ARTIGO ORIGINAL

Allelopathic interference of medicinal plants extract in the development of brassicas in a greenhouse

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RESUMO: Interferência alelopática do extrato de plantas medicinais no desenvolvimento de brássicas em casa de vegetação. O cultivo orgânico é tendência mundial, fazendo com que maneiras alternativas de incremento de características agronômicas se tornem essenciais aos produtores, destacando-se a alelopatia. O objetivo do presente trabalho foi avaliar a interferência da aplicação de extrato alecrim, camomila e hortelã, resultantes de infusão, no estágio inicial de plantas de rúcula e agrião, em condições de casa de vegetação. Foram cultivadas em vasos de 10 l, contendo solo rico em matéria orgânica, mudas de agrião e rúcula e posteriormente essas mudas foram submetidas a diferentes concentrações de extratos de alecrim, camomila e hortelã em casa de vegetação. Foram datados parâmetros morfológicos e submetidos à análise de regressão quando significativos. Diferentes concentrações de extrato de camomila atuaram positivamente no desenvolvimento de mudas de agrião e rúcula. Já extratos de alecrim e hortelã acentuaram o desenvolvimento de mudas de agrião e reduziram o desenvolvimento de mudas de rúcula de acordo com o aumento da concentração. Os três extratos demonstraram aumentos em parâmetros de parte aérea em ambas hortícolas testadas.
Palavras-chave: Agrião. Rúcula. *Rosmarinus officinalis*. *Matricaria recutita*. *Mentha x piperita*.

ABSTRACT: The organic crops are now a global tendency providing alternative ways to increase the essential agronomic characteristics to farmers, giving highlighting the allelopathy. The objective of this work was to evaluate the effect of different extracts derivates of infusion of rosemary, chamomile and mint on the first growing stages of arugula and cress on greenhouse conditions. Seedlings of arugula and cress were cultivated on 10 l flower pots rich on organic matter and after they were transplanted were sprayed different concentrations of the extracts on each plant. Were dated different morphological parameters and the results were submitted to regression analysis when significant. Different concentrations of chamomile acted positively on the seedling development of cress and arugula, on the other hand, higher levels of the extracts of rosemary and mint provided a decrease on the development of arugula. The three extracts improved the aerial development on both tested plants.
Keywords: Cress, Arugula *Rosmarinus officinalis*. *Matricaria recutita*. *Mentha x piperita*.

INTRODUCTION

Activities on vegetables grow involve labor high investments on fertilizer and agrochemicals for diseases, bugs or weeds. One of the characteristic of organic farming is the absence of those chemical products being necessary for the farmer the knowledge to use alternative growing techniques for his crops. (Souza et al., 2008; Sediyama et al., 2014; Sediyama et al., 2016).

Plants can produce on their secondary metabolite some compounds that may block the effect of pathogens and bugs, attract pollinators, stop the development of weeds or improve the development of other plants characteristics that help on the growth of the plants (Gobbo-Neto & Lopes, 2007). This potential can act on the development vegetables being characterized as positive allelopathy where the use of specific organic compounds act on these development being able to be used as substitutes for chemical products (Garcia & Carril, 2009).

The mutual crops of medical plants and vegetables can improve the use of the soil, the water

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and the cultivated area and also, helps to control diseases and bugs, according to the allelopathic potential of a plant and besides characterizing a viable and ecological way of handling the medical plants are also an alternative way for small farmers to earn money (Teixeira et al., 2005; Montezando & Pell, 2006).

The main goal of the experiment was to evaluate the interference of rosemary, chamomile and mint extracts made by infusion sprayed on the first developing stages of arugula and cress on greenhouse.

MATERIAL AND METHODS

The experimente was conducted at Toledo – Paraná, South region of Brazil, with the geographical coordinates of 24°71' W e 53°78' S, and altitude of 550m. The vegetable seeds were acquired at a local store as the medical plants were.

Seeds of cress (*Nasturium officinale)* and arugula (*Eruca sativa*) were seeded on 144 cells polyethylene trays with substrate Humusfertil and kept on greenhouse. Seven days after the seeding the thinning was performed keeping only one plant per cell. Fourteen days after the sprouting the plants were transplanted to 10 l flower pots filled with approximately 9 m³ of dirt this being classified as dystroferric red latosol rich on organic matter. Were transplanted four seedlings per pot and each pot was considered a parcel. Seven days after transplanting was performed the thinning leaving only two plants per pot.

At the same day was performed the application of the extracts, described on the sequence, according to their respective treatments. The medical plants: rosemary (*Rosmarinus officinales*), chamomile (*Matricaria recutita*) and mint (*Mentha x piperita*) were dried on forced circulation furnace at 50 ºC for 48 h and posteriorly mowed on mill Willey resulting in a thin powder.

This powder was used to make the extracts derivatives of infusion on the 5:1 concentration resulting on the treatments: T1 – just deionized water; T2 – extract at 25%; T3 – extract at 50%; T3 – extract at 75% and T4 – extract at 100%. Each pot was sprayed with 250 µl of their respective treatment to the leaf's and to the soil next to the roots. Was performed the cultivation when necessary.

Third days after sprayed the plants those were harvested and then analyzed the parameters: aerial length; root length; foliar area; aerial dry weight; root dry weight; aerial fresh weight and root fresh weight. For the dry tests, those plants were dried on forced circulation furnace at 65 ºC for 24 h.

The data were statistically analyzed doing the variance test and when significant submitted to regression analysis using the program SISVAR® (Ferreira, 2010).

RESULTS AND DISCUSSION

By using different concentrations of extracts made of chamomile flowers on *Allium cepa*, Vieira et al. (2009) concluded that elements present on the plant have the capacity to inhibit the cellular cycle of useful crops consequently reducing their development to cellular level causing even death. That did not happen on the present research where the increase of cress seedlings was proportional to the increase of the concentration of chamomile extracts. (Figure 1A, 1C, 1D, 1E, 1F).

Vieira et al. (2009) used only the chamomile flowers and at the present research was used all the plant, factor which can influence on the concentration of secondary composts due to the difference of metabolites on the whole plant and also the according to the plant stage of development (Gobbo-Neto & Lopes, 2007) factors that justify the opposite response on this research.

Inhibition on the germination and development of plants happened on seeds of lettuce submitted to different concentrations of chamomile, mint, *Peumus boldus, Cymbopongon citratus* and *Baccharis trimera.* The tomatoes were highlighted as a bioindicator of toxicity from the metabolites of medical plants (Aarestrup et al., 2013; Marques et al., 2015).

The seedling development of cress submitted to mint and rosemary extracts demonstrated an increase on the development when in higher concentrations of the extract however inferior results were obtained on plants submitted to chamomile extracts. (Figure 1A, 1C, 1D, 1E, 1F).

The use of water extracts of *Baccharis dracunculifolia* and *Lippia sidoides* on the development of lettuce, broccoli, cauliflower, cabbage and *Cyperus rotundus* demonstrated significant reductions on the germination, aerial part and roots of the tested species according to the increase of the extract (Rozete et al., 2007; Silveira et al., 2013). The characteristic of inhibition on root development was confirmed by the present study (Figure 1B, 1E) where higher concentrations reduced significantly the root development.

The answer of arugula seedlings submitted to different concentrations of the extracts of chamomile (Figure 2A, 2C, 2D, 2E, 2F) confirm the characteristics observed on cress seedlings where bigger concentrations of the extract stimulated positively its development.

Research performed with essential oil of chamomile to fight anthracnosis highlights the efficiency of the extract against the fungus that

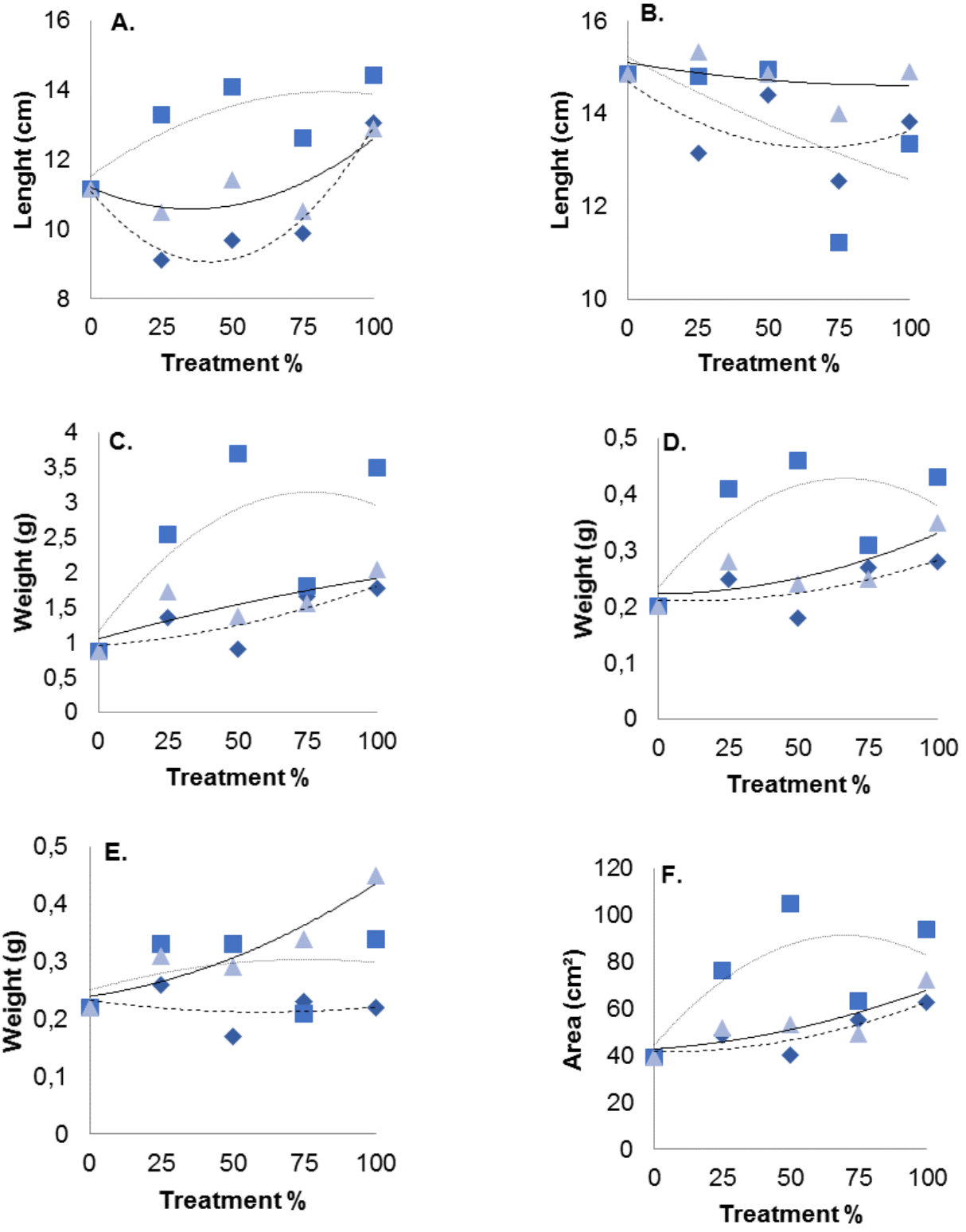

FIGURE 1. Effect of different infusion extracts and concentrations of Rosemary (▲), chamomile (■) and mint (♦) on the Aerial Length (A), Root Length (B), Aerial Part Fresh Weight (C), Aerial Part Dry Weight (D), Root Fresh Weight (E) and Foliar Area (F) of Cress on essay carried out on greenhouse at Toledo – Paraná, Brazil (formula at Table 1).

TABLE 1. Regression analysis for Cress on essay performed in greenhouse on Toledo – Paraná, Brazil.

Test	Treatment	Formula	R^2 %
Aerial Length (cm)	Rosemary	$y = 0{,}001152\ x^2 + 0{,}0003993\ x + 2{,}886$	94,03
	Chamomile	$y = -0{,}000337\ x^2 + 0{,}0003993\ x - 0{,}844$	59,3
	Mint	$y = 0{,}000488\ x^2 + 0{,}0003993\ x + 1{,}221$	65,52
Root (cm)	Rosemary	$y = 0{,}000326\ x^2 + 0{,}0004935\ x + 0{,}660$	37,39
	Chamomile	$y = 0{,}000055\ x^2 + 0{,}0004935\ x + 0{,}112$	42,39
	Mint	$y = 0{,}000055\ x^2 + 0{,}0004935\ x + 0{,}112$	17,89
Aerial fresh weight (g)	Rosemary	$y = 0{,}000056\ x^2 + 0{,}0002282\ x + 0{,}243$	67,33
	Chamomile	$y = -0{,}000341\ x^2 + 0{,}0002282\ x - 1{,}494$	48,11
	Mint	$y = -0{,}000022\ x^2 + 0{,}0002282\ x - 0{,}098$	61,92
Aerial dry weight (g)	Rosemary	$y = 0{,}000009\ x^2 + 0{,}0000248\ x + 0{,}345$	46,01
	Chamomile	$y = -0{,}000043\ x^2 + 0{,}0000248\ x - 1{,}745$	52,66
	Mint	$y = 0{,}000011\ x^2 + 0{,}0000248\ x + 0{,}442$	68,2
Root fresh weight (g)	Rosemary	$y = 0{,}000007\ x^2 + 0{,}000027\ x + 0{,}263$	9,29
	Chamomile	$y = -0{,}000008\ x^2 + 0{,}000027\ x - 0{,}292$	12,45
	Mint	$y = 0{,}000012x^2 + 0{,}000027\ x + 0{,}427$	87,38
Root dry weight (g)	Rosemary	$y = 0{,}000008\ x^2 + 0{,}0000085\ x + 0{,}909$	89,35
	Chamomile	$y = -0{,}000003\ x^2 + 0{,}0000085\ x - 0{,}321$	4,21
	Mint	$y = 0{,}000003\ x^2 + 0{,}0000085\ x + 0{,}366$	75,75
Foliar area cm^2	Rosemary	$y = 0{,}002261\ x^2 + 0{,}00470\ x + 0{,}481$	78,68
	Chamomile	$y = -0{,}009571\ x^2 + 0{,}00470\ x - 2{,}036$	53,41
	Mint	$y = 0{,}001727\ x^2 + 0{,}00470\ x + 0{,}367$	72,88

causes economical damage because of the active compounds that exist on the secondary metabolism as phenols and flavonoids (Rozwalka et al., 2008). This characteristic of high concentrations of phenols on chamomile is used as a justification to the inhibition on the plant development of near plants on the other hand, plants with elevated levels of phenol may not be affected by this characteristic and also use those compounds of the plant to potentialize their development that is what happen with arugula (Arbos et al., 2010)

The rosemary extract presented stimulus when in lower concentrations on the development of arugula seedlings (Figure 2A, 2B, 2C, 2D, 2E, 2F), however, higher concentrations proportionately reduced the development. These results confirm the ones from Magalhães et al. (2012) where lettuce seeds submitted to extracts of *Lippia sidoides* Cham and *Cymbopogon citratus* had a higher number of abnormal seeds.

Junqueira & Oliveira Junior (2015) submitted seedlings of *Tropaeolum majus* to rosemary, *Bryophyllum pinnatum* and *Thymus vulgaris* extracts and had results of inhibition on its development. E Dorneles et al., (2014) using extracts of rosemary, *Peumus* sp, *Ocimum basilicum* and *Origanum majorana* obtained a low germination rate and low plant development of *Cucumis* sp seedlings.

The root development (Figure 2B and 2E) was accentuated when submitted to mint extracts and seedlings submitted to higher concentrations of the extract presented higher root length and weight. The positive allelopathic effect of mint on crops and weeds, mostly related to root parameters is confirmed on research performed by Bonfin et al. (2013), Bido & Zonetti (2013), Pereira & Vidal (2013), and Dias et al. (2014).

The extract of chamomile on higher concentrations accentuated the seedling development of arugula and cress. Extracts of rosemary and mind accentuated the seedling development of cress, however, reduced the seedling development of arugula according to the increase of the extract concentration. The three extracts demonstrated gains on aerial parameters on arugula and cress.

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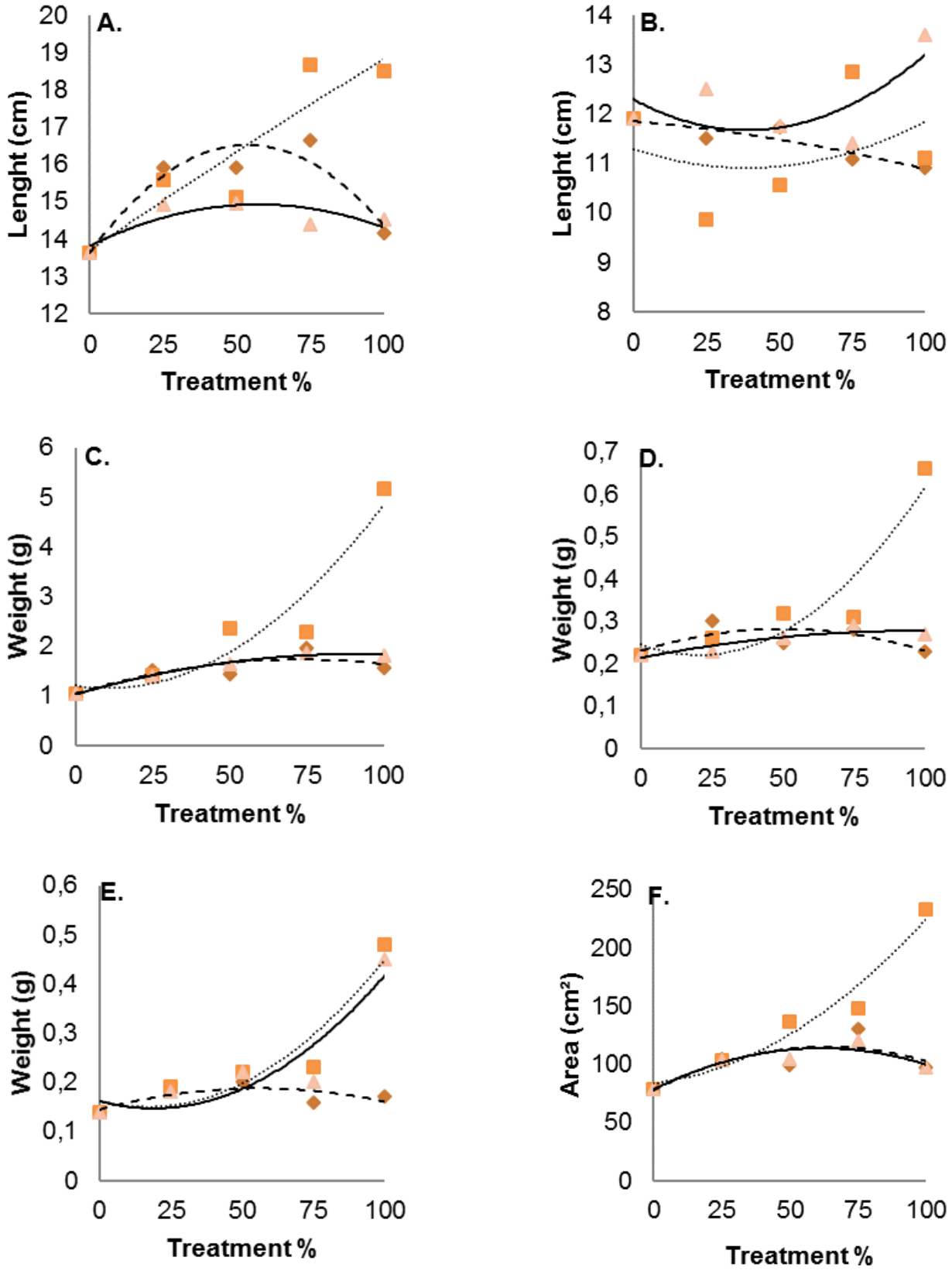

FIGURE 2. Effect of different infusion extracts and concentrations of Rosemary (▲), chamomile (■) and mint (♦) on the Aerial Length (A), Root Length (B), Aerial Part Fresh Weight (C), Aerial Part Dry Weight (D), Root Fresh Weight (E) and Foliar Area (F) of Arugula on essay carried out on greenhouse at Toledo – Paraná, Brazil (formula at Table 2).

REFERENCES

AARESTRUP JR, SOUZA AS, ARTMAN M, LEITZKE RCZ (2013) Análise comparativa da sensibilidade de sementes de *Lactuca sativa* L. e *Lycopersicon esculentum* Mill. submetidas aos tratamentos com plantas medicinais. Biofar – Rev Biol Farm 9(4): 26.

ARBOS KA, FREITAS RJS, STERTZ SC, DORNAS MF (2010) Atividade antioxidante e teor de fenólicos totais em hortaliças orgânicas e convencionais. Ciên Tecnol Aliment 30(2): 501–506. https://doi.org/10.1590/S0101-20612010000200031

ÁVALOS A, ELENA G (2009) Metabolismo secundário de plantas. Reduca Biol Serie Fisiol Veg I 2(3): 119–145.

BONFIM FPG, HONÓRIO ICG, CASALI VWD, FONSECA MCM, MANTOVANI-ALVARENGA E, ANDRADE FMC, PEREIRA AJ, GONÇALVES MG (2011) Potencial alelopatico de extratos aquosos de *Melissa officinalis* L. e *Mentha x villosa* L. na germinação e vigor de sementes de Plantago major L. Rev Bras Plantas Med 3(especial): 564–568. https://doi.org/10.1590/S1516-05722011000500010

DIAS LA, COSTA SML, PASIN LAAP (2014) Efeito alelopático in vitro de hortelã-pimenta e boldo sobre a germinação e desenvolvimento inicial de sementes comerciais de abóbora. Rev Cient FEPI 6(1): 1–4.

DORNELES KR, POZZEBON BC, ETHUR LZ, ZEIST AR (2015) Efeito alelopático de extratos de plantas medicinais e condimentares na germinação e no crescimento inicial do meloeiro. Ciência e Natura 37(2): 212-217. http://dx.doi.org/10.5902/2179460X14763

FERREIRA DF (2010) SISVAR - Sistema de análise de variância. v. 5.3. Lavras-MG: UFLA.

GOBBO-NETO L, LOPES NP (2007) Plantas medicinais: fatores de influência no conteúdo de metabólitos secundários. Quím Nova 30(2): 374–381. https://doi.org/10.1590/S0100-40422007000200026

JUNQUEIRA PS, OLIVEIRA JUNIOR CJF (2015) Cultivo e produção de óleos essenciais de capuchinha (*Tropaeolum majus* L.) sob influência alelopática de extratos vegetais aquosos. Cadernos de Agroecol 9(4): 1–12.

MAGALHÃES HM, AQUINO CF, SOARES EPS, SANTOS LDT, LOPES PSN (2013) Ação alelopática de óleos essenciais de alecrim-pimenta e capim-santo na germinação de aquênios de alface. Semina Ciên Agr 34(2): 485–496. http://dx.doi.org/10.5433/1679-0359.2013v34n2p485

MARQUES JO, OLIVEIRA MFF, LACERDA GA (2015) Efeito alelopático e análise dos rótulos de garrafadas comercializadas no Mercado Municipal de Montes Claros-MG. Rev Bras Plantas Med 17(4): 1134–1141. https://doi.org/10.1590/1983-084x/14_160

MONTEZANO EM, PEIL RMN (2006) Sistemas de consórcio na produção de hortaliças. Rev Bras Agroc 12(2): 129–132. https://doi.org/10.18539/cast.v12i2.4502

NARIAI MA, BIDO GS, ZONETTI PC (2013) Ação alelopática do extrato de babosa (*Aloe vera* L.) e hortelã (*Mentha sp*.) sobre alface (*Lactuca sativa* L.). Rev Agroneg Meio Amb 6(2): 337. https://doi.org/10.17765/2176-9168.2013v6n2p%25p

PEREIRA TS, VIDAL MC (2013) Uso de extratos de plantas aromáticas no desenvolvimento de plântulas de hortaliças. Cadernos Agroecol 8(2): 1-5.

ROZWALKA LC, LIMA MLRZC, MIO LLM, NAKASHIMA T (2008) Extratos, decoctos e óleos essenciais de plantas medicinais e aromáticas na inibição de *Glomerella cingulata* e *Colletotrichum gloeosporioides* de frutos de goiaba. Ciên Rural 38(2): 301–307. http://dx.doi.org/10.1590/S0103-84782008000200001

ROZETE FSS, OLIVEIRA PA, GUSMAN GS, VALENTIM JMB, VESTENA S, BITTENCOURT AHC (2007) Avaliação do efeito alelopático de extratos aquosos de *Bacharis dracunculifolia* DC . sobre a germinação e o crescimento de *Lactuca sativa* L. e *Brassica oleraceae* L. Rev Bras Biociên 5(2): 513–515.

SEDIYAMA MAN, SANTOS IC, LIMA PC (2014) Cultivo de hortaliças no sistema orgânico. Rev Ceres 61(Supl): 829–837. https://doi.org/10.1590/0034-737x201461000008

SEDIYAMA MAN, MAGALHÃES IPB, VIDIGAL SM, PINTO CLO, CARDOSO DSCP, FONSECA MCM, CARVAHO IPL (2016) Uso de fertilizantes orgânicos no cultivo de alface americana (*Lactuca sativa* L.). Rev Bras Agropec Sustent 6(2): 66–74. https://doi.org/10.21206/rbas.v6i2.308

SILVEIRA HRO, MATOS CC, FERRAZ EO, ALVARENGA ICA, SANTOS LDT, MARTINS ER (2013) Extrato aquoso de alecrim-pimenta no manejo da tiririca. Rev Ciên Agr - Amazon J Agricult Environm Sci 56(3): 221–226. http://dx.doi.org/10.4322/rca.2013.032

SOUZA JL, CASALI VWD, SANTOS RHS, CECON PR (2008) Balanço e análise da sustentabilidade energética na produção orgânica de hortaliças. Horticultura Brasileira 26(4): 433–440. http://dx.doi.org/10.1590/S0102-05362008000400003

TEIXEIRA IR, MOTA JH, SILVA AG (2005) Consórcio de Hortaliças. Semina Ciên Agrá 26(4): 507–514. http://dx.doi.org/10.5433/1679-0359.2005v26n4p507

VIEIRA A, GUIMARÃES MA, DAVID GQ, KARSBURG IV, CAMPOS ANR (2009) Efeito genotóxico da infusão de capítulos florais de camomila. Rev Trópica – Ciên Agrár Bio 3(1): 8–13.