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EFFECT OF ALTERNATIVE AND ROOTING MULCHING ON THE YIELD OF CV-TYPE CURLY LETTUCE. ELBE

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ABSTRACT

Lettuce is the most consumed vegetable by the Brazilian population, however, its cultivation faces significant challenges. Among the main obstacles in the production process, the high rate of soil evaporation, which induces water stress to the plants, and the limited rooting capacity of the crop stand out, as factors that compromise its agronomic performance in the field. Thus, the present study aimed to evaluate the impact of the use of alternative mulching (white TNT) and rooting on the yield of curly lettuce, cultivar Elba. The experiment was conducted in a randomized block design, 2 x 2 factorial scheme. The treatments consisted of: bare soil with and without a rooter, and soil protected with white TNT with and without a rooter. Fresh and dry shoot and root mass, head diameter, and yield were evaluated. The results showed that the treatment with soil without cover and with the use of a rooter obtained better performance, inferring that the rooter contributes positively to the initial growth and yield of lettuce. It is concluded that the rooter is an effective tool in crop management, and the bare soil, although it has presented significant prominence, can be used depending on the cultivation conditions.

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INTRODUCTION

Lettuce, (*Lactuca sativa* L.), is a leafy vegetable, where the leaves are attached to a small stem, sensitive to climatic factors such as temperature, luminosity, and rainfall. It belongs to the Asteraceae family, whose supposed origin occurred in the Mediterranean region and was inserted in Brazil through the Portuguese. A differential is its leaf coloration, which has a diverse spectrum of colors, from various shades of green to purple (EMBRAPA, 2014). In addition, according to data from the Brazilian Association of Seed and Seedling Trade (ABCSEM), lettuce cultivation is dominant in national retail, with an average equivalent to 8 billion reais with a production of more than 1.5 million tons per year (ABCSEM, 2013).

Referring to the national scenario, lettuce is one of the main vegetables produced - the most purchased leafy vegetable - and consumed daily by the aforementioned population. According to Freitas *et al.* (2013), as it is a perishable product, it is usually planted near consumer centers, in small properties located in peri-urban areas, or the green belts of municipalities, with production in the most varied Brazilian regions, throughout the year. With emphasis, it is determined as one of the main sources of income for several family farmers, where the loyal consumer market does not suffer from excessive variations about the pricing of products since it is defined by themselves, which differs from *commodities* whose value is determined by the foreign market and other factors.

Based on IBGE data (2017) regarding the lettuce crop, the amount produced corresponded to 671,509 tons, by about 108,382 units of establishments, with the equivalent production value of 1,204,557 thousand reais and the most prominent state was São Paulo. Also in this context, the comparative effect, according to data collected from the IBGE (2020), obtained 108.4 thousand establishments that cultivated lettuce, with resulting production of 671.5 thousand tons, whose 82.2% of producers are family farmers, with emphasis on the Southeast, South, and Northeast regions for accumulating 64.1, 16.2 and 10.5% of Brazilian production, respectively. The biggest highlight this year was the state of Alagoas since the corresponding production was 4,329 tons, where the city of Arapiraca was responsible for 97.5% of the production.

Management is also essential for the development of the species produced. For example, the Northeast region is characterized by high temperatures and inconstant rainfall, in addition to high evapotranspiration and, consequently, can generate negative

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water balance, where they must be correctly managed in irrigation to avoid water losses and ensure productivity (Santos & Brito, 2016).

As characterized by Gonçalves *et al*. (2005), the use of agricultural *mulching* or soil cover has been widely disseminated in agriculture, with the functions of increasing soil temperature, reducing water loss by evaporation, controlling weeds, optimizing harvesting and marketing, since the product is cleaner and healthier. In addition, *mulching* can be synthetic, with the main emphasis on polyethylene of different colors (transparent, black, white, green, brown, and red) or organic, from vegetable residues of different compositions, depending on availability on the property or in the region, such as rice husks, corn husks, sorghum or elephant grass (Queiroga *et al*., 2002).

One of the innovative technologies associated with agriculture currently used is the use of rooters, which can improve the growth and root performance of a seedling, which have in their composition macro and micronutrients essential for the development of the physiological stages of plants, generating more vigorous and productive plants (Malavolta, 2006). An example of success can be found in the study by Gheshm & Brown (2020), carried out in Kingston, in the United States, a region with a mild climate. In this project, the use of dark *mulching* (black polyethylene and organic compost) helped raise the soil temperature, which favored the growth of the romaine lettuce cultivars 'Ridgeline' and 'Coastal Star'. Thus, they obtained plants that reached a maximum leaf area, reaching 95% of soil cover by the canopy 40 days after transplanting, which generated an anticipation of harvest. The productivity recorded was 10.4 kg/m² for the treatment with black *mulching* and 7.6 kg/m² for the bare soil.

The objective of the present study was to evaluate the effect of *alternative mulching* (white TNT) and its association with rooting (with chelate in its composition) on the yield of curly lettuce of the Elba cultivar type for conditions of Imperatriz - MA.

METHODOLOGY

CHARACTERIZATION OF THE EXPERIMENTAL AREA

The study was carried out at the Center for Technological Diffusion, located in Imperatriz, Maranhão, Brazil (5º 31' 32' S; 47º 26' 35' W), in July 2024. The climate of the region, according to the Köppen classification, is of the Aw type, tropical with an average annual rainfall of 1,221 mm and an average annual temperature of 27.1 ºC.

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The soil of the experimental area has a texture ranging from medium to sandy, a condition that limits its water retention capacity and contributes to low levels of organic matter. These properties increase the vulnerability of the soil to water erosion.

EXPERIMENTAL DESIGN AND TREATMENTS

The experiment was designed in randomized blocks, 2 x 2 factorial scheme, with 4 treatments in 4 replications. The treatments consisted of the association of alternative soil cover and the use of rooters, as follows: T1: Control treatment (soil without cover and rooter); T2: soil without cover and with rooting; T3: soil with alternative *mulching* and without rooting and T4: soil with alternative *mulching* and rooting.

INSTALLATION AND CONDUCT OF THE EXPERIMENT

The experimental area has a history of growing leafy vegetables, characterized by uniformity in terms of soil color and topography, without the presence of evident spots or irregularities in the soil. The seedlings of the lettuce cultivar cv. Elba were obtained directly from a local producer, presenting 4 to 5 definitive leaves, corresponding to the ideal phenological stage for transplantation.

The experiment was implemented in July 2024, in an area of 33 m², with 4 beds with dimensions of 1.0 m x 6 m each, totaling 4 plots of 1.5 m2. For each plot, plant spacing of 0.25 m x 0.25 m was adopted, with 24 plants per plot. The two crop rows on the sides, as well as 0.25 m at each end of the central rows, were considered borders and were not used for the evaluations of the plants in the useful area of the plot.

Manual weeding was carried out, and cleaning of the area with the use of hoes and rakes. The soil was turned over for one week and exposed to solar radiation to reduce the population of the soil pest, nematode. Before transplanting the seedlings, 2 L of tanned poultry manure was added per plot and incorporated into the soil. In addition to organic fertilization, chemical fertilization was carried out using the commercial formula, 10-10-10, applying 35 g of fertilizer per plant.

The plots under the influence of the alternative cover were added to the white TNT soil before transplanting the seedlings. White TNT was used, due to its heat dissipation capacity, with a weight of 40 g/m². Regarding the seedlings submitted to the rooter, the seedlings were soaked for 30 minutes in a solution based on amino acids and

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micronutrients, at a concentration of 250 g b.w/1000 L of water. After the time of imbibition passed, transplantation was carried out.

The cultural treatments carried out during the lettuce crop performance included the daily application of 3 mm of water through a localized irrigation system by microsprinkler divided into two applications throughout the day. In addition, a topdressing fertilization was performed at 15 days after transplanting, using the commercial formula, 05-20-20. During the lettuce cycle in the field, no incidences of pests or pathogens were observed, which dispensed with the need to use pesticides.

VARIABLES ANALYZED

In 35 days after transplanting the seedlings, plants were harvested from the experimental area to evaluate the agronomic characteristics of the crop. For this, 5 plants were collected from the useful areas of each plot and later evaluated according to the established parameters.

The following determinations were made: aerial fresh mass, head diameter, root fresh mass, aerial and root dry mass and yield. The determination of fresh air and root mass was carried out by weighing on a semi-analytical scale, at the Weighing Laboratory of UEMASUL/CCA, and this measurement was expressed in g $^{plant-1}$. The diameter of the head was performed "*in loco*", using measurement using a graduated ruler. The aerial dry mass was obtained by drying the plants in a forced air circulation oven for 72 hours and then weighing them on a precision scale. And the yield, expressed in ton $^{ha-1}$, was estimated based on the fresh mass of the lettuce plant, and extrapolated to hectare.

STATISTICAL ANALYSIS

The data obtained were tested for normality of errors (Royston, 1995) and homogeneity of variance (Gastwirth et al., 2009), and were submitted to analysis of variance by the F test ($p<0.05$), and the means were compared by Tukey's test ($p<0.05$), using the Agroestat software, version 1.0.

RESULTS

Analyzing Figure 1, it was verified the absence of significant effects of the interactions between the factors, soil cover and rooter use ($p > 0.01$), on the variables shoot fresh mass, head diameter, and root fresh mass. However, statistical significance (p

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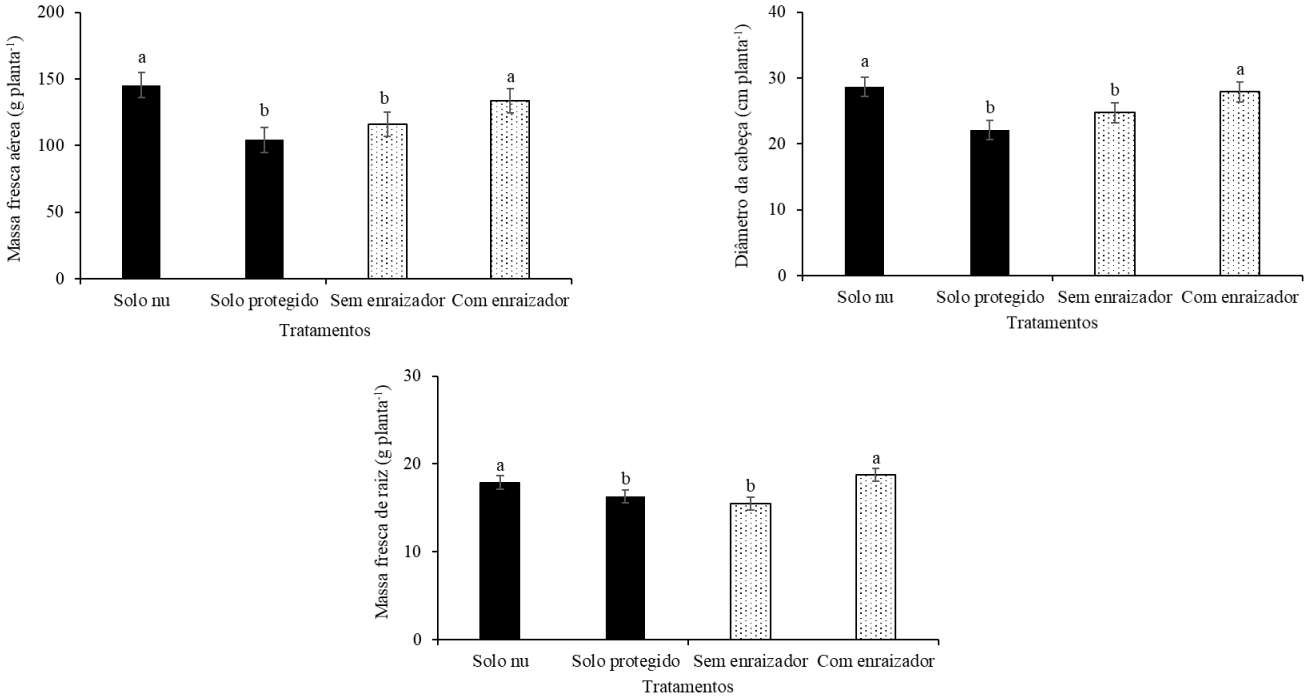
< 0.01) was observed when the factors were analyzed separately, indicating that both influenced the variables studied independently.

Figure 1 - Aerial fresh mass, head diameter and root fresh mass of curly lettuce under the effect of alternative *mulching* and rooting. ** significant at 1%.



Source: Silva (2024).

In compliance with Figure 2, it was possible to note that there was no significant interaction for the factors studied, p – value >0.01. However, a significant effect (p-value <0.01) was observed from the isolated factors.

For the averages of the variables aerial and root dry mass and yield, it was possible to observe greater increases when the soil remained without cover, reaching values of 17.21 g $^{plant-1}$; 8.97 g $^{plant-1,}$ and 24.24 ton $^{ha-1}$ (Figure 2).

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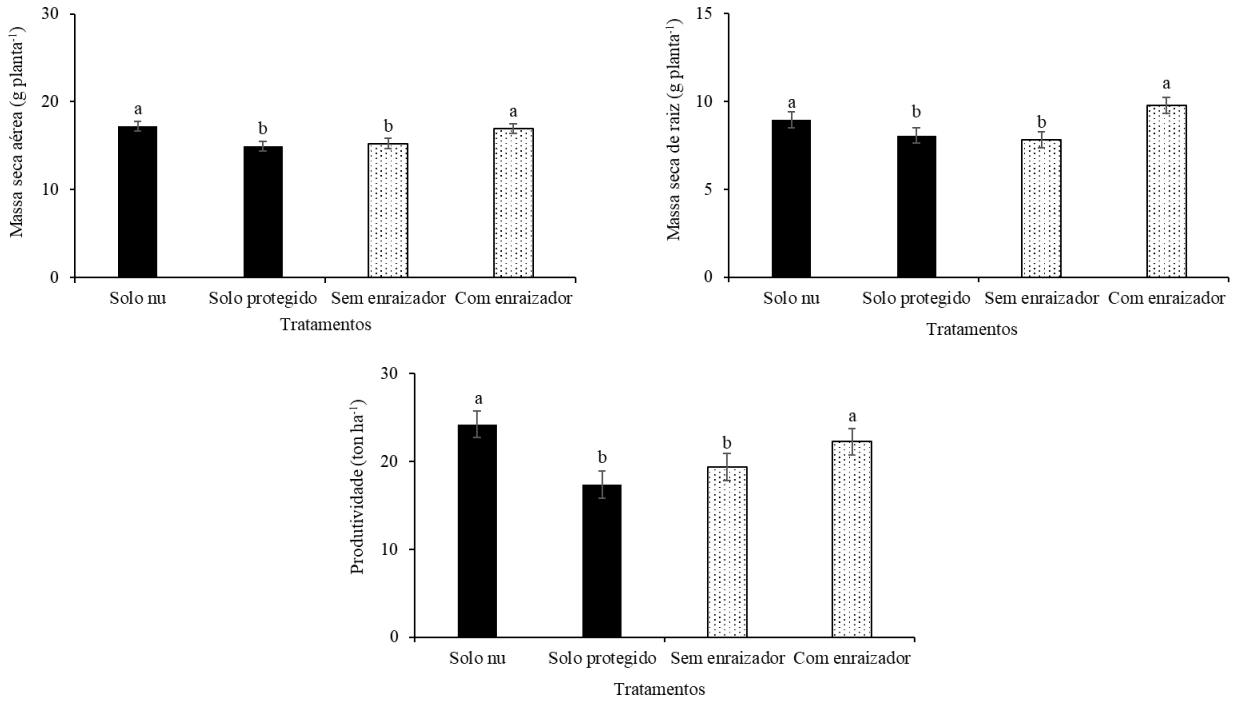
Figure 2 - Aerial and root dry mass, and yield of curly lettuce under the effect of alternative *mulching* and rooting. ** significant at 1%.



Source: Silva (2024).

DISCUSSION

For the variable aerial fresh mass, head diameter and root fresh mass, it was possible to observe higher mean values of 145.48 g $^{plant-1}$, 28.67 cm $^{plant-1}$ and 17.90 g $^{plant-1}$, respectively, for the treatment of soil without cover cover (Figure 1). The observed behaviors, which indicate a greater increase in the variables mentioned in comparison to the treatment with protected soil, can be attributed to the greater capacity of the exposed soil to absorb light energy, raising the temperature of the surface layer to more appropriate levels for the full development of the lettuce plant.

In addition, the increase in surface temperature favors a more efficient transpiration process, which, associated with a more abundant green biomass, optimizes photosynthetic efficiency.

Similar results were reported by Amaral (2005), who, when evaluating morphological parameters of curly lettuce, found that the treatment with soil without cover presented superior performance compared to soil with inorganic cover, in this case, plastic material.

Regarding the treatments in the absence and presence of rooters, it can be seen that the variables aerial fresh mass, head diameter and root fresh mass were positively

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influenced by the presence of the rooter at the time of transplanting the seedlings, p-value <0.01 (Figure 1). Maximum values found were 133.39 g $^{plant-1}$ for aerial fresh mass, 27.9 cm $^{plant-1}$ for head diameter, and 18.90 g $^{plant-1}$ for root fresh mass.

These performances observed for the evaluated variables are due to the rapid absorption of the commercial source of the rooter, considering that it is presented in the form of amino acid chelate, in addition to containing micronutrients and essential amino acids for the full development of lettuce.

The results obtained in this study corroborate the findings of Lima *et al.* (2017), who highlight that plant rooters can enhance the development of the root system of plants, allowing greater exploration of the soil and, consequently, greater absorption of nutrients. These factors contribute to the increase in the fresh mass of the aerial part, the root and the diameter of the head.

In line with Figure 2, the results obtained can be explained by the fact that the other variables showed the same behavior of increments when they were submitted to bare soil treatment. In uncovered soil, thermal regulation and increased nutrient uptake by the soil solution, especially during growing periods. Another fact, which elucidates such behaviors, is that bare soils stimulate the development of larger green biomass, improving photosynthetic efficiency, which induces efficient cell division, culminating in increased productivity.

Still corroborating the results mentioned above, Silva (2024) argues that the use of *mulching* also has some limitations. Linked to this, the initial cost can be a financial challenge for producers, since it requires a significant investment in materials, equipment, and labor. In addition, the need for continuous maintenance of *mulching* over time is a relevant aspect, which can generate additional costs and demand greater effort in lettuce production.

In this article, despite the statistical difference, with a new quantitative view, the use of white TNT *mulching* did not differ from the other treatments, with a percentage difference of 15.34% and 11.29%, for aerial and root dry matter, respectively, which corroborates the conception of Vilela *et. al* (2022) who found that this material can be an interesting alternative for soil cover, providing good plant development of this vegetable crop and reduction in the weed population.

Although the synthetic cover has benefits, in this study the excessive presence of weeds in the white TNT was verified, especially species of the Poaceae family. This can

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be explained by the TNT weight of 40 g/m², which allows the passage of solar radiation, favoring the germination of the weed seed bank in the soil, since some of these seeds have positive photoblastism.

At the core, the presence and absence of rooter, it is evident that the aerial and root dry mass and the yield have significant effects when exposed to the rooter, reaching increments of 11.16%, 24.77%, and 14.87%, respectively, in compilation to the treatment without rooter (Figure 2). Such effects can be attributed to the correlation between the growth of the aerial part and the root system, which directly impacts the increase in dry mass. The high bioavailability of the rooter optimized nutrient absorption, promoting greater total biomass gain and conferring greater tolerance to climatic and chemical stresses.

The maximum yield obtained in the value of 24.24 ton $^{ha-1}$ is a reflection of the good development of the morphological components of the lettuce crop, such as fresh mass of the shoot and root, head diameter, dry mass of the shoot and root, and also of the appropriate environmental conditions for the cultivation of curly lettuce. The low yields obtained for the treatment without rooter, 19.36 ton $^{ha-1}$, are similar to those presented by Gonçalves *et al.* (2015), which showed the non-increase in lettuce productivity without the use of rooters and phytoregulators in the treatment of seedlings.

CONCLUSION

It is inferred that the treatments of soil without cover and with rooting presented the best results for the variables analyzed, such as fresh and dry mass, head diameter and lettuce yield.

Therefore, the *white TNT mulching* did not demonstrate significant superiority, therefore, it presented low results in comparison with the plots with the absence of this synthetic covering, referring to the study in question. Rooters, on the other hand, stood out as positive inducers in the initial development of plants, corroborating previous studies. Therefore, the use of these techniques must be evaluated according to the conditions of the crop, considering both the agronomic benefits and the costs involved.

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