

Homeopathic drugs *Arsenicum album* and *Sulphur* affect the growth and essential oil content in mint (*Mentha arvensis* L.)

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ABSTRACT. Effects of homeopathic drugs *Sulphur* and *Arsenicum album* in growth variables and essential oil content of mint are analyzed. Four homeopathic dinamizations (6, 12, 24 and 30CH) were used for both drugs in the centesimal scale (CH=centesimal hahnemannian), besides control (water). Treatments were conducted in greenhouse and homeopathic drugs applied weekly (250 mL vase⁻¹) for 98 days. Plant height, root system's dry mass, shoot's dry mass and essential oil content were determined. Among the tested homeopathy drugs, *Sulphur* increased values of fresh and dry biomass more than *Arsenicum album*. Plant height increased by the two drugs and their respective dinamizations. Whereas *Sulphur* inhibited dry biomass production, except 6CH dinamization, it increased substantially mint plant's essential oil content. *Arsenicum album* presented the same behavior as *Sulphur* drug, with the difference that it increased the fresh biomass in 24 and 30CH dinamizations. Results suggest that *Sulphur* and *Arsenicum album* modify plant metabolism, especially by increasing secondary metabolism as occurs with essential oil contents.

Key words: ultradiluted, secondary metabolism, biomass, homeopathic drugs.

RESUMO. Os medicamentos homeopáticos *Sulphur* e *Arsenicum album* afetam o crescimento e o teor de óleo essencial em menta (*Mentha arvensis* L.). Este trabalho teve como objetivo analisar o efeito dos medicamentos homeopáticos *Sulphur* e *Arsenicum album* em algumas variáveis de crescimento e teor de óleo essencial da menta (*Mentha arvensis* L.). Utilizaram-se, para ambos os medicamentos, quatro dinamizações homeopáticas (6, 12, 24 e 30CH) na escala centesimal (CH=centesimal hahnemanniana), além do controle (água) para os dois medicamentos. Os tratamentos foram conduzidos em casa-de-vegetação, e os medicamentos homeopáticos aplicados semanalmente (250 mL vaso⁻¹) durante 98 dias. Foram determinados: altura das plantas, massa seca do sistema radicular, massa fresca e seca da parte aérea e teor de óleo essencial. Dentre as homeopatis testadas, o *Sulphur* proporcionou maiores valores de biomassa fresca e seca do que a homeopatia *Arsenicum album*. A altura das plantas foi incrementada por ambos os medicamentos e suas respectivas dinamizações. O *Sulphur* inibiu a produção de biomassa seca, com exceção da dinamização 6CH, e aumentou substancialmente o teor de óleo essencial nas plantas de menta. O medicamento *Arsenicum album* apresentou o mesmo comportamento do medicamento *Sulphur*, com a diferença de que este incrementou a biomassa fresca nas dinamizações 24 e 30CH. Os resultados sugerem que os medicamentos *Sulphur* e *Arsenicum album* modificam o metabolismo das plantas, especialmente aumentando o teor de metabólitos secundários como o teor de óleo essencial.

Palavras-chave: ultradiluição, metabolismo secundário, biomassa, medicamentos homeopáticos.

Introduction

The homeopathy in the agriculture was made official as input in 2008 (BRASIL, 2008). According Samuel Hahnemann (1755-1843), homeopathy is based on four main principles, namely, "likes cure like", infinitesimal doses, study in healthy organisms (pathogenesis) and single drug treatment. In the case of homeopathic science, diseases or physiological disturbances are not just the product of

phytopathological agents and abiotic factors (BONATO; SILVA, 2003; BONATO, 2007). Homeopathic solutions trigger the plants' recovery through the improvement of natural defences. Homeopathic science is currently being used efficiently in the control of plagues (FAZOLIN et al., 2000; ALMEIDA et al., 2003; BONATO et al., 2006) and plant diseases (VERMA et al., 1969; KUMAR, 1980; KHANNA; CHANDRA, 1983; ROLIM et al.,

2001a e b; BETTI et al., 2003), in the increase of medicinal plants' active principles (BONATO, 2007), in plant deintoxication by metals, such as aluminium (BONATO, 2007) and copper (NIETEN et al., 1969), and in plant metabolism (BETTI et al., 1997; BONATO; SILVA, 2003; SILVA et al., 2006).

Besides the advantage of low costs and since homeopathy doesn't leave any residue in the environment, it is one of the most promising tools to be used in agroecological systems. Consequently, the applicability of homeopathic drugs *Sulphur* and *Arsenicum album* in growth and essential oil content variables of the mint plant is hereby verified.

Material and methods

Experiment was conducted in the Didactic and Experimental Greenhouse of the Department of Biology of the State University of Maringá.

Homeopathic drugs

Sulphur (3CH) and *Arsenicum album* (3CH) homeopathic drugs were obtained from a suitable pharmaceutical laboratory (João Vicente Martins – Maringá – PR). Homeopathic drugs, in scale centesimal hahnemannian (CH), were prepared in the Laboratory of Vegetable Physiology and Plant Homeopathy of the Department of Biology of the State University of Maringá, with the aid of mechanical arm dinamizer (Model Denise 50), according to Brazilian Homeopathic Pharmacopoeia 2nd ed. (1997) - Manual of Technical Standards for Homeopathic Drugstore 3rd ed. (2003).

Sowing and conduction of experiment

Mentha arvensis (rhizomes) seedlings originated from plants cultivated in the farm Essência, district of Marilândia do Sul, Paraná state, Brazil. Seedlings were washed and approximately 3 cm-pieces were broken and allotted in approximately 144 homogeneous units. Four rhizomes were put, at a depth of approximately 1 cm, in vases (4 L) containing soil previously mixed with organic material. Experimental units were distributed homogeneously. Soluble fertilizers or pesticides were not employed in the experiment.

Application of drugs

Treatments consisted of applications of *Sulphur* and *Arsenicum album* homeopathic drugs in 6CH, 12CH, 24CH and 30CH dinamizations prepared in alcohol 70% (v v⁻¹). Homeopathic drugs were added in water (1 mL L⁻¹) at application. Control-vases

received water with alcohol 70% in the same proportion as the drugs (1 mL L⁻¹). Each vase received 250 mL of the diluted drug in a weekly application and always in the same schedule.

Statistics and experimental delineation

Experimental delineation consisted of entirely randomized blocks, with 4 repetitions. Treatments contained two types of drugs, *Sulphur* and *Arsenicum album*; 4 dinamizations in the hahnemannian centesimal scale (6CH, 12CH, 24CH and 30CH); and control (distilled water). Averages were compared by Scott-Knott test, 5% probability, for qualitative statistical tests.

Quantified variables

Plant height

Plant height was determined once a week by measuring the distance between the stem base and maximum plant height.

Fresh and dry mass

Mentha arvensis fresh mass was obtained by weighting, in an analytical scale (GEHAKA AG200), posterior to essential oil extraction and kiln drying (FANEM model 002 CB), at 40°C (constant mass).

Determination of essential oil content

Shoot essential oil extraction was made by hydro-distillation in steam drags, during approximately 3h, with Clevenger equipment. Calculation of essential oil was based on oil volume in kg of produced dry mass.

Results and discussion

Comparison of the effects of the two homeopathic drugs (average of the different dinamizations) shows that plants treated with *Sulphur* presented higher values of fresh (SFM) and dry mass (SDM) production in the mint shoot, when compared to that produced by *Arsenicum album* (Figure 1). Increase reached 34 and 21% for SFM and SDM variables, respectively. It is well known in homeopathy that different homeopathic drugs cause different pathogenesis, or rather, produces the same effects that it cures. In this case, *Sulphur* changes the physiological mechanisms through the accumulation of dry matter by intensifying photosynthesis and/or allocating photoassimilates for biomass accumulation.

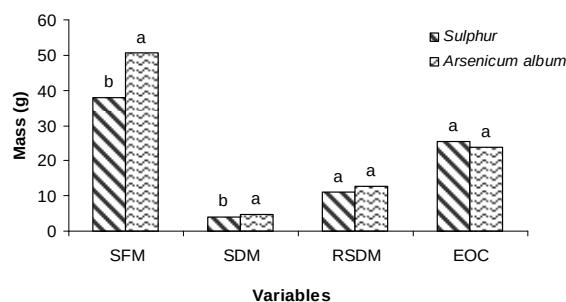


Figure 1. Shoot's average fresh (SFM) and dry mass (SDM), root system's dry mass (RSDM) and essential oil content (EOC) of *Mentha arvensis* in presence of *Sulphur* and *Arsenicum album* homeopathic drugs. (EOC = mL kg⁻¹ DM). Averages followed by the same letters, in the same class, do not differ statistically by Scott-Knott test, at 5% probability level.

In contrast to previous variables, the RSDM and EOC did not show significant differences when the two drugs were compared (Figure 1). In the case of oil content, this behavior may be explained by the fact that the homeopathic drugs increased the values of mint essential oil content in all dinamizations employed (Figures 4 and 5).

Sulphur increased the height of mint plants. Increases were 17, 15, 12 and 11.5% higher than those of control (Figure 2). This results suggest that homeopathic drugs somewhat increase plant metabolism by increasing production and/or allocation of carbon skeletons for growth. In the case of catabolism, respiration may allocate carbon skeletons that would be used from maintenance for growth. Growth induction by dispensed homeopathic drugs is more common in the literature.

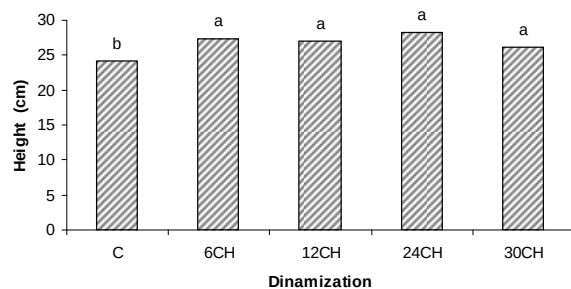


Figure 2. Average plant height of *Mentha arvensis* submitted to different *Sulphur* homeopathic dinamizations. Averages followed by the same letters, in the same class, do not differ statistically by Scott-Knott test, at 5% probability level.

Casali et al. (2006) verified substantial growth increase in beetroot when *Phosphorus* was applied. Bonato and Silva (2003) also reported significant increase in radish plants' height when weekly doses of *Sulphur* were applied.

In all dinamizations under analysis *Arsenicum album* also caused significant increase in the height

of mint plants when compared to that of control (Figure 3). Only dinamizations 24 and 30CH presented higher (30%) average heights when compared to control. Dinamizations 6CH and 12CH exhibited intermediate values (22%), albeit different from those of control (Figure 3).

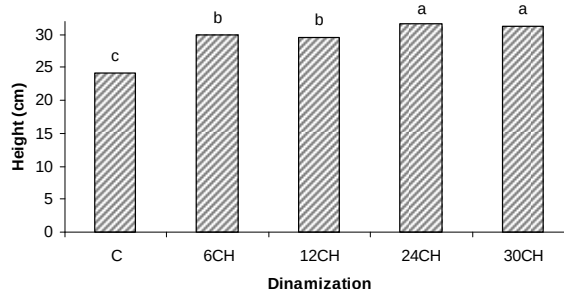


Figure 3. Average plant height of *Mentha arvensis* submitted to different *Arsenicum album* homeopathic dinamizations. Averages followed by the same letters, in the same class, do not differ statistically for the Scott-Knott test, at 5% probability level.

Shoot fresh mass (SFM) was affected by *Sulphur* and its respective dinamizations (Figure 4). Highest dinamizations (12, 24 and 30CH) inhibited the production of variable SFM and differed from both control and 6CH dinamization.

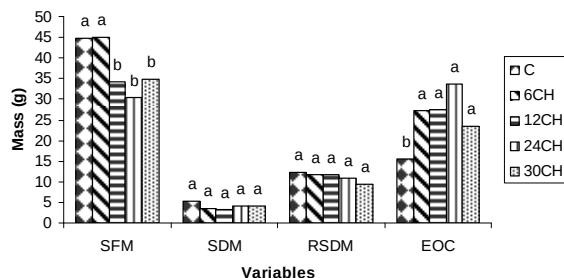


Figure 4. Shoot's average shoot fresh (SFM) and dry mass (SDM), root system's dry mass (RSDM) and essential oil content (EOC) of *Mentha arvensis* in presence or not of different dinamizations of *Sulphur* homeopathic drug (EOC = mL kg⁻¹ DM). Averages followed by the same letters, in the same class, do not differ statistically by Scott-Knott test, at 5% probability level.

According to Davenas et al. (1988), Godoy (1988), Bonato and Silva (2003) and Bonato (2007), in homeopathy the same drug frequently causes different effects, depending on the applied dinamization. In certain dinamizations, increase may occur, whereas in others inhibitions may be reported within a specific physiology variable (hormesis effect). Such behavior is still insufficiently explained. One of the hypotheses, based on biodynamic agricultural data, is that such behavior may be related to the existent rhythmic movements in nature. Another hypothesis, based on

experimental data, is that such behavior is due to similarity between the applied homeopathic drug and the organism (VITHOULKAS, 1997; BONATO, 2007).

Variable SDM and RSDM did not present different behavior when mint plants were treated with different dinamizations of *Sulphur*. Significance of SFM values and non-statistical significance in dry biomass variables (SDM and RSDM) may suggest that these homeopathies may be acting on water uptake more than on production of dry biomass. In this case, the homeopathy may be affecting somewhat the regulation of membrane's permeability and/or of the aquaporins (SUKUL; SUKUL, 2004). They are protein of paramount importance in the maintenance of the plant's hydric status.

Alternatively, the non-significance for RSDM variable may have occurred due to root growth restriction motivated by the vase's small volumetric capacity, which may have restricted the normal root growth. Experiments in vases naturally limit root expansion and may be the cause of non-significance in many experiments.

Sulphur homeopathy and their respective dinamizations, without exception, increased the mint plants' essential oil content (Figure 4). Increments amounted to 75, 77, 116 and 51%, respectively, in dinamizations 6, 12, 24 and 30CH when compared to those of control. Similarly to the above, these results may partly explain results obtained for the dry mass. *Sulphur* homeopathy application and their respective dynamizations may have stimulated the differential allocation of carbon skeletons, especially from the primary to the secondary metabolism. The tonic effect of the homeopathy *Sulphur* in mint essential oil content is thus explained. Since the essential oil is produced by the plant as a defense, this strategy may give the plant better conditions for bearing adverse conditions, such as the attack by plagues and diseases. Another relevant factor from these results is that homeopathy will be able to decrease drastically the operational labor for the extraction of the essential oil. Greater relationship essential oil/dry mass unit, means smaller operational costs of oil extraction at the industrial level. In fact, until the present, no culture and nutrition management has been able to increase essential oil contents at level reported in this paper.

Dinamizations 24 and 30CH (higher dilutions) of *Arsenicum album* increased fresh biomass when compared to that of control and of the other dinamizations under analysis (Figure 5). Increase reached 45 and 21% respectively for 24 and 30CH

dinamizations. In this case, alternation in the behavior of the physiologic answers (variables of biomass production) depends on dinamization. Physiologic and biological effects do not just depend on the homeopathic drug but on dinamization, as analysis by Bonato (2007) and Casali et al. (2006) has shown.

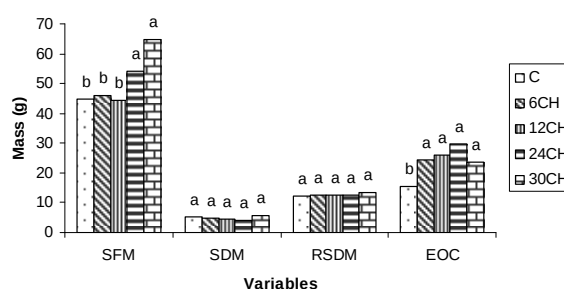


Figure 5. Shoot's average shoot fresh (SFM) and dry mass (SDM), root system's dry mass (RSDM) and essential oil content (EOC) of *Mentha arvensis* in presence or not of different *Arsenicum album* homeopathic drug dinamizations (EOC = mL kg⁻¹ DM). Averages followed by the same letters, in the same class, do not differ statistically by Scott-Knott test, at 5% probability level.

Dry biomass of shoot and root system was not affected by *Arsenicum album*, as has occurred in the case with *Sulphur* (Figure 5). Apparently a displacement of the carbon skeletons occurred that would be allocated from the primary metabolism to the production of essential oil (Figure 5). This is what probably occurred since all *Arsenicum album* homeopathy dinamizations increased the mint's essential oil (Figure 5). Increase amounted to 57, 73, 91 and 53% for 6, 12, 24 and 30CH dinamizations, respectively, when compared to control's. *Arsenicum album* induced a higher essential oil expression when compared to that of *Sulphur*.

Scanty literature exists on homeopathic drug effects with regard to increase in plants' active principle. Experiments in *Justitia pectoralis* reported that homeopathic products alter the primary and secondary metabolism and the electromagnetic field of medicinal plants (CASALI et al., 2006).

Cumarina content increased in approximately 77% when *matrix plant*, *Phosphorus*, *Arnica montana*, *Sulphur*, *Humic acid* were applied. Alteration was followed by modifications in the medicinal plant's electromagnetic pattern. Applications of homeopathic solutions of the *matrix plant*, *Humic acid* and *Sulphur* in 3, 12, 30, 200 and 1000C dinamizations affected the production of the shoot's essential oil content of the grass-lemon plants (CASALI et al., 2006). *Matrix-plant* in 12C dinamization increased the essential oil content by 25% when compared to that of control.

Conclusion

It is observed through the results that the homeopathy can be an important tool in agroecological systems.

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