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POPULATION FLUCTUATION OF *Tetranychus urticae* (ACARI: TETRANYCHIDAE) IN DIFFERENT CHRYSANTHEMUM VARIETIES IN GREENHOUSES

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Abstract: This research aimed at verifying the population fluctuation of the phytophagous spider mite *Tetranychus urticae* in four chrysanthemum (*Chrysanthemum morifolium* Ramat: Asteraceae) cultivars: Convington (Yellow - CVT), Kalamazoo (White - KLZ), White diamond (Cream - WD) and Royal Time (Pink - RT). Samples were taken every two weeks during two production cycles (March to April and August to October). In each sampling, leaves from 20 chrysanthemum plants were collected from each cultivar, one apical and one basal (40 leaves/cultivar sample). A total of 583 *T. urticae* individuals were collected, 41.9 % of the individuals in WD, 38.0 % in KLZ, 15.1 % in RT and 5.0 % in CVT. There were no significant differences in the populational density among the evaluated varieties ($p > 0.05$). Thus, the results indicated no significant differences in plant susceptibility to the phytophagous mite, suggesting that the four varieties are equally adapted to avoid *T. urticae* attack.

Keywords: flower shop; population density; two-spotted spider mite.

Chrysanthemum (*Chrysanthemum morifolium* Ramat: Asteraceae) is a long-life herbaceous plant with flowers appearing on branched stems (Streck 2004, Villanueva-Couoh *et al.* 2009), occurring throughout the year. The commercial production of these plants is performed in greenhouses, controlling environmental factors and thus obtaining a higher quality production (Barbosa *et al.* 2005). The precision in the photoperiod response with the floral stem production induced by this factor is other important characteristics, since the quality of the flowers depend on the light time (Brackmann *et al.* 2005).

The production area of chrysanthemum in Brazil is increasing over the years (Reddy *et al.* 2014). However, one of the main problems in flower cultivation are organisms that infest flowers and ornamental plants, such as mites, trips, whiteflies, aphids and mining larvae (Tamai *et al.* 1998), highlighting the phytophagous *Tetranychus urticae* Koch (Acari: Tetranychidae – two-spotted spider mite - TSSM) (Reddy *et al.* 2014). *Tetranychus urticae* (Trombidiformes, Tetranychidae) causes important damage to leaves of many crops, as cotton, strawberry, rose bush, tomato, bean, ornamental flowers, among others (Gallo *et al.* 2002). The species can be found in more than 1,100 host plant species of 140 families (Grbic *et al.* 2011). Spider mites feed on plant tissues using the stylet for breaking the leaf epidermis, damaging adjacent cells in a circle, resulting in the formation of small irregular spots (Moraes & Flechtmann 2008).

Considering the economic importance of chrysanthemum cultivation in the Brazilian market, the production of varieties susceptible to the phytophagous mite attack can cause diminished yield and market value loss. Therefore, this research aimed to improve the knowledge on population dynamics of the two-spotted spider mite by verifying the population density fluctuation in two production cycles in four chrysanthemum varieties to determine the magnitude of the attack and the possible effects on the reproduction rate caused by defense mechanisms of each cultivar.

Sampling was performed in commercial greenhouses and conventional production systems in Santa Clara do Sul County, Rio Grande do Sul, Brazil in 2017, using chrysanthemum plants from the following cultivars: Convington (Yellow - CVT), Kalamazoo (White - KLZ), White Diamond (Creme - WD) and Royal Time (Rosa - RT). Forty chrysanthemum leaves were collected in each cultivar, one apical and one basal per plant, totaling 20 plants per cultivar. The plants show similar leaf area, regardless of the variety. Sunil *et al.* (2018) report an average leaf area of 21.24 cm² in chrysanthemums. Samples were randomly collected during two production cycles (March to April and August to October), every two weeks. The material was stored in plastic bags, identified, numbered and packed in Styrofoam boxes containing artificial ice gel, for transport to the acarology laboratory of the Universidade do Vale do Taquari - Univates, Lajeado, Rio Grande do Sul state.

In the laboratory, the screening was performed with the aid of a stereoscopic microscope, where the adaxial and abaxial leave faces were evaluated for moving forms and mite eggs, as well as predatory mites. Immature forms and mite eggs were recorded, and the adult forms mounted on microscope slides in Hoyer's medium (Zhang 2003). The slides were kept in an oven at an average temperature of 50–60 °C for approximately eight days, for drying, fixation and clarification of the specimens. Identification was performed with a phase contrast optical microscope and using as reference the identification key of Baker *et al.* (1994). Vouchers were deposited at the Museu de Ciências Naturais (MCN) of the Universidade do Vale do Taquari-Univates, Lajeado, Rio Grande do Sul, Brasil.

For data analysis, we used descriptive statistics (mean ± standard deviation) of the density of the two-spotted spider mite per leaf. The phytophagous density in different chrysanthemum varieties were compared using the nonparametric Kruskal-Wallis test, following the recommendations of Callegari-Jacques (2006) and Gotelli and Ellison (2011), with significance level $\alpha = 5$ %, using PAST software version 3.22 (Hammer *et al.* 2001). The correlation of reproductive rate dynamics in different cultivars was established using Pearson's correlation test ($\alpha = 5$ %), as described in Zar (1996), using PAST software (Hammer *et al.* 2001).

The results indicated a total of 583 *T. urticae* individuals occurring in the four varieties; 41.9 % of the individuals were present in WD variety, 38.0 % in KLZ, 15.1 % in RT and 5.0 % in CVT, with a density average of 3.6 ± 8.9 mites/leaf. There were no significant differences in the density of mites among the evaluated varietals ($p > 0.05$). The higher density average of mites was observed at the end of each production cycle, corresponding to the final developmental stage of the chrysanthemums, being the plants almost ready for commercialization. The dynamics of the reproductive rate followed the trend described above, with more eggs per leaf present in the period that spider mite population peaks appeared (Figure 3 and 4), as confirmed by Pearson's Correlation test ($r = 0.7306$, $p < 0.05$).

Studies on cotton, gerbera, strawberry, tomato and papaya cultivars have demonstrated that significant differences in the population fluctuation of *T. urticae* might occur in varieties of different genotypes (Lourenção *et al.* 2000,

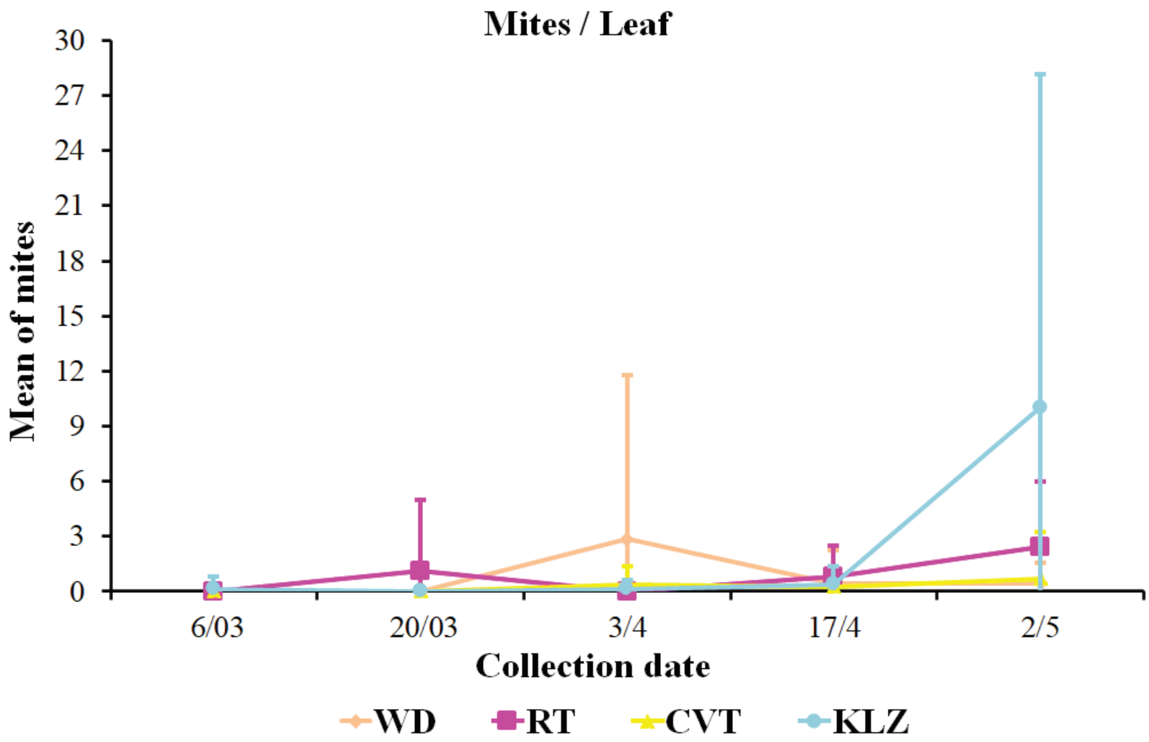

Figure 1. Average (± standard deviation) of mites per leaf in the varieties analyzed in March – April 2017 cycle in greenhouses of Santa Clara do Sul, Rio Grande do Sul, Brazil. Cultivars: CVT = Convington; KLZ = Kalamazoo; WD = White diamond; RT = Royal Time.

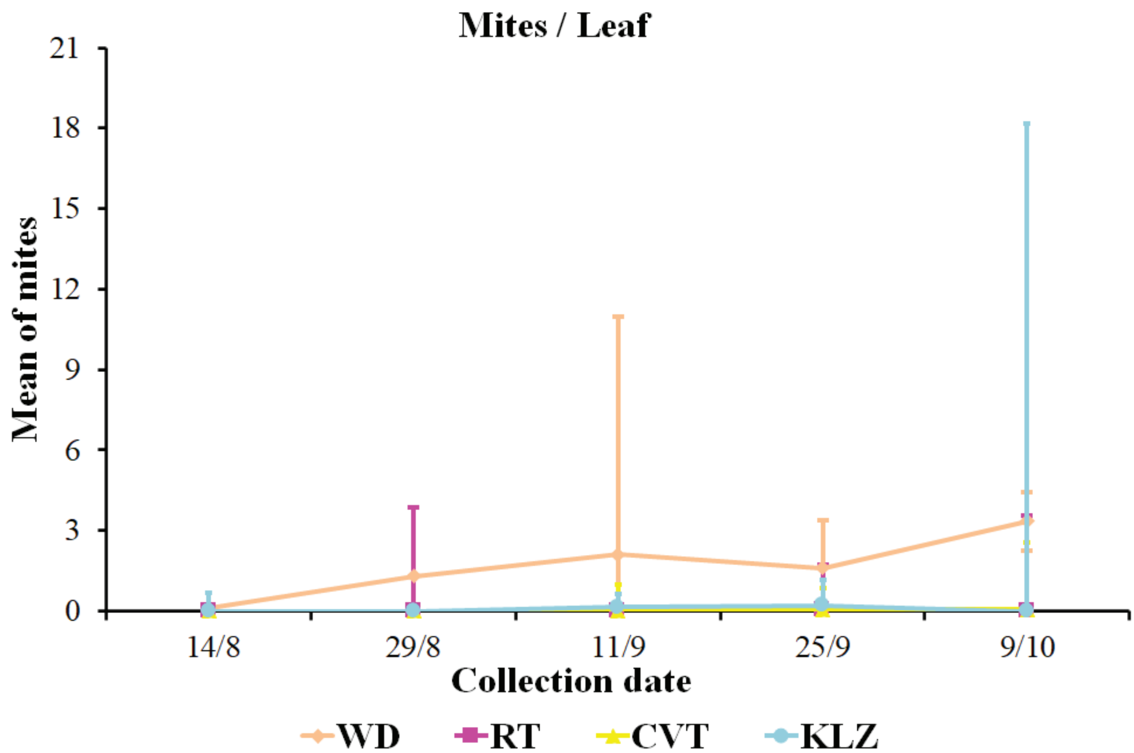

Figure 2. Average (± standard deviation) of mites per leaf in the varieties analyzed in the August – October 2017 cycle in greenhouses of Santa Clara do Sul, Rio Grande do Sul, Brazil. Cultivars: CVT = Convington; KLZ = Kalamazoo; WD = White diamond; RT = Royal Time.

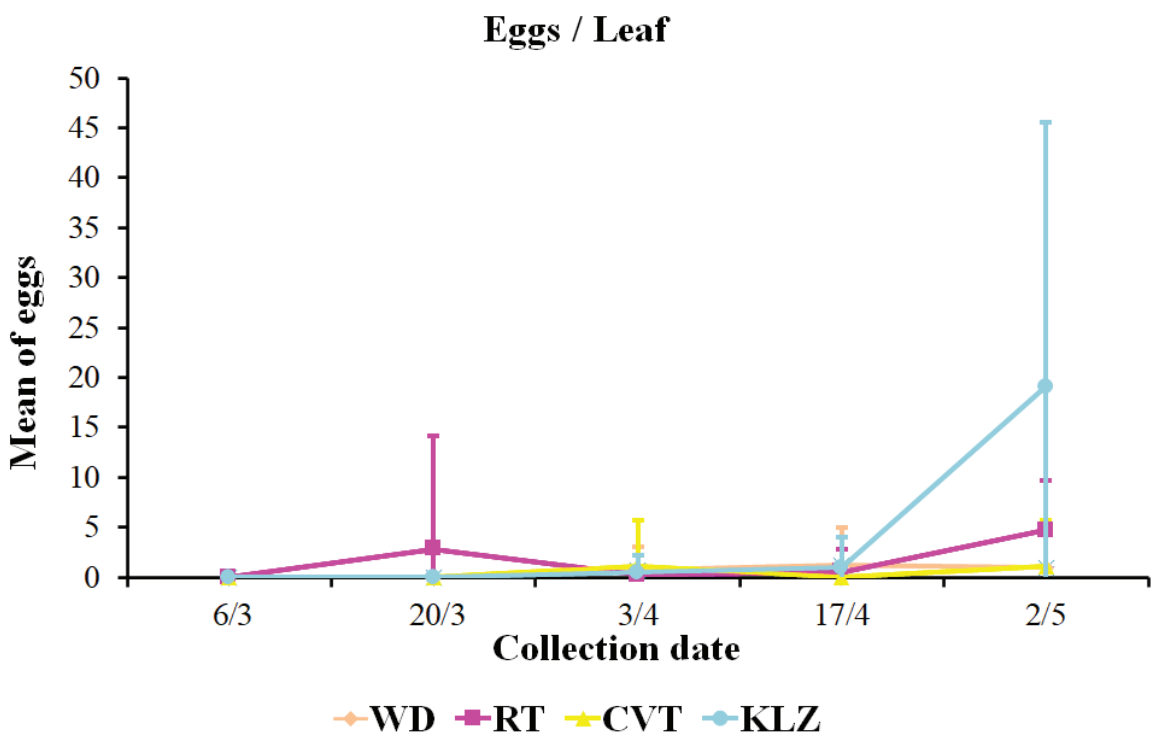

Figure 3. Average (± standard deviation) of *Tetranychus urticae* eggs per leaf in the varieties analyzed in the March – April 2017 cycle in greenhouses of Santa Clara do Sul, Rio Grande do Sul, Brazil. Cultivars: CVT = Convington; KLZ = Kalamazoo; WD = White diamond; RT = Royal Time.

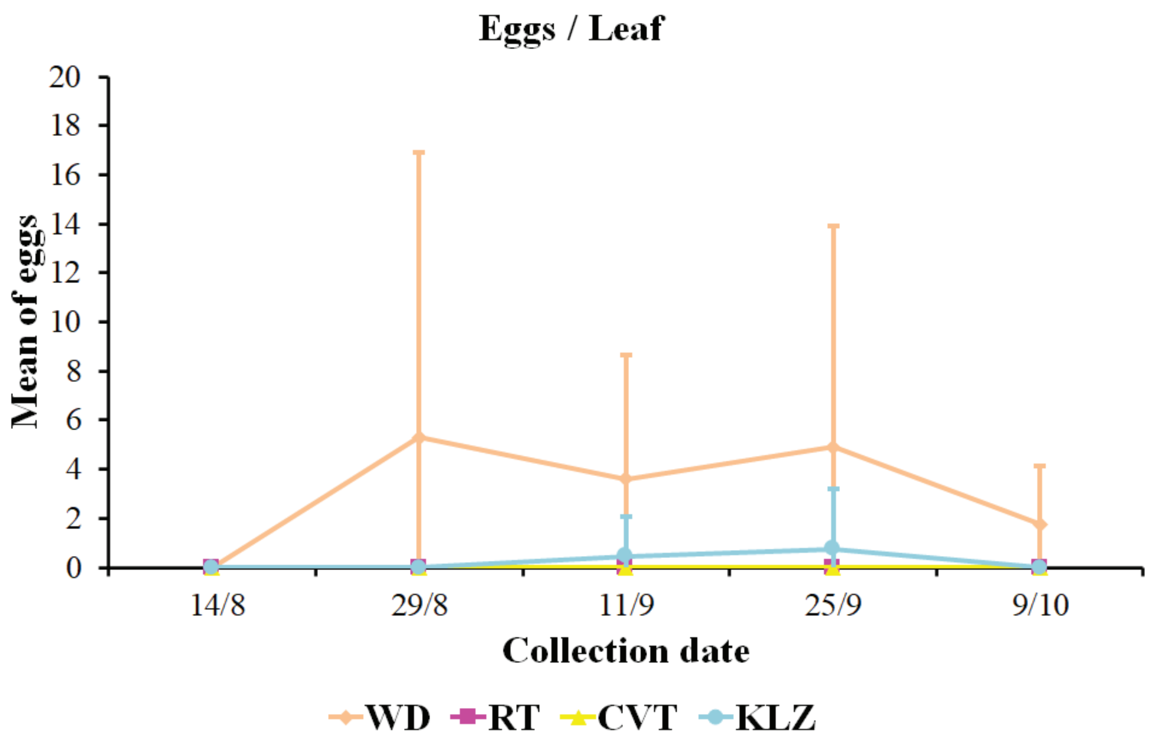

Figure 4. Average (± standard deviation) of *Tetranychus urticae* eggs per leaf in the varieties analyzed in the August – October 2017 cycle in greenhouses of Santa Clara do Sul, Rio Grande do Sul, Brazil. Cultivars: CVT = Convington; KLZ = Kalamazoo; WD = White diamond; RT = Royal Time.

Maruyama *et al.* 2002, Esteves Filho *et al.* 2010, Moro *et al.* 2012, Sulzbach *et al.* 2015). These differences can be attributed to different volatile types produced by plants when attacked by phytophagous mites (Dicke 1988, Pallini *et al.* 1997). In the present study, the mite density was low when compared to studies using other commercial crops. Sulzbach *et al.* (2015) observed an average density of 25.5 mites per gerbera leaf in Três Irmãos County, RS, and Noorbo *et al.* (2018) recorded an average population of 8.5 to 15.0 mites/leaf in 20 varieties of roses, yet for a better comparison, it is necessary to consider the leaf area of each species.

We ascribe the absence of predatory mites to the management established in the chrysanthemum varieties production, considering that phytoseiid predators are more sensitive than *T. urticae* to the use of pesticides, especially *P. macropilis* (Poletti *et al.* 2007, Uddin *et al.* 2015). We highlight that the resurgence of *T. urticae* infestations may occur due to the absence of natural control by predators and to its resistance to conventional pesticides.

The CVT variety presented a lower number of phytophagous mites in both evaluated periods. However, no significant differences in the population density among the evaluated varietals was found ($p > 0.05$). Consequently, no difference regarding the plant varieties' susceptibility to the phytophagous mite was found. These results suggest that these chrysanthemum varieties do not differ in their capacity to avoid mite phytophagy. Notwithstanding, the synthesis and accumulation of compounds that promote plant defense against herbivores are usually induced by phytophagy. The defense of plants consists of chemical and physiological processes. First the compounds act in repellency through direct or reduced toxicity in plant tissues, and second, the plant acts with inducible effects synthesized to responses caused by phytophagous organisms (Mello & Silva-Filho 2002). Therefore we consider that plant defense compounds might not be produced while *T. urticae* population densities are low. The cultivation of these plants in the Southern Region of Brazil stands out, considering their relationship with insects and mites. These arthropods can reach the status of pests when present in higher abundances and cause economic impact. To confirm these results, the authors recommend further studies on the biology of *T. urticae* and their interaction with the varieties of chrysanthemum evaluated in this study.

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