Chlorophyll Ratio in *Mentha peperita* L. grown in a protected environment under nutrient omission

**Proporção de clorofila em* Mentha piperita* L. cultivada em ambiente protegido por omissão de nutrientes**

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ABSTRACT
This study aimed to evaluate the initial growth of *Mentha piperita* L. under the omission of mineral macronutrients. The experiment was carried out in a protected environment, located at the Federal University of Recôncavo da Bahia – UFRB. It was arranged in a completely randomized design (DIC), consisting of 7 treatments, divided into one control with a complete solution, and 6 with individual omission of: nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and sulfur (S), for 50 days. The data were collected and subjected to the analysis of variance and the Tukey test at 5% probability. The nutrients omission interfered with the levels of chlorophyll a, b and total (a + b). The best indexes found were treatments with the calcium omission, the complete solution and the sulfur omission.

Keywords: Medicinal plants, Mineral plant nutrition, Mints.

RESUMO
Este estudo teve como objetivo avaliar o crescimento inicial de *Mentha piperita* L. sob a omissão de macronutrientes minerais. O experimento foi realizado em ambiente protegido, localizado na Universidade Federal do Recôncavo da Bahia - UFRB. Foi organizado em delineamento inteiramente casualizado (DIC), composto por 7 tratamentos, divididos em um controle com solução completa e 6 com omissão individual de: nitrogênio (N), fósforo (P), potássio (K), cálcio (Ca), magnésio (Mg) e enxofre (S), por 50 dias. Os dados foram coletados e submetidos à análise de variância e ao teste de Tukey a 5% de probabilidade. A omissão de nutrientes interferiu nos níveis de clorofila a, b e total (a + b). Os melhores índices encontrados foram tratamentos com omissão de cálcio, solução completa e omissão de enxofre.

Palavras-chave: Plantas medicinais, Nutrição mineral de plantas, Hortelã.

1 INTRODUCTION

*Mentha piperita* L., which is known as mint or peppermint, is widely used for medicinal and food purposes. It is about 30 cm tall, semi-erect, its branches vary in color from dark green to purple purplish, and the leaves are elliptical-acuminate, jagged and pubescent (Lorenzi; Matos, 2002). It is an aromatic plant that belongs to the Lamiaceae family, with an important economic value due to its essential oil, which is used in the pharmaceutical, food and cosmetic industries (DE FAZIO, 2007).

Considered a naturalized plant, not endemic to Brazil, it geographically occurs in the North (Acre, Amazonas, Pará, Rondônia and Roraima states), Northeast (Alagoas, Bahia, Ceará, Pernambuco, Piauí, Rio Grande do Norte and Sergipe states), Midwest (Federal District, Goiás and Mato Grosso do Sul states), Southeast (Espírito Santo, Minas Gerais, Rio de Janeiro and São Paulo states), South (Paraná, Rio Grande do Sul and Santa Catarina states) (BRASIL, 2014, INPI 2014, TROPICOS, 2014).
Blank et al., (2006), affirm that there is little information on the nutritional requirements of medicinal plants in Brazil, among which is peppermint (M. peperita L). Therefore, the nutrient omission is a viable way, both temporal and economical, to understand the symptoms of a species nutritional deficiency. In this process, the experiment consists of a series of treatments, omitting one nutrient at a time (SILVA et al., 2011).

Studies on the cultivation of medicinal plants regarding to their nutritional requirements are essential, since quality and quantity are determining factors for obtaining active ingredients, which may vary among them (Oliveira et., Al 2012). Among these factors, the visual diagnosis of nutritional deficiencies, concomitantly with the knowledge of nutrient contents, can be an auxiliary tool for the evaluation of the nutritional status and with implications for the recommendation of adequate fertilization for any crop (EPSTEIN, 1975).

An important tool is the use of chlorophyll contents, to monitor the plant nutritional status. Chlorophylls and carotenoids are pigments present in vegetables, and they are part of the primary metabolism being able to absorb visible radiation, triggering the photochemical reactions of photosynthesis, which is an essential process for plant survival (SEIFERMAN-HARMS, 1987).

Among the essential elements for plant development, nitrogen stands out, as it is part of several compounds, including chlorophyll molecules. For its concentration correlates with the chlorophyll content, and consequently with plant yield (PEREIRA et al., 2013).

One way to obtain the chlorophyll contents is by using the chlorophyllmeter, which allows to estimate, quickly and cheaply, the concentration of N in the plant leaves, and by doing so it can contribute to the reduction of nitrogenous fertilizer under or overuse (Sant'Ana et al., 2010). Instant readings in a non-destructive way of leaves, provided by this device, are presented as an alternative, for it indicates the chlorophyll levels present in the plant leaf (KLOOSTER et al., 2012).

Thus, the work aimed to evaluate the chlorophyll indexes in the initial growth of peppermint plants, under the omission of the mineral nutrient macronutrients: nitrogen, phosphorus, potassium, calcium, magnesium and sulfur.

2 MATERIAL E METHODS

The experiment was carried out at the Federal University of Recôncavo da Bahia (UFRB), from August to October 2014, and plants were grown for 50 days in a protected environment. The mint seedlings were obtained by cutting, which were sown in a 128 cell
styrofoam tray, containing commercial substrate (Vivatto). Then, they were transplanted, and when they reached approximately 8 cm high into pots with a 2 dm³ capacity, containing washed sand as an inert substrate. For first 5 days the plants received the Hoagland and Arnon (1950) nutritious solution at ½ fullness and, then the treatments started.

The experiment was distributed in a completely randomized design, with seven treatments consisting of the complete solution (macro and micronutrients) and six solutions with the individual omission of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and sulfur (S). It was applied daily a nutrient solution, in an amount sufficient for the good development of the plants, the stock solution pH was adjusted varying among 6.5 + 0.5. The chlorophyll index was measured with an electronic chlorophyllmeter Falker model CFL1030. The results obtained were submitted to the analysis of variance using the statistical program SISVAR.6 (Ferreira, 2008). The treatment means were compared using the F test and depending on the level of significance, and the Tukey test at 5% probability was used.

3 RESULTS AND DISCUSSION

The nutrient omission in the solution interfered with the chlorophyll a, b and total contents in the seedlings of M. piperita L., with significant differences (p <0.01) among the parameters evaluated. For chlorophyll a, b and total (a + b) indexes, the best averages were in the treatments with complete solution, with the potassium, calcium and sulfur omissions (Table 1). The highest average was 77.47 LCI at the calcium-free treatment, one of the hypotheses considered for this result, is that the amount of time for the experiment was insufficient for the element deficiency stands out in plants.

Almeida et al., (2011), by evaluating the macronutrients omission in lettuce plants, observed that in plants that did not receive calcium, there was a significant reduction in chlorophyll indexes when compared to plants treated with complete nutrient solution. Malavolta (1980), states that the presence of calcium is fundamental, for it is responsible for maintaining the integrity of the cell wall. And its disorder is characterized by the appearance of necrosis, mainly at the ends of developing leaves (COLLIER; TIBBITTS, 1982).
Table 1 – Clorophyll a and b indexes, Clorophyll ratio (a/b) and Total Clorophyll (a+b) index of *M. piperita* L. with nutrient omission in a protected environment. Cruz das Almas, BA, 2014.

| Treatment | Clorophyll a LCI | Clorophyll b LCI | Clorophyll ratio (a / b) | Total Clorophyll (a + b) |
|-----------|------------------|------------------|--------------------------|--------------------------|
| Complete  | 73,15 ab         | 23,53 ab         | 3,11 a                   | 96,68 ab                 |
| -N        | 38,92 c bc       | 10,87 c          | 3,58 a                   | 49,80 c                  |
| -P        | 57,35 bc         | 19,87 b          | 2,88 a                   | 77,22 b                  |
| -K        | 65,06 ab         | 23,35 ab         | 2,81 a                   | 88,41 ab                 |
| -Ca       | 77,47 a bc       | 26,62 a          | 2,93 a                   | 104,10 a                 |
| -Mg       | 57,25 bc         | 19,05 b          | 3,02 a                   | 76,30 b                  |
| -S        | 71,68 ab         | 22,08 ab         | 3,27 a                   | 93,77 ab                 |
| CV (%)    | 12,81            | 12,86            | 11,29                    | 11,65                    |

*Means followed by different letters in the column differ statistically from each other by the Tukey test (P=0,01).

Moretti et al., (2011), found in their nutrient omission study work with cedrus seedlings, similar results regarding to the complete treatment and the one without calcium in the growth of the seedlings where there was no significant difference.

The relation between chlorophyll a/b indexes did not differ statistically between the treatments in the study. On the other hand, Nascimento et at., (2012), by studying the nutrient omission in cowpea found compatible results, and they inferred that the treatments probably did not influence the chlorophyll content production, thus they remained constant.

Lobo et al., (2012) working with omission in groundnut observed that the levels of chlorophyll a, chlorophyll b and total chlorophyll (a + b) of groundnut plants did not vary much, obtaining practically the same behavior when submitted to the absence of nutrients. They highlighted that the best treatment was with potassium omission, surpassing even the complete solution.

The indirect determination of the leaf chlorophyll content is a tool used to diagnose the integrity of the photosynthetic apparatus, when plants are under environmental adversities (Torres-Netto et al. 2005). Therefore, it is noticed that these values vary from species to species, since each one has its preference for a certain nutrient.
4 CONCLUSION

The macronutrient omission affected chlorophyll a, b and total in Mentha piperita plants. L.

The treatments composed of complete solution, calcium, sulfur and potassium omission obtained the best indexes.

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