American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)

ISSN (Print) 2313-4410, ISSN (Online) 2313-4402

http://asrjetsjournal.org/

Selectivity of Herbicide 2,4-D, Isolated and In Association, In Pre-Emergency in Culture of Açaí

Ramon Witalo Dias Alves[a], Evaldo Morais da Silva[b], Mariana Casari Parreira[c], Jefferson dos Santos Martins[d], Elonha Rodrigues dos Santos[e], Clovis Maurilio de Souza[f], Meirevalda do Socorro Ferreira Redig[g], Thiago Gledson Rios Terra[h], Elessandra Laura Nogueira Lopes[i], Marcos Augusto de Souza Gonçalves[j], Antonio Carlos Martins dos Santos[k], Lucélia Martins de Andrade[l], Omar Machado de Vasconcelos[m], Antonio Marcos Quadros Cunha[n]

[a]Federal University of Pará. Tocantins/Cametá Campus, jatobá street, Monte Castelo, Tucumã-Pa, 68385000. Agronomist.

[b]Federal University of Pará. Tocantins/Cametá Campus, Rua Padre Antônio Franco - MATINHA, Cametá - PA, 68400-000. Agronomist. MSc Vegetal Production, PhD student in Biotechnology and Biodiversity.

[c]University of the Açores, Institute for Research and Agrarian Technologies and Environment (IITAA). Rua Capitão João D'Ávila, São Pedro, 9700-042, Angra do Heroísmo, Açores, Portugal. Professor Assistant. Phytotechnics.

[d]Federal Rural University of the Amazon. Avenida Presidente Tancredo Neves, Nº 2501 Neighborhood: Terra Firme Zip code: 66.077-830 City: Belém-Pará-Brasil. Eng. agro. esp. Agroforestry Systems, Master's Student in Agronomy.

[e]Faculty of the Amazon (FAMA), Address: Rua Walisson Junior Arrigo, 2043 - Bairro Cristo Rei, Vilhena - RO, 76983-496. Agronomist, MSc Plant Production, Phd Agronomy.

[f]Federal University of Tocantins, Gurupi Campus, Rua Badejós lt6 7 s/n farms 69/72, rural area, CP. 66 zip code 77402970, Gurupi TO. Agronomist. MSc in Phytotechnics, Dr. Temperate Climate Fruit.

[g]Federal University of Pará. Campus Tocantins/Cametá, Rua Padre Antônio Franco - MATINHA, Cametá - PA, 68400- 000. Agronomist. PhD in Agricultural Sciences.

[h]Federal University of Tocantins, Gurupi Campus, Rua Badejos, farms 69-72, s/n, Jardim Sevilha, Gurupi - Tocantins. Agronomist, Master in Plant Production, Doctor in Phytotechnics.

[i]Federal University of Pará. Campus Tocantins/Cametá, Rua Padre Antônio Franco - MATINHA, Cametá - PA, 68400-000. Agronomy. MSc Soils and Nutrition of Plants, Dr. In Agroecosystems of the Amazon.

[j]Federal Rural University Amazon. Belem Campus, Av. President Tancredo Neves, No. 2501, TERRA FIRME, Belém - PA, 66077-830. Agronomist. Master's student in Socioeconomics, Natural Resources and Agribusiness Development.

----

* Corresponding author.

[k]Federal Institute of Pará. Campus Itaituba, Rua Universitário, s/n - Bairro Maria Magdalena Itaituba / PA, CEP: 68183-300. Agronomist, Doctor in Plant Production.

[l]Federal Rural University of the Amazon. Avenida Presidente Tancredo Neves, Nº 2501, Neighborhood: Terra Firme. Belém - PA. Zip code: 66077-830. Veterinary Medicine msc. in animal health and production in the Amazon, doctoral student in animal health and production in the Amazon.

[m]Federal University of Pará. Belém Campus, Rua Augusto Corrêa, GUAMÁ, Belém - PA, 66075-110. Agronomy. Master's in Family Agriculture and Sustainable Development.

[n]Federal University of Pará. Campus Tocantins/Cametá, Rua Padre Antônio Franco - MATINHA, Cametá - PA, 68400-000. Zootechnician, Dsc in Animal Production

Abstract

With the growth of acai planted areas, further studies on herbicides are needed in this palm tree of great potential. Thus, the present work aimed to evaluate the selectivity of the 2,4-D herbicide applied in pre-emergence, isolated, and in association, with acai seedlings. The experimental design was randomized blocks with 4 replications. Increasing doses of 2,4-D isolated (502.5, 1,005 and 2,010 g e a ha) and associated with picloram (960 g e. a ha), triclopyr (960 g e. a ha) were applied as treatments. and glyphosate (1,110 g e. a ha), one more control without application. At 3,7,14,21,28 and 35 DAA, the percentage of phytointoxication, height (cm), and the number of leaves of the acai seedlings were determined. At the end of the evaluations (35 DAA), the 2,4-D isolated applications obtained the best results, with low phytointoxication visual percentage, higher plants, and a larger number of leaves, showing selective culture. However, the association of the 2,4-D herbicides with picloram, in all doses used, had negative effects on the evaluated parameters, evidencing the non-selectivity of the acai berry crop.

Keywords: *Euterpe oleracea* Mart; herbicide association; Phytoo-toxication.

1. Introduction

Herbicides mimicking plant growth-regulating hormones known as "auxins" are among the oldest herbicide classes used in agriculture. The herbicide 2,4-D, the first selective herbicide used on crops, emerged in the 1940s as a new tool to solve weed problems. Thus, for the first-time farmers had the opportunity to control selectively [1].

Selectivity is understood as the inability of the herbicide to kill a certain plant, that is, for some reason, usually metabolic, the plant can metabolize the product, reducing the toxic potential or even inactivating the product. One of the bases of the selectivity of crops to herbicides is the capacity and speed of degradation of the herbicide by the plant [2].

Different situations exist for pre-emergence and post-emergence, in addition to pre-plant management. Thus, it is important to divide herbicides into two application times about the crop (pre-planting and post-planting).

and four application times about the crop and weeds (pre-emergence and post-emergence of the crop and pre-emergence and post-emergence of weeds) [2].

The acai fruit (*Euterpe oleracea Mart.*) in the year 2017 had an increase of 22.2% in production over the previous year, with 195,006 hectares of harvested area, reaching 1.7% of the total national production. ([3]). The use of herbicides to control weeds in this crop is a reality because, with the slow initial growth of the species, and the favorable soil and climate conditions, weeds emerge that compete for nutrients, water, and light ([4]). However, the effect of chemical control on the crop needs to be evaluated and considered.

Thus, the present work aimed to evaluate the selectivity of the herbicide 2,4-D applied in pre-emergence of the crop, alone and in association, in açaí seedlings

2. Material and Method

The experiment was implemented in the field, at Fazenda Monte Sião, located in the municipality of Oeiras do Pará/PA (latitude 02º19'24.2"S and longitude 49º45'51.1"W), between April and June 2019. The soil of the region was classified as Dystrophic Yellow Red Latosol [5]. The herbicides were applied in desiccation in the experimental area, which contained an expressive majority (above 98%) of plants of Rhynchospora cephalotes L. (assapê grass) belonging to the Cyperaceae family, in the vegetative period. Soil samples were collected from the experiment installation area to determine the physical and chemical characteristics of the site, as described in Table 1.

Table 1: Chemical and physical properties of the soil in the 0 - 20 cm layer. Monte Sião Farm, Oeiras do Pará, PA. 2019.

pH	Ca	Mg	Al	H+Al	P	K	M.O	SB	CTC	Sand	Silt	Clay	V
CaCl2		Cmol/dm³			mg/dm³					%			%
4,2	0,9	0,2	0,7	3,4	9,0	0,03	1,0	1,3	4,53	25,3	11,8	28,0	24,94

Source: Unithal, 2019.

A randomized block experimental design with four repetitions was used, and the plots had dimensions of 3 x 2 m (6 m2), totaling 52 plots, with 12 herbicide treatments, plus a witness without application (Table 2). Uniform açaí seedlings aged 8 months were transplanted 15 days after application (DAA), at 1-m spacing, totaling 3 seedlings per plot.

Table 2: Treatments used in the experiment. Oeiras do Pará, PA. 2019.

Tretaments	Doses g e.a.[1] ha^{-1}	Doses L p.c.[2] ha^{-1}	Trade name
01. Witness	-	-	-
02. 2,4-D + Picloran	502,5 + 960	0,75 + 4,0	DMA 806 BR + Padron
03. 2,4-D + Picloran	1.005 + 960	1,5 + 4,0	
04. 2,4-D + Picloran	2.010 + 960	3,0 + 4,0	
05. 2,4-D + Triclopyr	502,5 + 960	0,75 + 2,0	DMA 806 BR + Garlon 480 BR
06. 2,4-D + Triclopyr	1.005 + 960	1,5 + 2,0	
07. 2,4-D + Triclopyr	2.010 + 960	3,0 + 2,0	
08. 2.4-D + Glyphosate	502,5 + 1.110	0,75 + 3,0	DMA 806 BR + Roundup Original DI
09. 2,4-D + Glyphosate	1.005 + 1.110	1,5 + 3,0	
10. 2,4-D + Glyphosate	2.010 + 1.110	3,0 + 3,0	
11. 2,4-D	502,5	0,75	DMA 806 BR
12. 2,4-D	1.005	1,5	
13. 2,4-D	2.010	3,0	

[1]grams of acid equivalent per hectare;[2] liters of commercial product per hectare.

The herbicide treatments were applied using a manual knapsack sprayer, duly regulated to work with constant pressure at a travel speed of 3.0 km h and a consequent spray volume equivalent to 200 L ha, the application bar being equipped with a "fan" type nozzle.

The climatic data collected during the experiment period are presented in Figure 1.

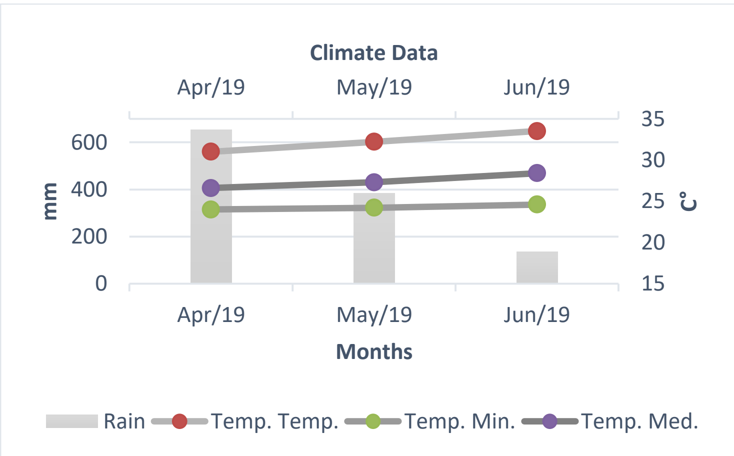

Figure 1: Precipitation in millimeters and temperatures (average, maximum and minimum) during the experiment. Oeiras do Pará, PA. 2019.

The evaluations occurred 3, 7, 14, 21, 28, and 35 days after application (DAA) and were: the number of leaves, plant height, and percentage of phytotoxicity of açaí seedlings. The evaluation of phytotoxicity was visual, assigning grades ranging from zero to 100, considering zero to 10% - null, 11 to 20% - minimum, 21 to 30% - very weak, 31 to 40% - weak, 41 to 50% - sensitive, 51 to 60% - medium, 61 to 70% - intense, 71 to 80% - severe, 81 to 90% - very severe and 91 to 100% - death, total damage [6].

Once the evaluations were finished, the data obtained were submitted to statistical analysis by variance analysis using the F test, and to verify the difference between the means, the Scott&Knott test was used at a 5% significance level.

3. Results and Discussion

3.1. Number of Leaves

The number of leaves decreased during the experimental period. The açaí seedlings had, on average, more than 4 leaves per plant at 3 DAA, reduced at 35 DAA to, on average, 3 leaves per plant (Table 3). At the beginning of the evaluation period (3 DAA to 21 DAA), there was no difference between treatments, and only after 28 DAA did the herbicides differ in the number of leaves, with the lowest dose of 2,4-D with the herbicide Picloran providing the lowest number of leaves, with an average of 2.12 leaves (Table 3). The highest number of leaves was obtained in the control treatments and the highest dose of 2,4-D alone, with more than 4 leaves per plant.

Table 3. Number of leaves of açaí seedlings during the experimental period as a function of the treatments of 2,4-D herbicide alone or in combination. Oeiras do Pará, PA. 2019.

Table 3: Leaves

Treatments	Doses g e. a. ha	Number of Leaves 3 DAA	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA
Witness	-	4,07 a	4,07 a	4,37 a	4,37 a	4,12 a	4,22 a
2,4-D + Picloran	502,5 + 960	4,15 a	4,05 a	3,60 a	3,22 a	2,12 b	1,72 b
2,4-D + Picloran	1.005 + 960	3,95 a	3,72 a	3,42 a	3,30 a	2,40 b	2,45 b
2,4-D + Picloran	2.010 + 960	4,15 a	4,07 a	3,55 a	2,95 a	2,22 b	1,40 b
2,4-D + Triclopyr	502,5 + 960	4,22 a	3,65 a	3,92 a	3,47 a	3,10 b	1,97 b
2,4-D + Triclopyr	1.005 + 960	4,12 a	3,62 a	3,80 a	4,15 a	3,32 a	2,90 a
2,4-D + Triclopyr	2.010 + 960	4,37 a	4,12 a	4,20 a	3,05 a	2,87 b	3,12 a
2,4-D + Glyphosate	502,5 + 1.110	3,97 a	4,07 a	4,05 a	3,62 a	3,97 a	3,47 a
2,4-D + Glyphosate	1.005 + 1.110	4,05 a	3,97 a	4,05 a	3,95 a	3,45 a	3,55 a
2,4-D + Glyphosate	2.010 + 1.110	3,97 a	3,87 a	3,62 a	3,70 a	3,70 a	3,45 a
2,4-D	502,5	4,15 a	4,05 a	3,97 a	3,70 a	3,95 a	3,90 a
2,4-D	1.005	3,80 a	3,87 a	3,97 a	3,65 a	3,47 a	3,55 a
2,4-D	2.010	4,22 a	4,30 a	4,30 a	4,22 a	4,15 a	3,50 a
F trat		0,79 ^{NS}	1,25 ^{NS}	2,00 ^{NS}	1,62 ^{NS}	3,25**	7,35**
CV (5%)		8,11	9,01	10,71	19,24	23,90	21,38

Means followed by the same letter in the column do not differ in the Scott&Knott test.

*, ** significant at 5 and 1% probability, respectively. ^{NS}- non-significant.

At 35 DAA all associations with picloram provided the lowest leaf numbers, along with triclopyr at the lowest doses of 2,4-D, ranging from 1.40 to 2.90 (Table 3). The other treatments provided above 3 leaves are statistically equal.

3.2. Height of plants

The plants increased in height throughout the experimental period, showing the development of the seedlings. Therefore, the highest heights were obtained with the treatments containing the herbicide 2,4-D without association (Table 4), being above 37 cm at 3 DAA, 44 cm at 21 DAA, and 49 cm at 35 DAA.

At 3, 7, and 14 DAA all associations with 2,4-D obtained the lowest heights, varying from 32.97 cm to 34.87 cm (3 DAA), except for 2,4-D in the smallest dose associated with picloram, being statistically equal to the isolated treatments; from 33.80 cm to 37.40 cm (7 DAA), except again for 2,4-D at the lowest dose with picloram, and 36.25 cm to 40.72 cm (14 DAA), except with association of 2,4-D with triclopyr at the highest dose, which was 40.72 (Table 4). Queiroz and his colleagues [7] also obtained the same results when using the herbicides fluazifopp-butyl (93.8 g ha), quizalofop-p-ethyl (75 g ha), and the mixture clethodim + fenoxapropp-ethyl (50 + 50 g ha) in açaí and juçara (Euterpe edulis), causing smaller plants. At 21, 28, and 35 DAA, it was found that all associations of 2,4-D provided smaller heights compared to the isolated treatments (Table 4).

Table 4: Associations with 2,4-D

Treatments	Doses	Plant Height (cm)					
	g e. a. ha	3 DAA	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA
Witness	-	34,62 b	36,00 b	38,20 c	40,00 c	42,80 d	46,55 b
2,4-D + Picloran	502,5 + 960	36,25 a	37,40 a	39,12 b	42,00 b	45,20 c	46,62 b
2,4-D + Picloran	1.005 + 960	34,62 b	35,97 b	37,32 c	39,75 c	43,22 d	45,30 c
2,4-D + Picloran	2.010 + 960	32,97 b	33,80 c	36,25 c	38,72 c	42,65 d	43,52 c
2,4-D + Triclopyr	502,5 + 960	33,25 b	34,35 c	36,32 c	39,15 c	41,92 d	44,12 c
2,4-D + Triclopyr	1.005 + 960	34,20 b	34,82 c	36,55 c	38,52 c	41,42 d	43,02 c
2,4-D + Triclopyr	2.010 + 960	34,62 b	36,10 b	40,72 a	43,37 b	46,77 b	47,92 b
2,4-D + Glyphosate	502,5 + 1.110	34,87 b	35,92 b	39,62 b	42,07 b	44,97 c	47,17 b
2,4-D + Glyphosate	1.005 + 1.110	34,50 b	36,22 b	39,10 b	43,12 b	45,95 b	48,12 b
2,4-D + Glyphosate	2.010 + 1.110	33,70 b	35,12 c	37,30 c	40,17 c	43,65 d	47,25 b
2,4-D	502,5	37,27 a	38,52 a	42,00 a	44,70 a	48,42 a	49,95 a
2,4-D	1.005	37,02 a	38,65 a	41,92 a	45,57 a	48,80 a	50,85 a
2,4-D	2.010	37,02 a	38,17 a	41,85 a	45.05 a	48,65 a	50,90 a
F trat		7,27**	7,83**	7,54**	8,34**	11,25**	9,53**
CV (5%)		3,06	3.07	4,04	4,14	3,44	3,56

Means followed by the same letter in the column do not differ in the Scott&Knott test.

*, ** significant at 5 and 1% probability, respectively. NS- non-significant.

3.3. Visual percentage of phytotoxication

The açaí seedlings showed different percentages of phytotoxicity according to the treatments and during the experimental period (Table 5). At 3 DAA, the treatment composed of 2,4-D alone at the lowest dose, and together with glyphosate at the highest dose obtained the highest percentages of phytotoxicity, with 17.87% and 19.62%, respectively, followed by the treatments of 2,4-D at the lowest dose associated with glyphosate (18.10%), according to Table 5, classified as minimal damage, according to Deuber [6]. While in the same evaluation, the treatments with 2,4-D at the median dose associated with picloram and 2,4-D with triclopyr at the lowest dose provided lower levels of intoxication 9.72% and 10.05% respectively, assigning as null damage.

Table 5: Phytotoxicity (%) of açaí seedlings during the experimental period as a function of 2,4-D herbicide treatments alone or in the association. Oeiras do Pará, PA. 2019.

Treatments	Doses g e. a. ha	Phytotoxication 3 DAA	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA
Witness	-	0,00 e	0,00 e	0,00 f	0,00 e	0,00 h	0,00 g
2,4-D + Picloran	502,5 + 960	12,32 c	19,92 b	20,90 c	49,15 b	78,75 b	77,37 b
2,4-D + Picloran	1.005 + 960	9,72 d	9,97 d	18,02 d	36,25 c	66,22 c	65,55 c
2,4-D + Picloran	2.010 + 960	13,77 c	28,72 a	36,22 a	48,12 b	84,90 a	89,27 a
2,4-D + Triclopyr	502,5 + 960	10,05 d	13,90 d	18,72 d	33,92 d	36,22 f	47,10 e
2,4-D + Triclopyr	1.005 + 960	15,47 b	15,97 c	16,65 d	45,40 b	35,37 f	33,12 f
2,4-D + Triclopyr	2.010 + 960	16,37 b	19,15 b	27,50 b	62,70 a	53,75 d	42,65 e
2,4-D + Glyphosate	502,5 + 1.110	18,10 a	12,85 d	24,87 c	33,60 d	37,05 f	44,00 e
2,4-D + Glyphosate	1.005 + 1.110	14,08 c	16,70 c	22,05 c	44,15 b	63,72 c	53,07 d
2,4-D + Glyphosate	2.010 + 1.110	19,62 a	13,95 d	32,05 a	38,72 c	46,85 e	47,02 e
2,4-D	502,5	17,87 a	12,47 d	22,00 c	31,22 d	46,62 e	38,50 f
2,4-D	1.005	15,75 b	22,95 b	25,40 c	39,12 c	31,22 g	37,45 f
2,4-D	2.010	14,20 c	12,45 d	11,80 e	31,22 d	32,05 g	33,45 f
F trat		47,15**	30,87**	29,77**	71,07**	223,13**	145,48**
CV (5%)		10,77	16,14	15,67	9,02	6,44	7,83

Means followed by the same letter in the column do not differ in the Scott&Knott test. *, ** significant at 5 and 1% probability, respectively. NS- not significant.

After 7 days of evaluation, the percentages of phytotoxicity provided by the herbicides tested on acai seedlings were increasing in all treatments (Table 5), and the highest percentages were obtained by the treatments 2,4-D in the highest dose associated with picloram of 28.72% and 2,4-D in the highest dose alone, with 22.95%, as well as 2,4-D with triclopyr in the highest dose (19.15%) and 2,4-D in the lowest dose associated with picloram (19.92%). The lowest phytotoxicities were presented by the treatments: 2,4-D + picloram (1,005 + 960 g e.a. ha); 2,4-D in the intermediate associated with triclopyr; 2,4-D in the highest and lowest dose associated with glyphosate and 2,4-D in the highest and lowest dose alone, all ranging from 9.97 to 15.97%. When working with seedlings of the species *Euterpe oleracea* and *Euterpe edulis*, the researchers, Queiroz and his colleagues [7] also found the percentages of herbicide poisoning to increase over the experimental period. Dan an and his colleagues [8] describe that systemic herbicides have a slow initial action in plants, due to the translocation process. The percentages of phytotoxicity provided by the treatments increased again over time, however, at 14 DAA, the treatment of 2,4 D alone at the highest dose decreased the intoxication caused in the seedlings from 12.45% to 11.80%, which was the lowest value evaluated. The treatment 2,4 D at the highest dose associated with picloram continued to cause the highest value of intoxication with 36.22% (Table 5). The treatment of 2,4-D + Glyphosate (2,010 + 1,110 g e. a. ha), provided similar results exceeding 32% of phytotoxicity.

At 21 DAA, only one treatment showed a phytotoxicity value above 62% in the association of 2,4-D + triclopyr (2,010 + 960 g e. a. ha). The treatments of 2,4-D, at the lowest and highest dose associated with picloram obtained intoxication of 48.12 to 49.15%. The lowest percentages (below 34%) were obtained by the treatments 2,4-D alone and at the lowest dose and 2,4-D + glyphosate (502.5 + 1,110 g e.a. ha) and 2,4-D + triclopyr (502.5 + 960 g e. a. ha) (Table 5). The other treatments did not exceed the intoxication level of 39.12%.

At 28 and 35 DAA, phytotoxication exceeded 80% with association of 2,4-D + picloram (2,010 + 960 g e. a. ha) and 77% with 2,4-D + picloram (502.5 + 960 g e. a. ha). (Table 5), and the lowest values were between 31% and 38% of 2,4-D treatments alone and associated at the highest dose with triclopyr at 35 DAA. Similar results were obtained by Franceschi and his colleagues [9], who used the association of 2,4-D with picloram, in Yellow Red Latosol, in the cucumber crop, at various soil depths, reaching the result of more than 90% of phytotoxic action of the crop, in the shallowest depth (0 - 8 cm).

4. Conclusions

The applications of 2,4-D alone obtained the best results, with the low visual percentage of phytotoxication, taller plants, and with a greater number of leaves, proving to be selective to the crop. However, the association of 2,4-D herbicides with Picloran, in all doses used, provided negative effects on the parameters evaluated, showing non-selectivity to the açaí crop.

References

[1]. Roman, E.S.; Vargas, L.; Rizzardi, M.A.; Hall, L.; Beckie, H.; Wolf, T, M.; How Herbicides Work: From Biology to Application. Passo Fundo: Berthier, 2005.

[2]. Carvalho,L.B. Herbicidas. Lages: Author's Edition, 2013. v.1, cap.1, p.12.

[3]. Brazil. Brazilian Institute of Geography and Statistics. PAM - Produção Agrícola Municipal. Available at: < https://www.ibge.gov.br/estatisticas/economicas/agricultura-e-pecuaria/9117-producao-agricola-municipal-culturas-temporarias-e-permanentes.html?=&t=downloads>. Accessed on: 20, Jul. 2019.

[4]. Brandão, B.B.; Costa, S.J; Nudes, D. P.; Marinho, G.A.; Erasmo, E.A.L. Selectivity of herbicides on the initial growth of açaí (*Euterpe oleracea* Mart.) seedlings. Journal of Biotechnology and Biodiversity. v.5, n.1, p. 95-100, 2014

[5]. EMBRAPA, Empresa Brasileira de Pesquisa Agropecuária. Recomendação de Adubação e Calagem para o Estado do Pará. Belém: Embrapa Amazônia Oriental, 2010. v.1, cap.1, pag. 26

[6]. Deuber, R. Weed science: fundamentals. Jabuticabal: UNESP/FUNEP, 1992. v.2. p. 291-330

[7]. Queiroz, J.R.G.; Silva Jr, A.C.; Pereira, M.R.R.; Martins, D. Initial development of *Euterpe* ssp. seedlings after herbicide application. Revista Brasileira de Fruticultura, v.38, n.1, pag. 72-80, 2014

[8]. Dan, H.A.; Barroso, A.L.L.; Procópio,S.O.; Moraes Dan, L.G; Olveira Neto, A.M.; Guerra, N.; Braz, G.B.P. Controle Químico de plantas voluntárias de soja Roundup Ready. Revista Brasileira de Herbicidas. v.8, n.3, p.96-101, 2009

[9]. Franceschi, M.; Yamashita, O.M.; Arantes, S.M.C.M.; Andrade, S.P. Behavior of 2,4-D + Picloran in Yellow Red Latosol. Revista Brasileira de Herbicidas, v. 16, n.3, p238-245, 2017