

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 agrônômicas 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 derivatives 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; Sediyaama et al., 2014; Sediyaama 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

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 experiment 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 dystroferic 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 °C 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 °C 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*, *Cymbopogon 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 anthracosis highlights the efficiency of the extract against the fungus that

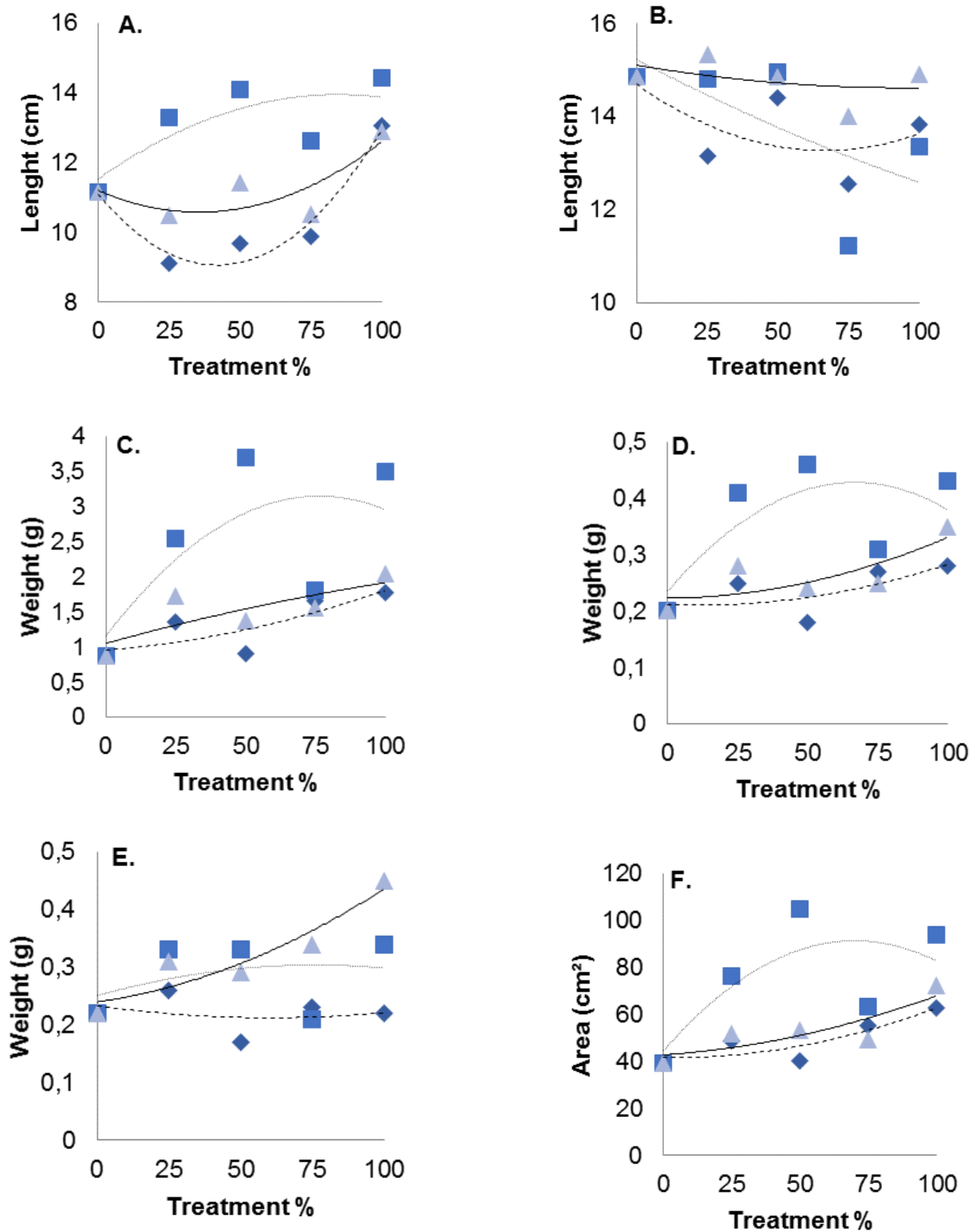


FIGURE 1. Effect of different infusion extracts and concentrations of Rosemary (▲), chamomile (■) and mint (◆) on the Aerial Length (A), Root Length (B), Aerial Part Fresh Weight (C), Aerial Part Dry Weight (D), Root Fresh Weight (E) and Foliar Area (F) of Cress on essay carried out on greenhouse at 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	$y = 0,000012 x^2 + 0,000027 x + 0,427$	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 mint 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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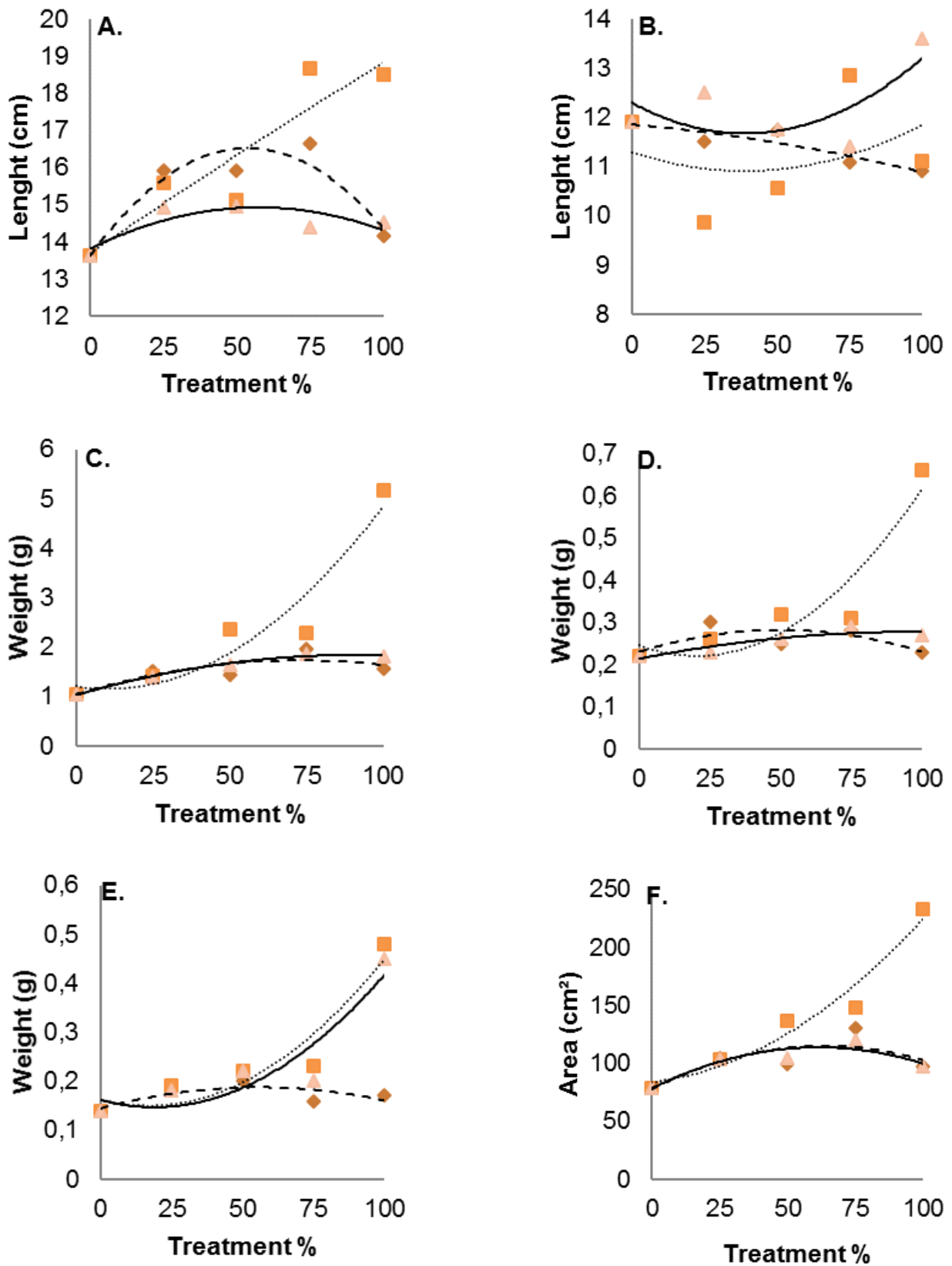


FIGURE 2. Effect of different infusion extracts and concentrations of Rosemary (▲), chamomile (■) and mint (◆) on the Aerial Length (A), Root Length (B), Aerial Part Fresh Weight (C), Aerial Part Dry Weight (D), Root Fresh Weight (E) and Foliar Area (F) of Arugula on essay carried out on greenhouse at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

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