



Initial Development of Melon when Grown in Different Concentrations of Exhausted Peat Organic Compost

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Authors' contributions

This work was carried out in collaboration among all authors. Author LAML designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors JVFE, CEOD, GCR, GDM, GSCJ, JVFE, LMR, RAS, TST and VBF managed the analyses of the study. Authors LAML and JVFE managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: One of the attributes responsible for the good quality of the seedlings is their cultivation on substrates with good drainage and availability of nutrients, where the use of alternative sources of organic matter makes it a strategy for seedling producers.

Objective: The objective of this work was to evaluate the initial development of melon when grown in different concentrations of exhausted peat organic compost.

Materials and Methods: The experiment was carried out in September 2019, at Faculdades Integradas Stella Maris (FISMA), located in the Municipality of Andradina, State of São Paulo, at

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geographic coordinates 20°53'26,482"S and 51°22'24,822"W and with altitude approximately 396 meters above sea level. A completely randomized design was used, in a 2x5 factorial scheme, with two varieties of melon (V), namely: Goldmine and Imperial interacting with five concentrations of exhausted peat organic compound (C), that is: zero%; 3%; 6%; 13% and 25% and with four repetitions, totaling 40 plots or plastic vases.

Conclusion: It is recommended to use 15% exhausted peat compound in the composition of the substrate in the initial phase of the melon. The melon varieties showed similar responses in terms of exhausted peat compound concentrations.

Keywords: *Cucumis melo L.*; plant nutrition; fruit growing.

1. INTRODUCTION

In recent years, the country stopped being an importer of European melon (*Cucumis melo L.*) and became an exporter, due to the increase in the production of this fruit in northeastern Brazil, which has favorable climatic conditions for its cultivation throughout the year, which contributes to a high productivity, favors the appearance and flavor of the fruit. The Northeast Region is the main melon producer, contributing more than 90% of the national production [1]. New production methods have been studied in order to increase their productivity and facilitate their cultural treatment, which demands the production of quality and vigor seedlings [2].

The success in the production of seedlings is in the good treatment and the way in which they were grown [3] one of the attributes responsible for the good quality of the seedlings is their cultivation on substrates with good drainage and availability of nutrients, where the use of alternative sources of organic matter makes it a strategy for seedling producers [4].

The use of organic compounds represents an adequate technique to nourish the substrate that will be used in the initial development of melon seedlings, [5] but you should be aware of the relation between carbon and nitrogen (C/N), where high ratio relationship between these two elements can negatively affect the development of these seedlings as it can cause nutritional deficiencies, mainly nitrogen, for the decomposition of organic matter microorganisms consume the available N in the soil to do all the decomposition reactions [6].

These organic residues as a source of nutrients become an alternative to reduce expenses with industrial fertilizers [5] and it also provides a better rooting of the seedlings, thus guaranteeing a minimization in post-planting stress, this is due to the greater number of roots, in which they start

to seek more nutrients in deeper layers in the substrate profile and in this way greater absorption occurs of nutrients, thus guaranteeing a better development of the plants in the initial stages [7]. In general, plants that receive organic fertilization show greater development of the aerial part mainly of young shoots [8]. Studies prove that compounds exhausted over time release organic substances and are also associated with the release of high levels of nitrogen and calcium due to their initial composition [9].

The combination of the exhausted compound can provide substrates with adequate characteristics for plant development, due to its high concentration of nutrients, and also allows changes in physical properties, thus ensuring greater water retention. The organic compound found in the substrates obtains a great advantage for containing a rich macrobiotic that is important for the crop's phytosanitary, as some species of microorganisms have the ability to induce resistance to diseases [10].

Given the above, the objective of this work was to evaluate the initial development of melon when grown in different concentrations of exhausted peat organic compost.

2. MATERIALS AND METHODS

The experiment was carried out in September 2019, Educational Foundation of Andradina (FEA), located in the city of Andradina, State of São Paulo, at the geographic coordinates 20°53'26,482"S e 51°22'24,822" W and with an altitude of approximately 396 meters above sea level. A completely randomized design was used, in a factorial scheme of 2x5 two varieties of melon (V), namely: Goldmine and Imperial interacting with five concentrations of exhausted peat organic compound (C) present in the substrate, that is: zero%; 3%; 6%; 13% e 25% (v:v) and with four repetitions, totaling 40 plots represented by plastic vases.

Table 1. Chemical attributes of soil and organic compounds

| pH | OM CaCl ₂ g dm ⁻³ | P mg dm ⁻³ | K | Ca | Mg | H+Al | Al mmol _c dm ⁻³ | SB | CEC | V% m% | B | Cu | Fe | Mn | Zn | |
|-------|---|--------------------------|-----|----|------|------|--|------|-----|----------|---|------|------|----|----|-----|
| S 5.9 | 11 | 21 | 2.0 | 19 | 7 | 15 | 0 | 28 | 43 | 65 | 0 | 0.21 | 1 | 25 | 9 | 3.4 |
| N | | P | | K | | | Ca | | Mg | | S | | | | | |
| | | | | | | | g kg ⁻¹ | | | | | | | | | |
| EC | 17.2 | | 8.0 | | 16.3 | | | 70.2 | | 8.8 | | | 21.0 | | | |

OM: Organic matter; SB: Sum of bases; CEC: Cation exchange capacity; V%: Base saturation;
m%: Saturation by aluminum. S: Soil; EC: Exhausted compound.

The chemical attributes of the soil and the organic compost are shown in Table 1.

After mixing the concentrations of organic compounds in the soil, a viable melon seed was sown two centimeter deep in pots with a volumetric capacity of 4.0 dm³. During the conduction of the experiment all phytosanitary treatments of the seedlings were carried out and the pots were irrigated whenever necessary, respecting the field capacity.

After 30 days of sowing, the following variables were determined: NL - number of leaf determined by direct counting on the plant; APL - air part length determined by using a ruler graduated in millimeters; SD - stem diameter at two centimeter from the soil surface, using a caliper graduated in millimeters, DMAP - dry mass air part and DMR - dry mass root determined by drying the wet mass in a circulation oven and renewing the temperature at air 65°C until they reach constant weight.

For statistical analysis, the variables were subjected to normality tests where the Shapiro-Wilk test was used, after meeting the test precepts, the analysis of variance was performed by the F test ($p<0.05$) and the analysis of regression to the concentrations of organic compounds, where their models were tested: linear; quadratic and cubic. The Tukey test was also applied at 5% probability for melon varieties [11]. A Pearson correlation was performed and was used statistical program R Studio [12].

3. RESULTS

No statistical difference was observed between the varieties of melon for the variables: NL - number leaves; APL - air part length; SD - stem diameter; DMAP - dry mass air part, there was only one difference in DMR - dry mass root, where the Imperial variety stood out, with the highest average, with 28.05% more than Goldmine, as shown in Table 2.

Table 2. Average values of NL - number leaves; APL - air part length; SD - stem diameter; DMAP - dry mass air part and DMR - dry mass root of melon varieties when grown in different concentrations of exhausted peat organic compost

| Variety (V) | NL | APL (cm) | SD (cm) | DMAP (g) | DMR (g) |
|-------------------|----------|----------|----------|----------|----------|
| Goldmine | 10.08a | 26.97a | 0.73a | 7.79a | 1.00b |
| Imperial | 9.76a | 26.88a | 0.68a | 6.99a | 1.39a |
| DMS | 1.17 | 5.00 | 0.08 | 1.18 | 0.30 |
| p value of V | 2.33Ns | 0.9734Ns | 0.2712Ns | 0.1802Ns | 0.0152* |
| Concentration (C) | | | | | |
| 0% | 3.91c | 7.27b | 0.39c | 1.02c | 0.30c |
| 3% | 10.36ab | 30.85a | 0.90a | 8.78ab | 2.07a |
| 6% | 15.07a | 35.57a | 0.80ab | 10.88a | 1.24b |
| 13% | 10.65ab | 29.78a | 0.76ab | 9.32ab | 1.53ab |
| 25% | 9.62b | 31.15a | 0.68b | 6.94b | 0.85bc |
| DMS | 5.23 | 11.25 | 0.19 | 2.65 | 0.68 |
| p value of C | 0.0001** | 0.0001** | 0.0001** | 0.0001** | 0.0001** |
| CV% | 36.39 | 28.80 | 18.92 | 24.76 | 39.45 |
| OA | 9.92 | 26.92 | 0.70 | 7.39 | 1.20 |
| p value of VxC | 0.2257Ns | 0.0129* | 0.0069** | 0.0308* | 0.0019** |

DMS: Minimum significant difference. CV: Coefficient of variation. OA: Overall average. Ns- $p>=0.05$; * $0.01=p<0.05$; ** $p<0.01$. The averages in the column followed by the same letter do not differ statistically. The Tukey test was applied at the level of 5% probability

It is worth mentioning that the statistical differences were observed for the concentrations of exhausted organic compost in the composition of the substrate for the production of melon in the initial phase of the culture for the variables: NL - number of leaves; APL - air part length; SD - stem diameter; DMAP - dry mass air part. As for DMR - dry mass root, the Goldmine variety did not present a statistical difference between concentrations, which was already observed in the Imperial variety, which presented a quadratic response as shown in Table 3.

Quadratic responses were observed in the two varieties of melon for the variable number leaves as shown in Fig. 1, where the maximum point was approximately 14.69% for the Goldmine variety and 12.11% for Imperial.

The positive corrections between the variables in the melon crop in the initial stages after its cultivation are different, different concentrations of exhausted peat organic compound as shown in Fig. 2.

These correlations can be presented by the linear responses of Pearson's correlation as shown in Table 4.

Quadratic responses for plant height (APL) were also observed in the two varieties of melon Goldmine and imperial that presented the maximum points of approximately 17.19% and 14.22% respectively as shown in Fig. 3.

Again the Goldmine and Imperial varieties showed a quadratic response as shown in Fig. 4, where the maximum concentration points of exhausted peat organic compound present in the substrate were 15.00% and 13.58% respectively for the melon varieties.

The concentration of exhausted peat organic compost in the substrate in the initial phase of the melon showed a quadratic response for dry mass air part (DMAP), where the maximum points were 15.40% for the Goldmine variety and 13.38% for Imperial as shown in Fig. 5.

No statistical difference was observed for dry mass root (DMR) in the Goldmine variety when it was grown in different concentrations of exhausted peat organic compost, whereas the Imperial variety showed a quadratic response with a maximum concentration point of 11.39% of compound on the substrate as shown in Fig. 6.

Table 3. Analysis of variance of regressions of the concentrations of exhausted organic peat present in the substrates of melon varieties, where the models were tested: linear, quadratic and cubic

| Variety | | NL | APL (cm) | SD (cm) | DMAP (g) | DMR (g) |
|----------|------------|--------|----------|---------|----------|---------|
| Goldmine | p value | 0.0184 | 0.0098 | 0.0022 | 0.0009 | 0.3047 |
| | Regression | Q* | Q** | Q* | Q** | Ns |
| Imperial | p value | 0.0025 | 0.0050 | 0.0092 | 0.0001 | 0.0032 |
| | Regression | Q** | Q** | Q* | Q* | Q** |

Ns- $p > 0.05$; * $0.01 < p < 0.05$; ** $p < 0.01$. L: polynomial of 1st degree. Q: polynomial of 2nd degree. NL – number leaves; APL – air part length; SD – stem diameter; DMAP – dry mass air part and DMR – dry mass root

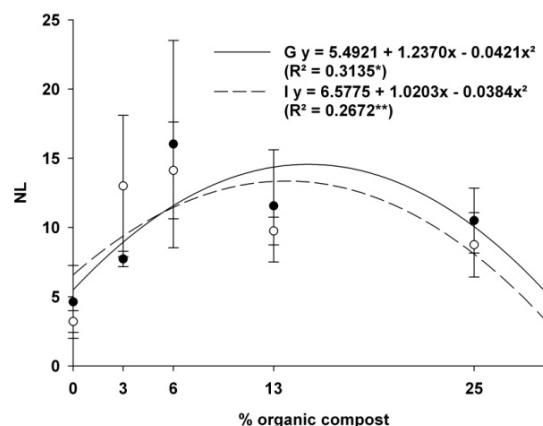


Fig. 1. Average values NL - number of leaves of the melon varieties when grown in different concentrations of exhausted peat organic compost. Andradina, 2018

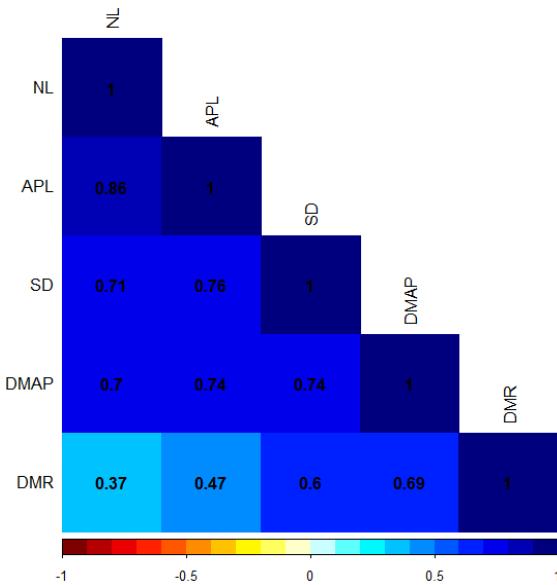


Fig. 2. Pearson correlations between the variables evaluated in the melon varieties when grown in different concentrations of exhausted peat organic compost

Table 4. Matrix of significant Pearson correlations of melon varieties when grown in different concentrations of exhausted peat organic compost

| $Y = \beta_0 + \beta_1 o + \beta_2 J + \dots + \beta_n N$ | | p value | R^2 |
|---|------------------------------------|-----------|--------|
| APL | APL = 4.44191777 + 2.26532674 NL | <0.0001** | 0.7451 |
| SD | SD = 0.38203478 + 0.03291512 NL | <0.0001** | 0.5088 |
| | SD = 0.35013532 + 0.01331785 APL | <0.0001** | 0.5737 |
| DMAP | DMAP = 1.86554216 + 0.55703356 NL | <0.0001** | 0.4919 |
| | DMAP = 1.38673253 + 0.22311585 APL | <0.0001** | 0.5436 |
| | DMAP = -1.6150268 + 12.7122173 SD | <0.0001** | 0.5455 |
| | DMAP = 3.50018329 + 3.24074694 DMR | <0.0001** | 0.4705 |
| DMR | DMR = 0.58770466 + 0.06186771 NL | 0.0080** | 0.1355 |
| | DMR = 0.38849898 + 0.03020326 APL | 0.0020** | 0.2224 |
| | DMR = -0.3476466 + 2.18616147 SD | <0.0001** | 0.3602 |

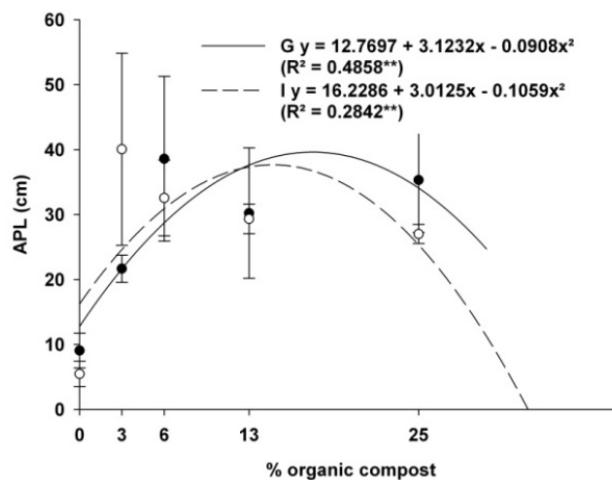


Fig. 3. Average values of APL - air part length of melon varieties when grown in different concentrations of peat exhausted organic compost. Andradina, 2018

4. DISCUSSION

The number leaves (NL) was influenced by the availability of a higher concentration of exhausted peat organic compost which was around 15% of concentration in the substrate (Fig. 2). Thus with the highest number of leaves, the seedlings have a higher photosynthetic rate, which guarantees a greater accumulation of dry mass in the area, as shown in Table 1 and Fig. 1, this phenomenon can be well explained due to the positive correlations between the two NLxDMAP variables. The development of the aerial part more accentuated in the highest concentrations of organic compounds in the substrate, it may have been potentiated by the

greater root development (Fig. 6), because with greater amount of root, the seedlings can explore the deeper layers of the substrate where inserted, thus ensuring a greater assimilation of nutrients [4].

These nutrients become available in greater quantity for the leaves, where they play fundamental roles in the physiological processes of the plant or / and may even cause changes in the external morphology of the plant tissues. With the increase in the concentration of organic compound in the melon substrate, it can cause toxicity due to the excess of these nutrients only up to a maximum of 15%, which leads to less efficiency in its photosynthetic processes [13,14].

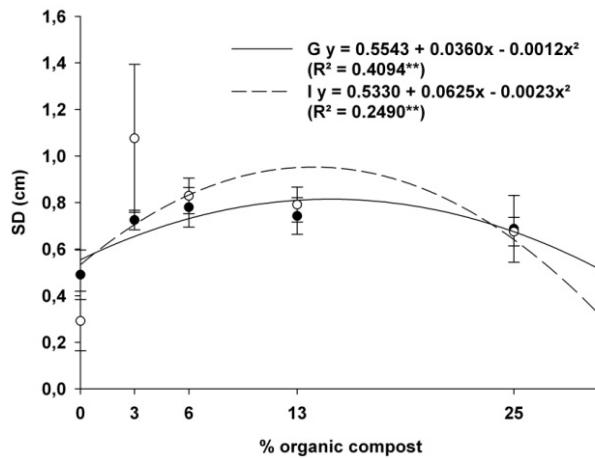


Fig. 4. Average values of SD - stem diameter of melon varieties when grown in different concentrations of exhausted peat organic compost. Andradina, 2018

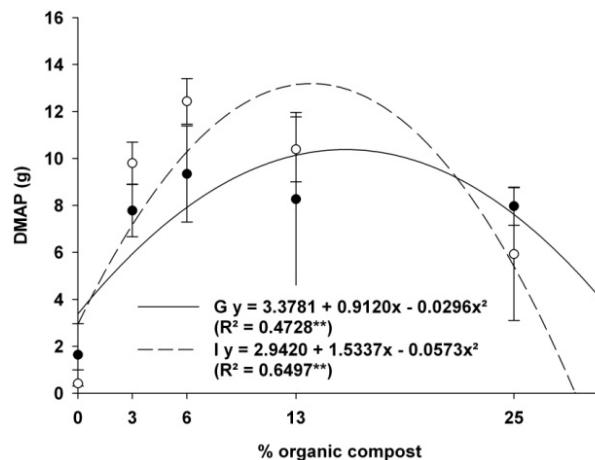


Fig. 5. Average DMAP values - dry mass air part of melon varieties when grown in different concentrations of exhausted peat organic compost. Andradina, 2018

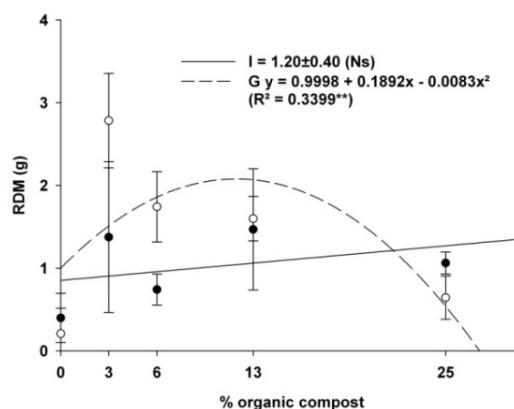


Fig. 6. Average DMR values - dry mass root of melon varieties when grown in different concentrations of peat exhausted organic compost. Andradina, 2018

The availability of nutrients in the initial stages for the melon seedlings was a limiting factor for the growth of the aerial part [6,7], where seedlings cultivated in different concentrations of the exhausted compost generally presented quadratic responses, showing that there is a limit to the availability of nutrients in the substrate. In this way, high concentrations compromise the development of plants, due to the elevation of the levels of salts available in the soil solution which starts to increase its electrolytic and osmotic potential, where the very high concentrations to the seedlings begin to compete with the saturation of the solution of the soil and consequently lose water [5,15].

Thus, concentrations above 15% of the exhausted compost started to compromise the development of melon in the initial phase, this availability may have been enhanced with the action of microorganisms present in the composition of the organic compost, thus increasing the cycling of nutrients and that became available in high concentrations in the substrate [16,17].

5. CONCLUSION

It is recommended to use 15% exhausted peat compound in the composition of the substrate in the initial phase of the melon.

The melon varieties showed similar responses in terms of exhausted peat compound concentrations.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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