, which increases production costs, is reduced. Moreover, there is a growing consumer market demand for healthy foods.

Vegetable production in organic systems is a growing activity worldwide; however, weed management is one of the main constraints to this production (Sediyama et al., 2014). In this system, chemical weed control is mostly replaced with mechanical control, which stimulates the regrowth of stolons and rhizomes from weeds that have vegetative propagation (Vaz de Melo et al., 2007). In addition to mechanical control, which increases weed infestation in the organic system, Smith et al. (2010) suggested that organic systems that favor crop rotations, cover crops, and alternative sources of fertility maintain a relatively diverse pool of resources in the soil from which crops and weeds derive their nutrients. Thus, the diversity of niche sources in the organic system also contributes to high weed abundance.

Yield losses caused by weed interference in okra crops grown in the conventional cropping system range from 85% to 95% (Santos et al., 2010; Bachega et al., 2013), compared to 51% in the organic system (Santos et al., 2017). This lower loss in the organic system probably resulted from crop tolerance to weeds because of soil fertility management. Benaragama et al. (2016) pointed out that despite high weed density in the organic compared to the conventional cropping system, soil nutrient diversity resulting from crop rotations and varied input sources of organic systems can increase crop tolerance to weeds.

Another factor that may influence competition between weeds and crops in agricultural systems is the weather season in which they are developing. Olabode et al. (2010) highlighted that the response of weeds and crops to a climate season is a consequence of water availability and day length, which probably promote greater competition for water and space in the dry season than in the rainy season. These authors added that general recommendations according to the critical period of weed interference in agricultural crops cannot be the same during the seasons. However, in conventional okra cultivation, Adeyemi et al. (2016) found that only a single weeding at 28 days was sufficient to minimize weed interference on fruit weight, height and leaf area, both at the beginning and end of the rainy season.

In okra grown in the organic cropping system during the rainy season, Santos et al. (2017) determined a critical period from 12 to 36 days after emergence, but information about this period during the dry season in this system is scarce but relevant for farmers in the humid tropics to adapt the management of these species. Thus, the hypothesis of this research is that, in okra grown in the organic cropping system during the dry season, weed competition with okra increases the critical period of interference of these species and yield losses. Thus, the objective of this research was to determine the critical period of weed interference in okra grown in the organic cropping system during the dry season in São Luís, state of Maranhão, notheastern Brazil.

MATERIALS AND METHODS

The experiment was conducted in the dry season from October 2014 to January 2015, in a certified organic production area in the municipality of São Luís, state of Maranhão, located at latitude 2°37’39" S and longitude 44°11’15" W. Local climate is, in the Köppen classification, Aw ‘equatorial, hot and humid, with rainy season from January to June (average 2010 mm) and dry season from July to December (average 180 mm), annual average temperature of 26.1 °C, with variations of 30.4 °C and 23.3 °C, and average relative humidity of 88% (Instituto Nacional de Meteorologia, 2009). Figure 1 shows the climatological data on temperature (maximum and minimum, in °C) and rainfall (mm) and water balance during the experiment.

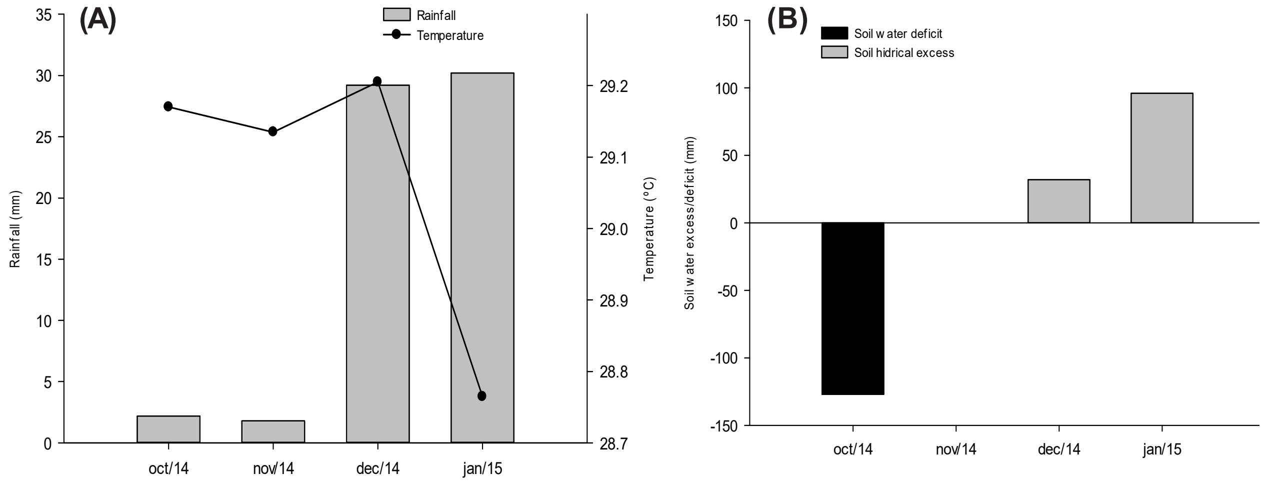

Figure 1 - (A) Average temperature and amount of rainfall and (B) water balance during cultivation of okra in an organic cropping system. São Luís, State of Maranhão, 2014/2015.

The soil is classified as Arenic Red-Yellow Dystrophic Argisol (Embrapa, 2013), sandy loam texture, with 20 dag kg^{-1} of coarse sand, 64 dag kg^{-1} of fine sand, 8 dag kg^{-1} of silt and 8 dag kg^{-1} clay, whose main chemical characteristics are shown in Table 1.

Table 1 - Chemical characteristics of the soil in the experimental site. São Luís, state of Maranhão, 2014/2015

O. M.	pH	P	K	Ca	Mg	SB	H+Al	CTC	V	K/CTC	Mg/CTC
(g dm^{-3})	($CaCl_2$)	(mg dm^{-3})	(mmol$_c$ dm^{-3})						(%)		
26	5.4	111	2.3	33	14	49.3	26	75.3	65	3.1	18.6

The soil was prepared by mowing, followed by furrowing with the help of a micro tractor. Planting fertilization consisted of 27.80 ton ha^{-1} chicken manure, 0.46 ton ha^{-1} natural phosphate, 0.023 ton ha^{-1} potassium sulfate and 0.20 ton ha^{-1} ash. Leaf fertilization was also performed at 31 days after transplantation (DAT) with bovine manure biofertilizer and sugarcane bagasse in the amount of 180 L ha^{-1}, in the proportion of 0.5 L to 20 L of water.

The okra cultivar in use was Valença, which has early maturity with flowering at approximately 40 DAT. The seeds were immersed in water for 24 hours to break dormancy, and then sown in trays to obtain the seedlings that were transplanted when they emitted two definitive leaves. Total rainfall during the experiment period was 63.4 mm (Figure 1), and water depth was 495 mm, totaling a 558.4 mm depth.

The experiment was laid out in a randomized complete block design with four replications. The experimental plots consisted of four rows 3.20 m long, 1.00 m between rows and 0.40 m between plants within rows, in a total of 12.8 m². The usable area of the plot was the two central rows, excluding 0.40 m from the ends, in a total of 4.8 m².

The treatments consisted of periods of weed control and of coexistence of okra with weeds at 7, 14, 21, 28, 35 and 42 days after transplantation (DAT). In the weed control treatments, after each established period, the emerged plants grew freely until harvest, when they were collected. In the treatments with weeds, at the end of each period, weeds were controlled through manual weeding until harvest. Weeding in the control treatments started three days after transplanting.

The weeds were evaluated by means of three random samplings in the usable area of the plot, using open metal squares of 0.50 m x 0.50 m. At each release, the aerial parts of the plants were harvested, counted, identified and dried in a forced air ventilation oven at 65-70 °C for 72 hours. Then the samples were weighed on a 0.01 g precision scale.

Weed density and dry matter were expressed as number of plants m^{-2} and grams of dry weight m^{-2}, respectively. These data from each weed population were used to determine the following phytosociological parameters: relative density, absolute and relative frequency, relative dominance and importance value index. Each of these parameters was determined after application of specific formulas, according to Mueller-Dombois and Ellemberg (1974).

The harvests started at 45 DAT with manual cutting of the fruits every two days, when they were 12 to 15 cm long, and ended at 82 DAT, in a total of 18 harvests. Data on density, weed dry matter and okra fruit yield per treatment were subjected to analysis of variance by 5% probability F test and the means were compared by Tukey's test at 5% (Barbosa and Maldonado, 2010). Then, for productivity, nonlinear regression was applied by the Boltzmann sigmoidal model (Originlab Corporation, 2002).

RESULTS AND DISCUSSION

In total, we identified 29 weed species distributed into 15 families. The monocotyledonous class was represented by 31.04% of the species, and the eudicotyledonous class, by 68.96% (Table 2). This result indicated that the eudicotyledonous class had higher weed species richness and also that, in the dry season, there was a reduction in species richness. In an organic system during the rainy season, Santos et al. (2017) found 44 weed species in an okra crop and predominance of the eudicotyledonous class. Awodoyin and Olubode (2011), in conventional okra cultivation under similar climatic conditions to those of the experiment in this research, found 31 weed species with relevance of 80.7% of the eudicotyledonous group. Therefore, regardless of cropping system, the climatic season with the largest water deficit reduces the species richness of the weed community, and the botanical group of eudicotyledonous predominates.

The relevant botanical families in terms of species richness in the coexistence treatments were Poaceae and Amaranthaceae, with three species each, and, in the weed control treatments, Amaranthaceae, with three species (Table 2). These families were also important during the rainy season in okra grown with organic matter, 12 ton ha^{-1} cattle manure (Dada and Fayinminnu, 2010) and 27 ton ha^{-1} chicken manure (Santos et al., 2017).

Weed density in the okra crop in coexistence treatments was adjusted by the quadratic regression model, with decreases from 7 DAT to 42 DAT. The highest densities were found at 7 DAT, with 344.75 plants m^{-2}, and at 14 DAT, with 314 plants m^{-2} (Figure 2A). The higher weed density at the beginning of crop development is probably due to the slow initial growth of okra, the increase of weed seeds by the manure used and the high soil nutrient supply. Santos et al. (2017), in organic okra cultivation during the rainy season with an average of 805.5 mm, also found higher population density of the weed community at 7 DAE, but with higher average values than the experimente in this research: 793.65 plants m^{-2}. Adeyemi et al. (2016), in okra grown in a conventional croppinng system with bimodal rainfall distribution, an initial 840.2 mm and a late 692 mm, cropping low density of individuals, with an average of 4.09 plants m^{-2} and 2.94 plants m^{-2}, respectively, in okra grown in coexistence with weeds. These differences in weed density between cropping systems probably resulted from the various soil nutrient sources in the organic system; however, they show that, regardless of cropping system, the weather season negatively interferes with the weed community.

Weed dry matter weight in the coexistence with treatments was also adjusted by the quadratic regression model with increases during the periods with higher values at 35 DAT, with 115 g m^{-2}, and at 42 DAT, with 107.4 g m^{-2} (Figure 2B). In okra grown in a conventional cropping system in clayey soil and amount of rainfall of 717.3 mm, Bachega et al. (2013) found weed dry matter weight accumulation at 35 DAE of 69 g m^{-2}, with an average of 207 plants m^{-2}. This result was lower than the one found in the experiment on this research, in which weed density at 35 DAT was 221.5 plants m^{-2} in a sandy loam soil with 558.4 mm water availability, which suggests higher accumulation of weed dry matter because of higher soil nutrient content in an organic croping system. Benaragama et al. (2016) have shown that low weed biomass in a given crop system may be due to lower weed density, better weed suppression or lower soil fertility.

Weed density in the control treatments was higher from 14 DAT to 21 DAT, ranging from 104.5 to 106.8 plants m^{-2}. However, as of 28 DAT, there was a decrease until the last evaluation (Figure 3A). The reduction of weed density showed that the initial control during the dry season was efficient because there was lower water availability (63.4 mm) in this season, compared to the rainy season (805.5 mm); therefore, the lower soil water availability acted as a selection factor over the weed community.

Table 2 - List of families and weed species identified in the treatments of okra in coexistence and of weed control in the okra crop grown in the organic cropping system in the dry season. São Luís, state of Maranhão, 2014/2015

Family/Species	Common name	Coexistence	Control
AMARANTHACEAE			
Alternanthera tenella Colla	Apaga-fogo	X	X
Amaranthus deflexus L.	Caruru-rasteiro	X	-
Amaranthus retroflexus L.	Caruru, bredo	-	X
Amaranthus spinosus L.	Caruru-de-espinho	X	X
Amaranthus sp.		X	X
ASTERACEAE			
Eclipta alba (L.) Hassk.	Erva-botão	X	X
Ageratum conyzoides L.	Mentrasto	X	-
CLEOMACEAE			
Hemiscola aculeata (L.) Raf.	Sojinha	X	-
CYPERACEAE			
Cyperus sp.	Tiririca	X	X
Cyperus flavus (Vahl) Nees	Tiririca	-	X
Cyperus distans L. f.	Tiririca	X	-
Cyperus sphacelatus	Tiririca	X	X
COMMELINACEAE			
Commelina benghalensis L.	Trapoeraba	X	X
EUPHORBIACEAE			
Chamaesyce hirta (L.) Millsp	Burra-leiteira	X	X
Euphorbia heterophylla L.	Amendoim-bravo	-	X
LINDERNIACEAE			
Lindernia crustacea (L.) F. Muell.		X	X
LOGANIACEAE			
Spigelia anthelmia L.	Lombrigueira	-	X
MALVACEAE			
Corchorus argutus Kunth	Toma-roça	X	X
MOLLUGINACEAE			
Mollugo verticillata L.	Capim-tapete	X	X
ONAGRACEAE			
Ludwigia octovalvis (Jacq.) PH. Raven	Cruz-de-malta	X	X
POACEAE			
Cynodon dactylon (L.) Pers.	Capim-de-burro	X	X
Eleusine indica (L.) Gaertn.	Capim-pé-de-galinha	X	X
Digitaria sp	Capim-colchão	X	X
Paspalum maritimum Trin.	Capim-gengibre	X	-
PORTULACACEAE			
Portulaca oleracea L.	Beldroega	X	-
PHYLLANTHACEAE			
Phyllanthus niruri L.	Quebra-pedra	X	X
RUBIACEAE			
Hedyotis corymbosa (L.) F. Muell	Falso-molugo	X	X
Spermacoce latifolia Aubl.	Vassoura-botão	X	-
Spermacoce verticillata L.	Vassourinha-de-botão	X	-

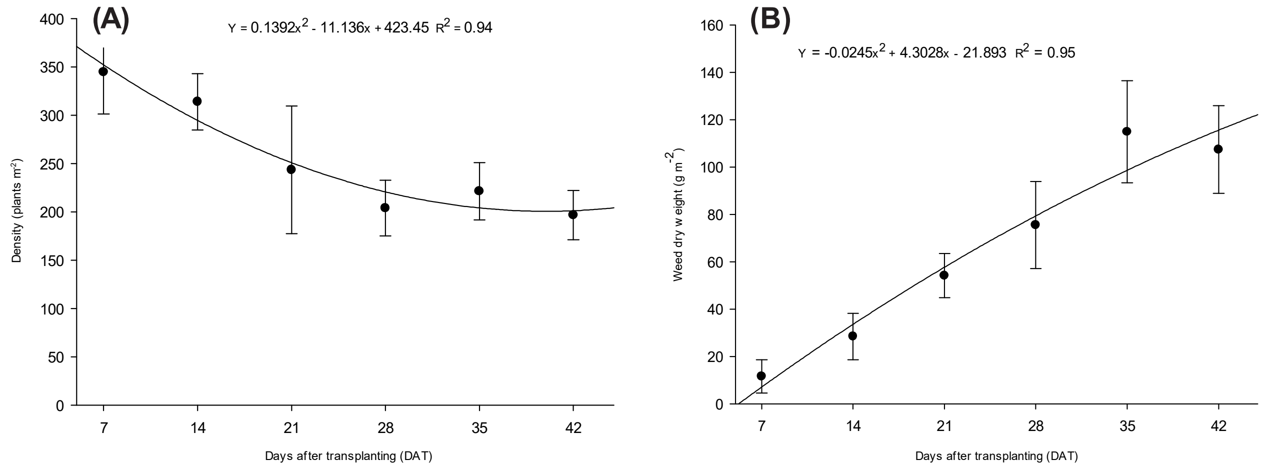

Figure 2 - Weed density (A) and dry weight (B) in the treatments of coexistence in okra grown in the organic cropping system in the dry season. São Luís, state of Maranhão, 2014/2015.

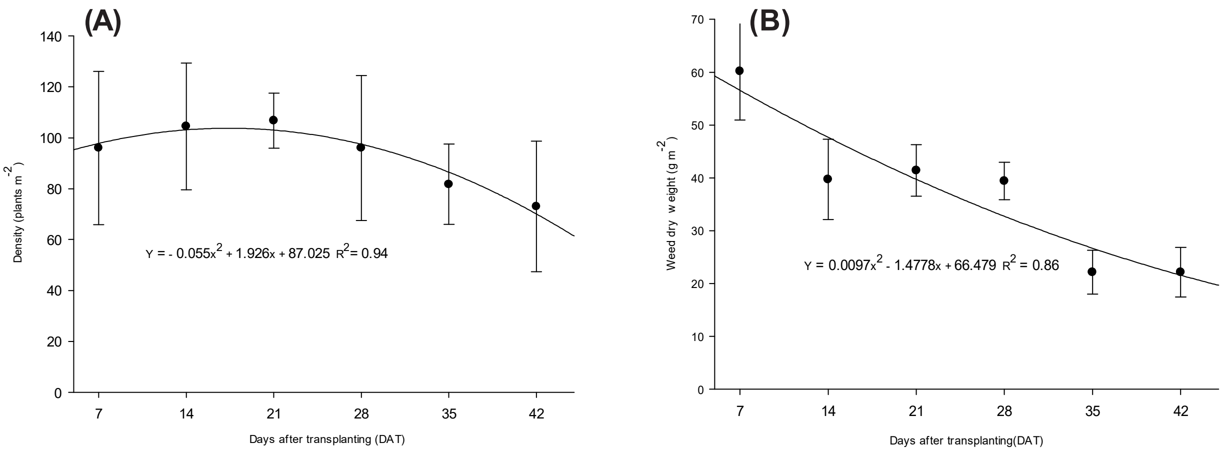

Figure 3 - Weed density (A) and dry weight (B) in the treatments of weed control in okra grown in the organic cropping system in the dry season. São Luís, state of Maranhão, 2014/2015.

Weed dry matter in control treatments decreased during the evaluation, with the highest values at 7 DAT, with 60.23 g m^{-2}, and the lowest at 35 DAT and 42 DAT, with 22.12 g m^{-2} (Figure 3B). The reduction of dry matter in the weed community resulted from an efficient weed control, which, together with water deficit in the soil in the dry season, contributed to increasing the competition for resources from the environment. In okra grown in a conventional cropping system, Olabode et al. (2010) found that the dry season decreased density and consequently dry matter of the weed *Thitonia diversifolia* during the control periods.

The species with the highest importance value index (IVI) in the weed treatments were *C. dactylon, E. indica, A. spinosus* and *C. benghalensis* (Figure 4A). The species *C. dactylon* obtained the highest IVIs during the evaluation, with values between 42.48% and 48.54%, followed by *E. indica*, whose IVI values ranged from 30.63% to 43.64%.

The predominance of *C. dactylon* is probably due to tillage, which produced fragmentation and dispersion of stolons and rhizomes, possiby leading to new tillers (Fernandez, 2003). Also, the high temperatures during the conduction of the experiment may have contributed to the higher IVI of the species, because of its tolerance to drought and photosynthesis by the C4 cycle (Kissmann and Groth, 1997), which minimizes water use. In conventional cultivation under humid tropic conditions, *C. dactylon* is one of the most relevant species (Law-Ogbomo et al., 2013).

The species *E. indica*, with type C4 photosynthetic cycle and reproduction by seeds (Kissmann and Groth, 1997), was also reported by Santos et al. (2010) in conventional okra grown in

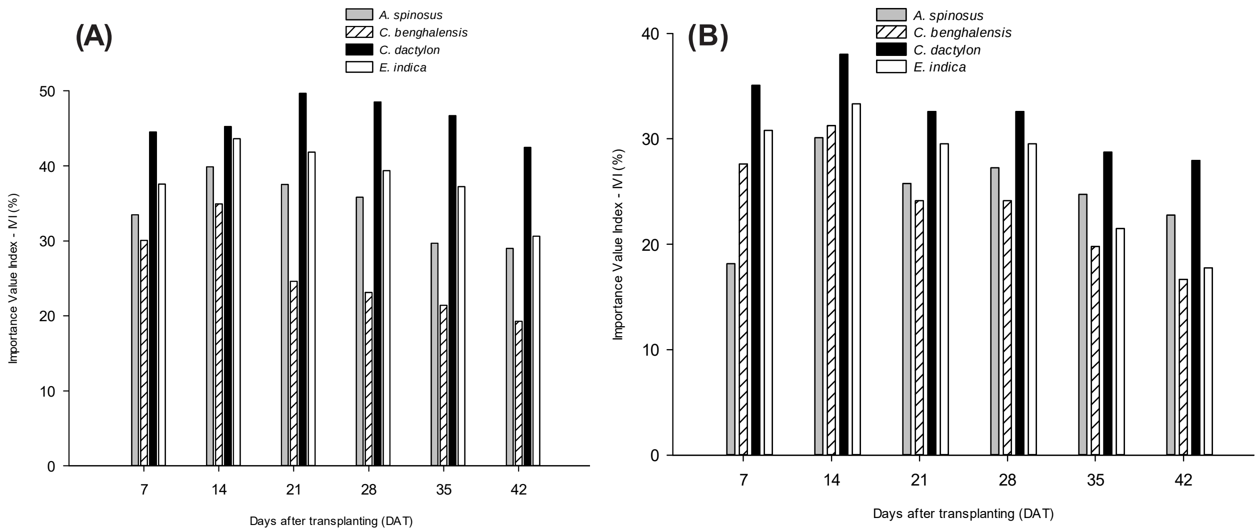

Figure 4 - Importance Value Index (IVI) of major weeds in the treatments of coexistence (A) and of weed control (B) in okra grown in the organic cropping system during the dry season. São Luís, state of Maranhão, 2014/2015.

conventional cropping system with high competitive capacity. In Nigeria, this species predominated in the rainy season in conventional okra cultivation (Law-Ogbomo et al., 2013; Adeyemi et al., 2016). The results indicate that under conditions of low rainfall, *C. dactylon* and *E. indica* species showed important or relevant competitive ability in the weed community in okra grown in an organic cropping system.

The species *A. spinosus* also registered high IVIs in the treatments in coexistence, mainly from 14 DAT to 28 DAT, with variation from 39.86% to 35.82% (Figure 4A). The presence of this species in the area hindered cropping practices and okra harvesting because of its thorns. Its spread in the dry season probably resulted from the high temperatures, which stimulated the germination of the seed bank of this species in the soil from previous crops. In contrast, Santos et al. (2017), in organic cultivation of okra during the rainy season, did not find this species among those with the highest importance value index.

Chauhan and Johnson (2009) reported *A. spinosus* as adapted to various environmental conditions in the tropics, with germination stimulated by warmer temperatures and light availability, but it was not affected under conditions of low osmotic potential. Additionally, Chauhan and Abugho (2013) found that this species is tolerant to water stress as a result of its C4 photosynthetic pathway, which minimizes water loss in hot and dry environments.

C. benghalensis showed higher IVIs at 7 DAT, with 30.09%, and at 14 DAT, with 34.94% (Figure 4A). The greater importance of this species in the initial periods of coexistence was possibly due to the branch fragments left on the soil surface after mowing, in the experimental setup. These fragments allowed the reestablishment of the species, but its gowth and development were impaired because the dry period lasted longer. Riar et al. (2016) pointed out that *C. benghalensis* presents greater reproductive aggressiveness and competitive efficiency in an environment with high nutrient content, such as organic farming systems. Webster and Gray (2008) pointed out that the mechanism by which *C. benghalensis* does not support water stress is its fibrous root system, which is close to the surface.

C. dactylon predominated in the control treatments in all evaluations, with IVI ranging from 27.95% to 38.02%. *E. indica* was also relevant from 7 DAT to 28 DAT, ranging from 30.09% to 27.83% (Figure 4B). This behavior of these Poaceae family species, *C. dactylon* and *E. indica*, showed that weed control pressure decreased their IVI compared to coexistence treatments, suggesting that the initial control was efficient in reducing the participation of these species in the weed community.

The species *A. spinosus* was also representative in the control treatments, mainly from 14 DAT to 28 DAT, ranging from 30.11% to 27.27%. *C. benghalensis* showed a similar behavior from 14 DAT to 28 DAT, with IVI ranging from 31.25% to 25.43% (Figure 4B). It is evident that these species were also negatively affected by the weed control treatments, because of the lower IVI values that were determined in the coexistence treatments. Chauhan and Abugho (2013) suggested the use of drought-tolerant and competitive crop cultivars, high sowing rate and availability of fertilizer for the crop at the right time, as management strategies to control *A. spinosus*.

The treatments with weed coexistence negatively interfered with okra crop production during the dry season in the organic system, resulting in a 4 DAT Period Before Interference (PBI), based on an established maximum loss of 5%. (Figure 5). This result indicates that the crop cannot live with the weed community during the dry season in an organic cropping system, as there is greater competitiveness for water and soil nutrients. Olabode et al. (2010) mentioned that the okra crop coexisting with the weed *Tithonia diversifolia* presented lower yield performance during the dry season, compared to the rainy season. In the dry season, coexistence did not exceed 14 days after planting, while in the rainy season, it was allowed to coexist until 28 days after planting. Dada and Fayinminnu (2010), in okra grown in the rainy season with 12 ton ha^{-1} of cattle manure, found longer coexistence with weeds until 21 days after sowing. Santos et al. (2017), in the rainy season in organic system, determined a PBI of 12 DAE. These results show greater tolerance of the okra crop to the presence of weeds in the rainy season in organic system.

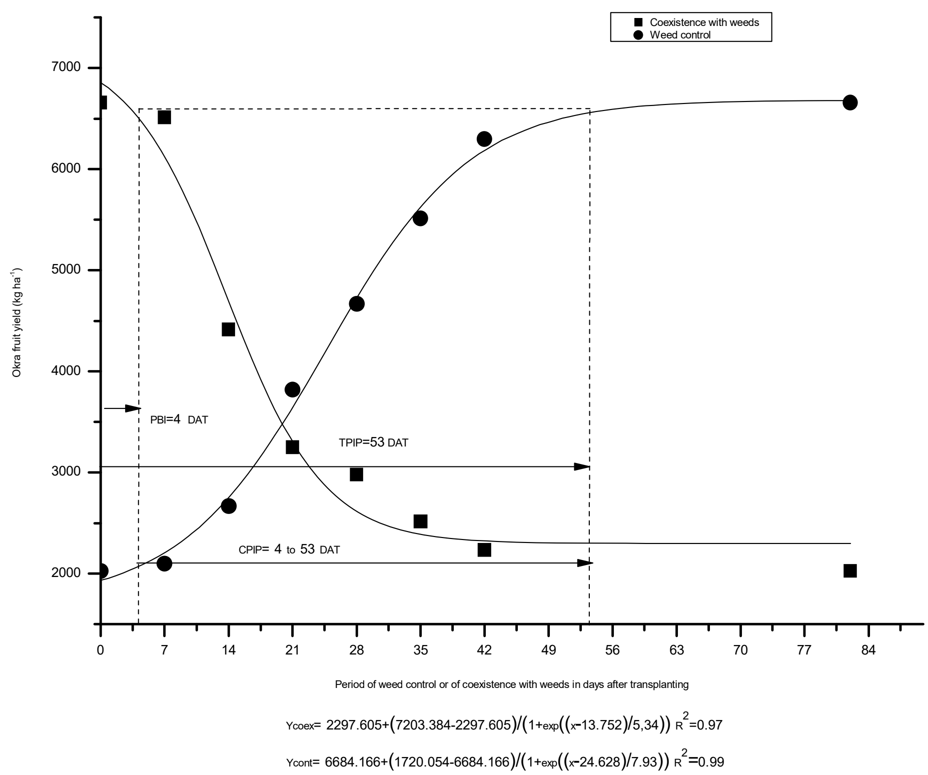

Figure 5 - Okra comercial fruit yield during the dry season in the organic cropping system and adjustment by the Boltzmann sigmoidal model according to treataments of coexistence and weed control, considering a 5% yield loss. São Luís, state of Maranhão, 2014/2015.

Regarding weed control treatments from an established maximum loss of 5%, the Total Period of Interference Prevention (TPIP) was 53 DAT, hence weeds did not affect crop yield (Figure 5). This period comprised the entire vegetative phase and the beginning of crop harvesting during the dry season in the organic system, suggesting a reduction in crop tolerance to the weed community in competition for environmental resources. Dada and Fayinminnu (2010) and Santos et al. (2017) found shorter control periods than those found in this study during the rainy season, with TPIP of 42 DAE and 36 DAE, respectively.

In the conventional okra cultivation system, Awodoyin and Olubode (2011) determined TPIP of 32 days after transplanting, Santos et al. (2010) determined TPIP of 100 DAE and Bachega et al. (2013) of 14 DAE, which indicates a great variation in the TPIP in the conventional system, compared to the organic system. Ryan et al. (2009) pointed out that conventional and organic cropping systems differ in the competition relationships between crops and weeds, with more intense competition in the conventional cropping system. These authors suggested that organic systems were more tolerant to weed abundance compared to conventional systems, and that soil fertility management may influence competition between crops and weeds in organic systems.

The Critical Period of Interference Prevention (CPIP) on okra crop in the dry season in the organic cropping system was 4 to 53 DAT (Figure 5). This control period, that is, 49 days after transplanting, showed how sensitive the crop was to weed competition during the dry season in the organic system, whose competition of these species for soil resources, according to the theory of Smith et al. (2009), decreases with the increase in the pool of soil resources. In the rainy season, in okra grown in an organic croppping system, the critical period of weed competition occurred from 21 to 42 DAS (Dada and Fayinminnu, 2010) and from 12 to 36 DAE (Santos et al., 2017), which indicates greater tolerance from the crop to weed competition. Beneragama et al. (2016) state that because of differences in crop management between different regions and climatic conditions, the greater tolerance of crops to weed competition should be understood under local conditions. Thus, determining the critical period in okra crops is essential to adjust weed management measures in the organic cropping system.

The okra fruit yield in the absence of weeds was 6,659 kg ha^{-1} and 2,028 kg ha^{-1} in coexistence with the weed community, with yield losses of 69.5%. This loss was greater than the rate of 51.3% that was found in the okra grown in the organic system in the rainy season (Santos et al., 2017). This result showed that the dry season influenced crop development and competition with weeds. Olabode et al. (2010), in okra grown in a conventional cropping system during the dry season, found lower crop yield (2.8 kg ha^{-1}) in the absence of the weed *Thitonia diversifolia* in the dry compared to the rainy season (5.4 kg ha^{-1}). However, the crop in coexistence with this weed resulted in 100% loss of production in both seasons. Additionally, Adeyemi et al. (2016), also in conventional okra cultivation, showed higher losses at the end of the rainy season (84.97%), compared to the beginning of the season (39.02%). The yield loss of okra crop in the dry season was lower in the organic cropping system compared to the conventional system, which is probably due to the soil fertility management in this system. Smith et al. (2010) suggested that diversified cropping systems are able to support higher yields in the presence of weeds than those with low niche source diversity, as they allow nutrient differentiation between weeds and crops.

The practice of organic cropping system in the dry season negatively affects the density and dry matter weight of the weed community coexisting with the okra crop, as well as weed species richness. The most favored and aggressive species in the organic system during the dry season are *C. dactylon*, *E. indica*, *A. spinosus* and *C. benghalensis*.

Okra grown in the organic cropping system during the dry season should be weed-free until harvesting to avoid high yield losses.

AKNOWLEDGEMENTS

To the Fundação de Amparo à Pesquisa e ao Desenvolvimento Científico e Tecnológico do Maranhão (FAPEMA), for the funding of the research, and to the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), for granting the scholarship to the first author, and to the Company Alimentum Ltda. for providing the area for the experiment carried out in this study.

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