Journal of Agricultural Science; Vol. 10, No. 8; 2018
ISSN 1916-9752 E-ISSN 1916-9760
Published by Canadian Center of Science and Education

Chamomile Cultivation Submitted to Ultra-diluted Phosphorus Solutions

Cassiane Ubessi[1], Valéria dos Santos da Rosa[1], Dionatan Ketzer Krysczun[1], Fernanda Carini[1], Solange Bósio Tedesco[2], Cristiane de Bona da Silva[3] & Jerônimo Luiz Andriolo[1]

[1] Department of Plant Science, Federal University of Santa Maria, Santa Maria, Rio Grande do Sul, Brazil

[2] Department of Biology, Federal University of Santa Maria, Santa Maria, Rio Grande do Sul, Brazil

[3] Department of Industrial Pharmacy, Federal University of Santa Maria, Santa Maria, Rio Grande do Sul, Brazil

Correspondence: Cassiane Ubessi, Department of Plant Science, Federal University of Santa Maria, Santa Maria, RS, CEP: 97105-900, Brazil. E-mail: cassi.ubessi@yahoo.com.br

Received: April 4, 2018 Accepted: May 15, 2018 Online Published: July 15, 2018

doi:10.5539/jas.v10n8p305 URL: https://doi.org/10.5539/jas.v10n8p305

Abstract

Homeopathic medicines may present differentiated responses in the cultivation of medicinal plants, altering the plant metabolism. The aim was to verify and describe the pathogenic symptoms caused by the application of Phosphorus in the cultivation of chamomile, aiming at the production of flowers. Four dynamizations, 3CH, 6CH, 12CH and 30CH (centesimal scale: CH = centesimal hahnemannian), were evaluated in the Mandirituba chamomile cultivar. Control pots received only distilled water and 70% alcohol in the same amount and proportion of homeopathic medicine. The variables analyzed from the harvest of the flowers are related to the parameters of inflorescence and plant production of chamomile. There was no difference between the dynamizations applied for the number of flowers plant^{-1}, dry mass plant^{-1}, dry mass hectare^{-1}, number of branches and plant height. The characters of flowers mass plant^{-1}, and production of fresh and dried flowers did not differ from the averages presented by the witnesses; however, in the 30CH dynamization, values higher than the others were observed, as well as for fresh mass plant^{-1} and hectare^{-1}. The diameter and the height of the flower expressed better results in the 3CH dynamization. The application of Phosphorus promotes pathogenesis in the cultivation of chamomile with increases in the characters related to the inflorescence.

Keywords: *Chamomilla recutita*, Homeopathy, dynamization, pathogenesis

1. Introduction

Homeopathy is a science founded by the German physician Samuel Hahnemann (Relton et al., 2017) and had its basis described by Hippocrates 450 years B.C. in ancient Greece. It is a science based on four principles: similarity, experimentation in healthy individuals; minimal or infinitesimal doses; and unique remedy. In Brazil, the use of Homeopathy is regulated by law in organic agriculture (Brasil, 2008), however, it is also widely used in other agricultural systems, either for improvements in the production system or in pest and disease control.

There are numerous homeopathic medicines being used in agriculture, according to their peculiarity and effect promoted in the vegetables. Dilutions of Carbo vegetabilis (6CH), Silicea land (30CH) and Sulphur (30CH) promoted increase in the fresh and dry mass of broccoli inflorescences (Pulido et al., 2017), as did Phosphorus 30CH applied to seeds of lettuce (*Lactuca sativa* L.) (Queiroz et al., 2015). Some homeopathic medicines are used in the control of phytopathogenic microorganisms (Trebbi et al., 2016; Shah-Rossi et al., 2009), such as Berberis vulgaris in the control of rust, powdery mildew and downy mildew (Bonato, 2014), and Propolis (6CH, 12CH and 30CH) to minimize the severity of early blight in tomato (Toledo et al., 2015). They are also used to reduce the incidence of insects such as aphids and thrips (Wyss et al., 2010; Gonçalves et al., 2017).

The homeopathic medicines can also be used instead of chemical inputs. As an alternative of sustainable agriculture, the Homeopathy is inserted in this scenario aiming at the production of healthy foods, in equilibrium with the environment, without leaving toxic residues and reducing the use of chemical inputs, such as phosphorus. This chemical element is present in the processes of respiration and photosynthesis of plants, directly related to plant growth (Taiz & Zeiger, 2013). It presents little availability in soils and in the form of phosphate fertilizer comes from phosphate rocks, a non-renewable resource, in addition to the pollutant potential of surface water (Klein & Agne, 2012). Phosphorus homeopathic medicine comes from organic salts of phosphorus (Casali et al., 2009), diluted numerous times until it reaches the desired dynamization. In agriculture, its use is indicated for crops in soils with low availability of phosphorus, when the species exhibits excess sweating due to heat intolerance and when there is a reduction in the photosynthetic rate (Tichavsky, 2007; Bonato 2014; Resende, 2014). However, there is still a lack of clarity about its potential effect on vegetables, especially on medicinal plants.

Medicinal plants have been used by humanity for many years with the intention to treat and cure diseases. Among these, chamomile (*Chamomilla recutita* (L.) Rauschert) is among the most consumed species in the world and has the largest cultivated area in Brazil (Corrêa Junior & Scheffer, 2014; Singh et al., 2011). This is due to its therapeutic properties and its production of essential oil of high economic value (Raal et al., 2012; Amaral et al., 2014). In chamomile, essential oil is only found in floral chapters and, like its aqueous extracts, it has anti-inflammatory, bactericidal, healing and soothing properties (Singh et al., 2007; Bakkali et al., 2008; Vieira et al., 2009; Raal et al., 2012). The flower is the main marketable product in the cultivation of chamomile, which does not present studies with homeopathic medicines aiming the production of flowers.

The application of homeopathic medicines is capable of altering the plant metabolism (Casali et al., 2010; Andrade et al., 2012), which respond to factors that surround the plant in the growing environment. Considering the healthy plant a living being, it undergoes action from the homeopathic medicines, and as a defense to this effect, it reacts and responds with alterations in its metabolism, characterizing the pathogenesis of the medicine, that is, the set of symptoms (any and every reaction/response of the plant, compared to a blank test) that a homeopathic substance can cause in the plant. The pathogenic symptoms make up the medical matter of the homeopathic medicine, and the experimentation in healthy plants contributes to the employment of Homeopathy in agriculture, that is, its indication of use.

Given the economic importance of chamomile, its use and cultivation, and the scarcity in describing the effects of homeopathic medicines on this species, the objective of this work was to verify and describe the pathogenic symptoms caused by the application of Phosphorus in the cultivation of chamomile, aiming at the production of flowers.

2. Material and Methods

The experiment was conducted in a protected environment and carried out by the Plant Science Department at the Federal University of Santa Maria (UFSM), Santa Maria, RS, Brazil (29°42′23″S; 53°43′15″W and 95 meters of altitude at sea level). The climate of the region is of type Cfa, according to the classification of Köppen (Alvares et al., 2013).

2.1 Sowing and Conducting the Experiment

The seeds of chamomile of the cultivar Mandirituba were acquired directly from a seed producer in the municipality of Mandirituba, Paraná, Brazil, through Emater - Paraná. The sowing was carried out in pots with volume of 4.9 liters containing H.Decker® substrate, distributed in asbestos cement tiles filled with crushed stone. After the emergence there was thinning and maintenance of only one plant per pot.

The nutrient solution was supplied according to the needs of the crops and in the following proportions for macronutrients (m mol L^{-1}): 9.85 NO_3; 1.15 NH_4; 0.80 H_2PO_4; 6.00 K; 3.50 Ca^{2+}; 2.50 Mg^{2+}; 2.50 $(SO^{2-})_4$, and micronutrients (mg L^{-1}): 0.03 Mo; 0.26 B; 0.06 Cu; 0.50 Mn; 0.22 Zn and 1.00 Fe. The nutrient solution presented electrical conductivity (EC) equal to 1.4 dS/m and pH of 6.2. The fertilizers used as the source for the macronutrients were potassium nitrate, monoammonium phosphate, magnesium sulfate and Calcinit®. The formulation of the nutrient solution took into consideration the recommendation of cultivation for chamomile and the cultivation of medicinal plants in a semi-hydroponic system. The distribution of the solution was performed by means of a dripping hose arranged in each row of pots, so that each dripper matched a pot. The other cultivation procedures followed the technical recommendations for the chamomile (Corrêa Junior et al., 2008).

During the experiment the temperature inside the protected environment was monitored with the help of the manual appliance Datalogger Akso® 170 model, with eight daily measurements of temperature at 1, 4, 7, 10, 13, 16, 19 and 22 h.

2.2 Application of Homeopathic Medicines

The treatments consisted in the application of the homeopathic medicine Phosphorus, in the 3CH, 6CH, 12CH and 30CH dynamizations. The drug was purchased from a homeopathic pharmacy in the city of Santa Maria, RS, prepared in 70% alcohol (v v^{-1}). The different dynamizations were diluted in distilled water in the proportion of

0.5 mL L^{-1}. The application was carried out in the aerial part of the plants by spraying, in the amount of 100 mL per plant, twice a week, after the emergence of the plants until the end of the experiment at 136 days after sowing (from August to December). Control treatment received only distilled water and 70% alcohol in the same amount and proportion of homeopathic medicine.

2.3 Measurement of Variables

The flowers were harvested manually when the flowers were at 180° angle (Corrêa Junior et al., 2008; Amaral et al., 2014). From the harvest, the other variables were estimated.

Flowers number $plant^{-1}$: Number of flowers collected throughout the experiment in each plant (number (n)).

Flowers mass $plant^{-1}$: Mass of flowers collected throughout the experiment in each plant (grams (g)).

Production of fresh flowers: Mass of flowers collected at the end of the experiment transformed into hectares (kilograms per hectare (kg ha^{-1})).

Production of dried flowers: Determined by means of the 20% discount of fresh mass loss of the production of fresh flowers (kilograms per hectare (kg ha^{-1})), that is, every kilo of fresh flowers results in 200 grams of dry flowers.

Fresh mass $plant^{-1}$: At the end of the experiment the plants were harvested and weighed in a precision analytical balance (grams (g)).

Dry mass $plant^{-1}$: Determined with the conditioning of the plants in a drying oven, with forced circulation of air, the temperature of 60 °C, until reaching constant mass.

Fresh mass $hectare^{-1}$: Obtained by means of fresh mass per processed plant for hectares (kilograms per hectare (kg ha^{-1})).

Dry mass $hectare^{-1}$: Defined as the dry mass value per transformed plant per hectare (kilograms per hectare (kg ha^{-1})).

Number of branches: The count at the end of the experiment of all branches at the base of the plant (number (n)).

Plant height: Evaluated at the end of the experiment from the central branch of the plant (centimeters (cm)).

Flower diameter: Diameter of the floral structure including the center and the ligulate flowers (millimeters (mm)).

Flower height: The value of the floral structure measured vertically from the base to the apex of the floral structure (millimeters (mm)).

2.4 Statistics and Experimental Design

The experiment was conducted according to a completely randomized and double-blind design with 6 treatments: 4 Phosphorus dynamizations (3CH, 6CH, 12CH and 30CH), distilled water and 70% alcohol. Each bench represented a treatment and was composed of 20 pots spaced 0.30 meters apart in two rows, totaling 4 replicates of 5 experimental units. The treatments were compared using an analysis of variance ($p < 0.05$) and by the means comparison test of Scott and Knott (1974) at a 5% error probability level, with the aid of the statistical program Genes (Cruz, 2013).

3. Results

The analysis of variance showed a significant difference between dynamizations for most of the analyzed characters, including: flowers mass $plant^{-1}$, fresh flower production, dry flower production, fresh mass $plant^{-1}$, fresh mass $hectare^{-1}$, flower diameter and height of flower. In the other characters, number of flowers $plant^{-1}$, dry mass $plant^{-1}$, dry mass $hectare^{-1}$, number of branches and plant height, there was no difference between the dynamizations applied.

For the characters flowers mass $plant^{-1}$, fresh flower production and dry flower production, the dynamizations did not differ from the means of the controls and are shown in Figures 1 and 2. Even so, it should be noted that among the dynamizations, the 30CH showed values higher than the others, while 6CH showed a decrease.

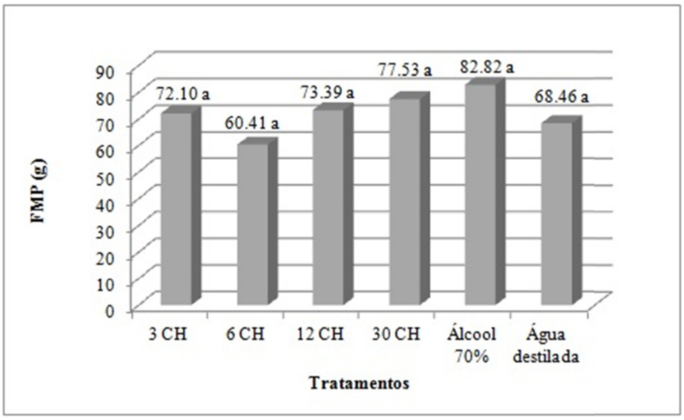

Figure 1. Flowers mass plant^{-1} (FMP) of chamomile submitted to different Phosphorus dynamizations

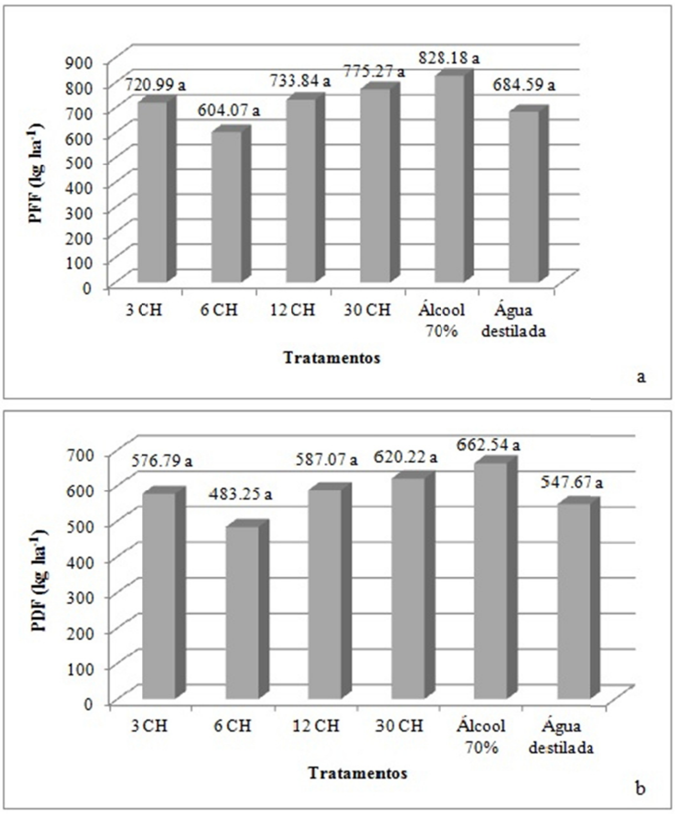

Figure 2. Production of fresh flowers hectare^{-1} (PFF) (a) and production of dried flowers hectare^{-1} (PDF) (b) of chamomile submitted to different Phosphorus dynamizations

For the variables fresh mass plant^{-1} and fresh mass hectare^{-1}, the 30CH dynamization provided higher efficiency, but did not diverge from the control distilled water (Figure 3). For these two characters, the dynamizations 3CH and 12CH showed a decline in relation to the others, that is, they promoted a limiting effect on the production of fresh mass.

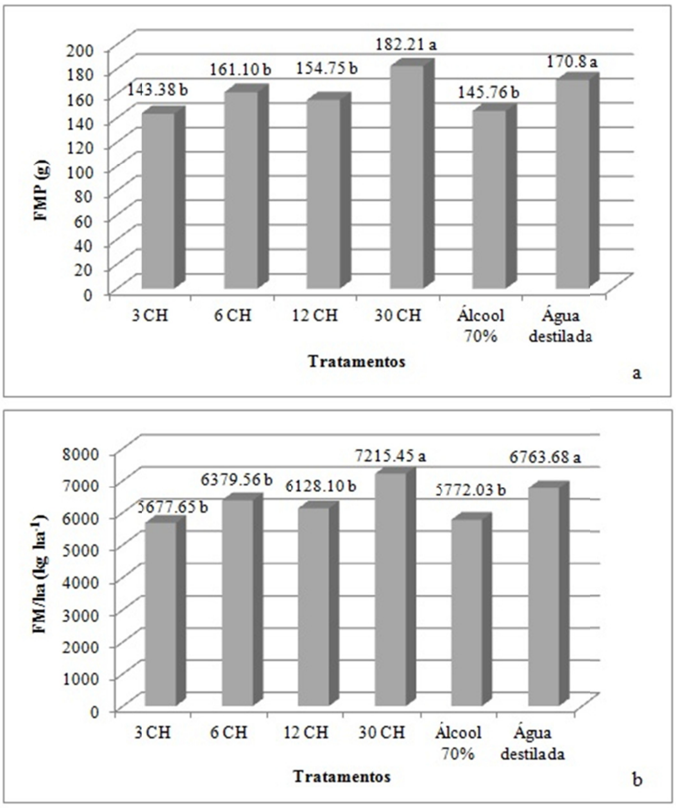

Figure 3. Fresh mass plant^{-1} (FMP) (a) and fresh mass hectare^{-1} (FM/ha) (b) of chamomile submitted to different Phosphorus dynamizations

The attributes specifically related to the inflorescence of the species, such as diameter and height of flower, obtained better performance in 3CH dynamization, however, the height did not differ from 12CH and the alcohol control (Figure 4). For the 6CH dynamization, lower results were observed for the other characters related to the inflorescence of chamomile.

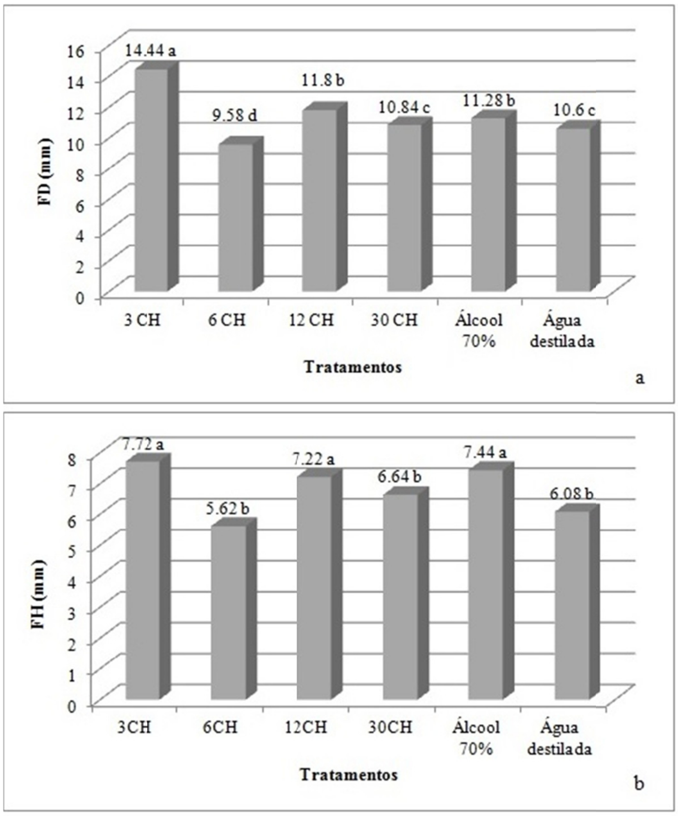

Figure 4. Flower diameter (FD) (a) and flower height (FH) (b) in chamomile submitted to different Phosphorus dynamizations

It should be noted the average production of fresh and dried flowers was above 400 kg hectare^{-1} (Figure 2), average value of field production. It is important to emphasize the contribution of the homeopathic medicine in reaching this level, regardless of the dynamization used. During the experiment the temperature inside the protected environment was also monitored to ensure the full development of the plants (Figure 5), at intervals of 15 days until the end of the experiment. The temperature showed an oscillation between 13.4 °C and 30.5 °C during the experiment, with an average of 17 °C minimum and 26 °C maximum throughout the experiment (Figure 5).

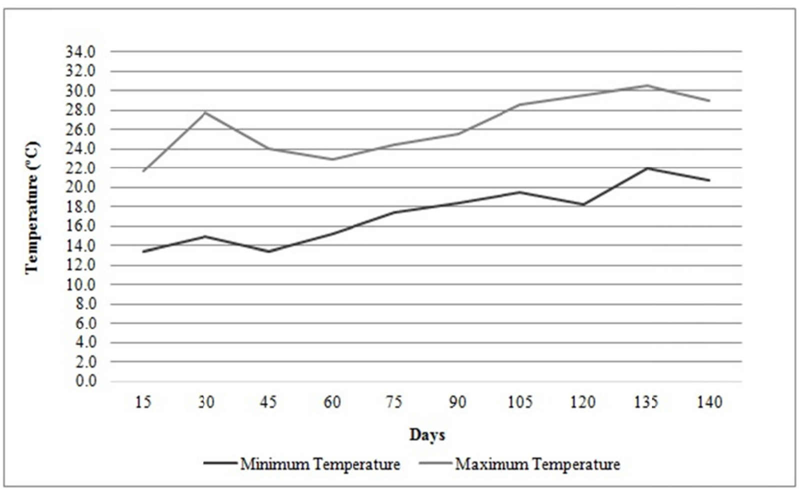

Figure 5. Minimum and maximum temperature in the cultivation of chamomile in protected environment

4. Discussion

The homeopathic medicine Phosphorus promoted changes in the parameters evaluated in chamomile when compared to the controls that did not receive the medicine. These changes characterize the pathogenic symptoms of Phosphorus application. Chamomile is a species that responded positively to the different dynamics used, except for some morphological characters such as the number of flowers plant^{-1}, dry mass plant^{-1}, dry mass hectare^{-1}, number of branches and plant height. This is in agreement with the hypothesis that the homeopathic treatment is able to significantly interfere in plant metabolism (Santos et al., 2011). Chamomile has been shown to be sensitive to the homeopathic medicine Phosphorus by altering the response of some characters, especially those related to the inflorescence of the species, such as diameter and flower height. These two characters are linked to the production of essential oil and the marketable factor of the crop, which can thus aggregate value to the production of chamomile flowers without the need of excessive use of chemical inputs.

Research with healthy plants is a useful tool to investigate the specificity of homeopathic medicines, especially the fluctuations between levels of dynamizations (Jäger et al., 2015). Considering the experimentation in a healthy being, the symptomatic context, with increments or decreases in certain characters, configures pathogenesis. The changes observed in chamomile are the result of the action of the homeopathic medicine Phosphorus and the symptoms provoked in the vegetable (pathogenesis), in which each dynamization determines a differentiated response according to the evaluated character. Thus, it was observed that there is no linear relationship between the increase in dynamization and the response of the plant.

The minimum morphological changes in some of the analyzed characters can be explained by the equilibrium cultivation that the plants were submitted to, with ideal and satisfactory conditions for the production, and also by the natural balance of the plant itself in relation to the evaluated characteristics. However, pathogenesis is dependent on the homeopathic drug, the dynamization and the plant species (E. Kolisko & L. Kolisko, 1978; Casali et al., 2009; Santos et al., 2011), so this response is random and variable.

Vasconcelos et al. (2004) studied the effect of Phosphorus on wheat plants (*Triticum aestivum* L.) with and without organic fertilization and verified that the drug in the 3CH and 6CH dynamizations reduced the values of fresh mass. The best results corresponded to the higher dynamizations, above 12CH, corroborating the response obtained for chamomile, for which the 30CH dynamization showed better results. When evaluating the effect of Phosphorus 3CH on lemon grass (*Cymbopogon citratus*), Casali et al. (2009) observed that this dynamization decreased plant height and leaf mass. In chamomile, this same dynamization only showed decreases in the characters fresh mass plant^{-1} and fresh mass hectare^{-1}, while 6CH showed a reduction in the other variables. Phosphorus response was also shown to be variable by Scherr et al. (2007) when evaluating several dynamizations in Water Lentil (*Lemna gibba* L.). The species *Aloysia gratissima* L. also showed sensitivity to homeopathic Phosphorus, with positive responses on germination and seedling initial growth (Santos et al., 2011).

The response to homeopathic medicines can manifest itself in several parts or different pathways of the metabolism of the plant organism (Jäger et al., 2015). It is common to observe that the same homeopathic remedy can cause diverse and distinct effects by increasing or decreasing a variable (Santos et al., 2011; Andrade et al., 2012; Oliveira et al., 2013; Capra et al., 2014), this characterizes the importance of the agronomic research to elucidate what effects each homeopathic medicine can cause in the plants and thus, to expand its recommendation of use. In addition, plants are organisms that respond to the action of homeopathic medicine, once they react to these substances.

5. Conclusions

Phosphorus dynamizations promoted differentiated responses in the cultivation of chamomile, characterizing the pathogenic symptoms.

The production of flowers hectare^{-1} can be increased with the application of the 30CH dynamization and the flower diameter and height with the use of 3CH dynamization.

References

Alvares, C. A., Stape, J. L., Sentelhas, P. C., Gonçalves, J. L. M., & Sparovek, G. (2013). Köppen's climate classification map for Brazil. *Meteorologische Zeitschrift, 6*, 711-728. https://doi.org/10.1127/0941-2948/2013/0507

Amaral, W., Deschamps, C., Machado, M. P., Koeler, H. S., Scheer, A. P., & Côcco, L. C. (2014). Desenvolvimento da camomila, rendimento e qualidade do óleo essencial em diferentes idades de colheita. *Revista Brasileira de Plantas Medicinais, 16*, 237-242. https://doi.org/10.1590/S1516-05722014000200011

Andrade, F. M. C., Casali, V. W. D., & Cecon, P. R. C. (2012). Efeito de dinamizações de *Arnica montana* L. no metabolismo de chambá (*Justicia pectoralis* Jacq.). *Revista Brasileira Plantas Medicinais, 14*, 159-162. https://doi.org/10.1590/S1516-05722012000500006

Bakkali, F., Averbeck, S., Averbeck, D., & Idaomar, M. (2008). Biological effects of essential oils. *Food and Chemical Toxicology, 46*, 446-475. https://doi.org/10.1016/j.fct.2007.09.106

Bonato, C. M. (2014). *Homeopatia simples: Alternativa para a agricultura familiar* (4th ed.). Marechal Cândido Rondon: Gráfica Escala.

Brasil. (2008). *Instrução Normativa n. 64 de 18 de dezembro de 2008* (Seção 1, p. 21). Ementa: Aprova o Regulamento Técnico para os Sistemas Orgânicos de Produção Animal e Vegetal, Diário Oficial da União, Brasília. Retrieved from http://www.agencia.cnptia.embrapa.br/Repositorio/instrucao_normativa_num64_de_18_dezembro_2008_000g0kwipmd02wx5ok026zxpgygu2tcm.pdf

Capra, R. S., Gratão, A. S., Freitas, G. B., & Leite, M. N. (2014). Preparados homeopáticos e ambiente de cultivo na produção e rendimento de quercetina em carqueja (*Baccharis trimera* (Less) DC.). *Revista Brasileira de Plantas Medicinais, 16*, 566-573. https://doi.org/10.1590/1983-084X/13_043

Casali, V. W. D., Andrade, F. M. C., & Duarte, E. S. M. (2009). *Acologia de Altas Diluições: Resultados científicos e experiências sobre uso de preparados homeopáticos em sistemas vivos*. Universidade Federal de Viçosa, Departamento de Fitotecnia, Viçosa, MG.

Casali, V. W. D., Castro, D. M., Armond, C., Fonseca, M. C. M., Andrade, F. M. C., Duarte, E. S. M., & Arruda, V. M. (2010). Benefícios da homeopatia no cultivo de plantas medicinais. *Informe Agropecuário, 31*, 79-84.

Corrêa Junior, C., & Scheffer, M. C. (2014). As plantas medicinais, aromáticas e condimentares e a agricultura familiar. *Horticultura Brasileira, 32*, 376-376. https://doi.org/10.1590/S0102-05362014000300023

Corrêa Junior, C., Scheffer, M. C., Borsato, A. V., & Dranka, E. (2008). *O cultivo da camomila (Chamomilla recutita (L.) Rauschert)*. Curitiba: Emater.

Cruz, C. D. (2013). Genes: A software package for analysis in experimental statistics and quantitative genetics. *Acta Scientiarum. Agronomy, 35*, 271-276. https://doi.org/10.4025/actasciagron.v35i3.21251

Gonçalves, P. A. S., Boff, P., & Araújo, E. R. (2017). Altas diluições dinamizadas de nitrato de cálcio e sulfato de potássio no manejo de tripes, míldio e rendimento de cebola em sistema orgânico de produção. *Revista Thema, 14*, 16-24. https://doi.org/10.15536/thema.14.2017.16-24.563

Jäger, T., Scherr, C., Shah, D., Majewsky, V., Wolf, U., Betti. L., & Baumgartner, S. (2015). The use of plant-based bioassays in homeopathic basic research. *Homeopathy, 104*, 277-282. https://doi.org/10.1016/j.homp.2015.06.009

Klein, C., & Agne, S. A. A. (2013). Fósforo: De nutriente à poluente! *Revista Eletrônica em Gestão, Educação e Tecnologia Ambiental, 8*, 1713-1721. https://doi.org/10.5902/223611706430

Kolisko, E., & Kolisko, L. (1978). *Agriculture of tomorrow* (2nd ed.). Acorn Press, Bournemouth, England.

Oliveira, J. S. B., Gomes, S. M. T. P., Schwan-Estrada, K. R. F., Mesquini, R. M., Bonato, C. M., & Romano, E. D. B. (2013). Patogenesia do óleo essencial e homeopatias de *Eucalyptus citriodora* em plantas de feijão (*Phaseolus vulgaris*). *Revista Brasileira de Plantas Medicinais, 15*, 734-741. https://doi.org/10.1590/S1516-05722013000500014

Pulido, E., Boff, P., Duarte, T., & Boff, M. I. (2017). High dilution preparations for organic production system of broccoli. *Agronomía Colombiana, 35*, 53-58. https://doi.org/10.15446/agron.colomb.v35n1.58586

Queiroz, R. L., Duarte, E. S. M., Marques, M., Goulart, V. A., & Marques, G. F. (2015). Formação de mudas de alface provenientes de sementes peletizadas com altas diluições. *Revista Fitos, 9*, 161-252. https://doi.org/10.5935/2446-4775.20150014

Raal, A., Orav, A., Pussa, T., Valner, C., Malmiste, B., & Arak, E. (2012). Content of essential oil, terpenoids and polyphenols in commercial chamomile (*Chamomilla recutita* L. Rauschert) teas from different countries. *Food Chemistry, 131*, 632-638. https://doi.org/10.1016/j.foodchem.2011.09.042

Relton, C., Cooper, K, Viksveen, P., Fibert, P., & Thomas, K. (2017). Prevalence of Homeopathy use by the general population worldwide: A systematic review. *Homeopathy, 106*, 69-78. https://doi.org/10.1016/j.homp.2017.03.002

Resende, J. M. (2014). *Caderno de homeopatia: instruções práticas geradas por agricultores sobre o uso da homeopatia no meio rural*. Viçosa, MG: UFV.

Santos, F. M., Monfort, L. E. F., Castro, D. M., Pinto, J. E. B. P., Leonardic, M., & Pistelli, L. (2011). Characterization of essential oil and effects on growth of *Verbena gratissima* plants treated with homeopathic Phosphorus. *Natural Product Communications, 10*, 1-6.

Scherr, C., Simon, M., Spranger, J., & Baumgartner, S. (2007). Duckweed (*Lemna gibba* L.) as a test organism for homeopathic potencies. *The Journal of Alternative and Complementary Medicine, 13*, 931-937. https://doi.org/10.1089/acm.2007.0506

Scott, A. J., & Knott, M. (1974). A cluster analysis method for grouping means in the analysis of variance. *Biometrics, 30*, 507-512. https://doi.org/10.2307/2529204

Shah-Rossi, D., Heusser, P., & Baumgartner, S. (2009). Homeopathic treatment of *Arabidopsis thaliana* plants infected with *Pseudomonas syringae*. *Scientific World Journal, 9*, 320-330. https://doi.org/10.1100/tsw.2009.38

Singh, G., Maurya, S., DeLampasona, M. P., & Catalan, C. A. (2007). A comparison of chemical, antioxidant and antimicrobial studies of cinnamon leaf and bark volatile oils, oleoresins and their constituents. *Food and Chemical Toxicology, 45*, 1650-1661. https://doi.org/10.1016/j.fct.2007.02.031

Singh, O., Khanam, Z., Misra, N., & Srivastava, M. K. (2011). Chamomile (*Matricaria chamomilla* L.): An overview. *Pharmacognosy Reviews, 5*, 82-95. https://doi.org/10.4103/0973-7847.79103

Taiz, L., & Zeiger, E. (2013). *Fisiologia vegetal* (5th ed.). Porto Alegre: Artmed.

Tichavsky, M. R. (2007). *Manual de Agrohomeopatía* (1st ed.). Monte Rei, México.

Toledo, M. V., Stangarlin, J. R., & Bonato, C. M. (2015). Controle da pinta preta e efeito sobre variáveis de crescimento em tomateiro por preparados homeopáticos. *Summa Phytopathologica, 41*, 126-132. https://doi.org/10.1590/0100-5405/1944

Trebbi, G., Nipoti, P., Bregola, V., Brizzi, M., Dinelli, G., & Betti, L. (2016). Ultra high diluted arsenic reduces spore germination of *Alternaria brassicicola* and dark leaf spot in cauliflower. *Horticultura Brasileira, 34*, 318-325. https://doi.org/10.1590/S0102-05362016003003

Vasconcelos, E. S., Bonato, C. M., Pintro, J. C., Chicati, M. L., Massariol, D. M., & Pricinotto, L. F. (2004). Avaliação do crescimento de *Triticum aestivum* submetido a diferentes níveis de adubação e preparado homeopático Phosphorus. *Arquivos Apadec, 8*, 1261.

Vieira, M. C., Zárate, N. A. H., Sanches, M. A. S., Nunes, M. C., & Bendassolli, F. (2009). Doses de nitrogênio e de cama de frango na produção da camomila "Mandirituba". *Acta Scientiarum. Agronomy, 31*, 79-85. https://doi.org/10.4025/actasciagron.v31i1.6632

Wyss, E., Tamm, L., Siebenwirth, J., & Baumgartnet, S. (2010). Homeopathic preparations to control the Rosy Apple Aphid (*Dysaphis plantaginea* Pass.). *The Scientific World, 10*, 38-48. https://doi.org/10.1100/tsw.2010.12

Copyrights