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Application of hairy Woodrose (*Merremia aegyptia* L.) plant matter in coverage in the agronomic characteristics of arugula

Paulo César Ferreira Linhares [1,*], Lunara de Sousa Alves [2], Caroline dos Santos de Oliveira [3], José Roberto de Sá [4], Uilma Laurentino da Silva [5], Aline Carla de Medeiros [6], Joaquim Odilon Pereira [7], Walter Martins Rodrigues [7], Wyara Ferreira Melo [6], Maria Yasmim Silva Almeida [3] and Ana Flávia Pinheiro Francisco [3]

[1] *Department of Agronomic and Forestry Sciences at the Federal Rural University of the Semi-Arid Region –UFERSA, Brazil.*
[2] *Federal University of Paraíba-UFPB-Brazil.*
[3] *Department of Agronomic and Forestry Sciences at the Federal Rural University of the Semi-Arid Region –UFERSA, Brazil.*
[4] *Vale do Acaraú State University, Brazil.*
[5] *Federal Rural University of the Semi-Arid Region –UFERSA- Brazil.*
[6] *Federal University of Campina Grande-UFCG, Brazil.*
[7] *Federal Rural University of the Semi-Arid Region- UFERSA-Brazil.*

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Abstract

The use of plant resources available in production areas is of paramount importance for farmers who work in the production of horticultural plants. The experiment was conducted at the Rafael Fernandes experimental farm of the Federal Rural University of the Semi-Arid Region (UFERSA), Mossoró-RN-Brazil, with the objective of evaluating the application of hairy woodrose (*Merremia aegyptia* L.) plant matter as topdressing on the agronomic characteristics of arugula. The experimental design used was a randomized complete block design with six treatments and four replications. The treatments consisted of applying doses of hairy woodrose (*Merremia aegyptia* L.) plant biomass as topdressing during the following periods of plant residue retention. (0 days of residue permanence in cover; 14 days of residue permanence in cover; 28 days of residue permanence in cover; 42 days of residue permanence in cover and 56 days of residue permanence in cover). The arugula cultivar used was Cultivada. The characteristics evaluated were plant height, number of leaves per plant, yield, and dry mass. Application of hairy woodrose as a top dressing provided an increase in all agronomic characteristics of arugula, with a maximum yield of 1,109.32 g/m^2, 56 days before planting the crop. The use of fertilizers present in agricultural areas is of paramount importance for horticultural plant farmers.

Keywords: Agriculture; Organic Horticulture; Family Farming; Spontaneous Plants of the Semi-Arid Region

1. Introduction

The growing concern for the environment is extremely important for farmers who work in the production of horticultural plants, contributing to quality of life through the increased demand for healthy products and the need to develop new concepts of agricultural production systems, based on soil conservation, nutrient input from renewable sources, and the use of locally available organic waste.

The search for self-sufficient and diversified agricultural systems, with low input usage and efficient utilization, has been a cause for concern among researchers, farmers, and politicians worldwide [1].

* Corresponding author: Paulo César Ferreira Linhares

Due to the high cost of chemical fertilizers, coupled with the consequences of using these inputs on soil conditions, which increase soil salinity and decrease macro and microorganisms in arable areas, leading to increased production costs for farmers who cultivate horticultural plants and use them as a food source, the use of alternative fertilization sources that increase soil fertility in the edaphic environment is of great importance.

According to [2], in order to improve the use of agricultural land, it is important to use appropriate techniques for food production. The use of ground cover is a practice that conserves soil and water, contributing significantly to soil fertility and increased vegetable productivity. This practice has other advantages, such as maintaining soil moisture, protecting the soil against chemical, physical and biological degradation, and reducing runoff and soil loss [2,3].

According to [2], in order to improve the use of agricultural land, it is important to use appropriate techniques for food production.

Among the plant species within the herbaceous layer of the semi-arid region, there is hairy woodrose (*Merremia aegyptia* L.), which is of great importance for use as green manure in vegetable production, given its abundance of green phytomass (40,000 kg ha^{-1}), rich in nitrogen and potassium, with concentrations of 22 and 20 g kg^{-1}, respectively, with a carbon/nitrogen ratio of 20/1 [4].

In the semi-arid region of Brazil, arugula is widely produced by hardworking farmers in areas with low levels of technology, who sell the surplus at organic farmers' markets.

1.1. Objective of the study

Given the importance of using alternative sources in the production of horticultural plants, the objective was to study the application of hairy woodrose (*Merremia aegyptia* L.) plant matter as topdressing on the agronomic characteristics of arugula.

2. Materials and methods

2.1. Characterization of the experimental area

The experiment was conducted in an experimental area of the Rafael Fernandes experimental farm, in the district of Alagoinha (5º03'37"S, 37º23'50"W), northwest of Mossoró, state of Rio Grande do Norte, Brazil, with an area of 400 hectares [5].

According to [6] and the Köppen classification, the local climate is BSwh‘, dry and very hot, with a dry season, often from June to January, and a rainy season from February to May, with an average annual rainfall of 673.9 mm and an average relative humidity of 68.9%. The soil is classified as a sandy loam Red-Yellow Latosol [7].

2.2. Soil chemical analysis

Before the field experiment was set up, soil samples were collected down to the 0-20 cm layer and sent for processing and analysis to the Water, Soil and Plant Analysis Laboratory at UFERSA, yielding the following results: pH (water 1:2.5) = 7.04; exchangeable cations Ca = 1.65 cmolc dm^{-3}; Mg = 1.13 cmolc dm^{-3}; K = 46.23 mg dm^{-3}; Na = 8.32 mg dm^{-3}; P (Mehlich) = 2.97 mg dm^{-3} and organic matter = 1.19 g kg^{-1}.

2.3. Experimental design and treatments

The experimental design used was a randomized complete block design with six treatments and four replications. The treatments consisted of applying doses of hairy woodrose (*Merremia aegyptia* L.) plant biomass as topdressing during the following periods of plant residue retention. (0 days of residue permanence in cover; 14 days of residue permanence in cover; 28 days of residue permanence in cover; 42 days of residue permanence in cover and 56 days of residue permanence in cover).

The arugula cultivar used was [cultivated variety]. The spacing used was 0.20 m x 0.10 m, with six planting rows, with seventy-eight plants per plot, for a total area of 1.20 m^2. The usable area was 0.8 m^2, with 40 plants. Irrigation was carried out daily in two watering shifts, totaling 60 minutes per day.

For the construction site surveys, a rotary tiller attached to a tractor was used. Following this, the blocks and experimental plots were marked out.

2.4. Chemical composition of hairy woodrose (*Merremia aegyptia* L.)

The hairy woodrose (*Merremia aegyptia* L.) plant was harvested from within the herbaceous layer of the caatinga during the flowering period, when the plant has the highest concentration of nutrients. It was then crushed with a manual tool (machete) and added to the experimental plots. Three samples of the harvested material were taken and sent to the chemical analysis laboratory of the Federal Rural University of the Semi-Arid Region - UFERSA - Brazil, where the hairy woodrose (*Merremia aegyptia* L.) samples showed the following chemical concentrations: 600 g kg^{-1} of carbon (W); 23.0 g kg^{-1} of nitrogen (N); 16.6 g kg^{-1} of phosphorus (P); 18.7 g kg^{-1} of potassium (P); 10.3 g kg^{-1} of calcium (Ca); 11.4 g kg^{-1} of magnesium (Mg); and a carbon-nitrogen ratio of 26/1 (C/N) (Figure 1).

Figure 1 Development of the hairy woodrose 120 days after emergence under field conditions in the teaching garden of the Federal Rural University of Semi-Arid (UFERSA, Mossoró, RN). Photo: Researcher PhD Paulo César Ferreira Linhares [4]

2.5. Agronomic characteristics of arugula cultivation

The harvest was carried out 35 days after planting the arugula, harvesting all plants from the usable area. After harvesting, the plants were transported to the Post-Harvest Vegetable Laboratory of the Department of Phytotechnics at UFERSA, where they were analyzed. The following characteristics were evaluated: plant height, determined from a sample of twenty plants per plot, measuring from the base of the plant to the apex, and expressed in cm $plant^{-1}$; number of leaves, determined by counting all the leaves of the plant, and expressed in units $plant^{-1}$; yield, for this characteristic all plants in the useful area were weighed, being harvested above the apical bud and expressed in g m^{-2}; and dry mass, determined by placing three 150g samples in a forced-air oven at 65ºC to determine the dry matter content, which was then multiplied by the yield of each treatment, and expressed in g m^{-2}.

2.6. Statistical analysis

Statistical analysis was performed according to conventional analysis of variance methods [8], using the statistical software ESTAT [9]. The response curve fitting procedure was performed using the ESTAT software [9], applying regression analysis and conducting hypothesis tests that help the researcher to accept or reject a statistical hypothesis based on experimental results [10]; [11].

3. Results and discussion

There was a significant effect at the probability level of $p<0.01$ for plant height, number of leaves, yield, and dry matter of arugula, respectively. Among the blocks (repetitions), there was a statistically significant difference at the $p<0.01$ probability level, which demonstrates the need to use blocks to block environmental heterogeneity (Table 1). These results overwhelmingly demonstrate the efficiency of applying hairy woodrose (*Merremia aegyptia* L.) as a top dressing in promoting beneficial soil conditions, thus contributing to an increase in the evaluated characteristics of the arugula crop.

Among family farmers in the Mossoró-RN-Brazil region, a large number cultivate using organic systems, utilizing inputs found in the agricultural areas, which is of great importance from both an economic and environmental standpoint.

The Pearson linear correlation coefficient (r), observed in this research, presented values of 97.42%; 97.02%; 98.95% and 99.33% for plant height, number of leaves, yield and dry matter of arugula, respectively, which demonstrates a

strong correlation or strong association. In practice, these values correspond to the variations in "Y", being 97.42%; 97.02%; 98.95% and 99.33% explained by the variations in X through the specified functions.

According to [11], a strong association of Pearson's linear coefficient corresponds to values with intervals [± 0.71 ≤ r ≥ 1.00].

Table 1 Plant height values, expressed in cm (PH), number of stems, expressed in units plant^{-1} (NS), arugula yield, expressed in g m^{-2} (AY) and arugula dry mass, expressed in g m^{-2} (DM) as a function of the application of plant mass of hairy woodrose (*Merremia aegyptia* L.) in topdressing

Causes of Variation	GL	PH	NS	AY	DM
Treatments	3	66.21**	48,92**	72.32**	81.94**
Blocks	4	5.84*	4.23**	6.33**	6.14**
Residue	12	----	------	----	----
Average	----	14.10	7.95	656.60	67.50
Coefficient of variation (%)	----	8.80	8.51	12.88	12.07

**= significativo a 1% *= significativo a 5% ns= não significativo.

3.1. Height of arugula

For plant height, a quadratic equation adjustment was performed during the application of hairy woodrose (*Merremia aegyptia* L.) as a cover crop, 56 days before planting, with a maximum height of 18.45 cm plant^{-1}. Santos et al. (2023), evaluating the productivity of arugula-coriander intercropping fertilized with a mixture of carnauba straw (*Copernicia prunifera*) and bovine manure, found a plant height of 17.88 cm plant^{-1} in a monoculture system, lower than the research mentioned previously. Melo et al. (2024), studying the agronomic efficiency of hairy woodrose (*Merremia aegyptia* L.) as an organic fertilizer in mint-arugula intercropping, obtained a height of 19.2 cm plant^{-1}, higher than the previous research. Linhares (2009), studying spontaneous vegetation as green manure in the agroeconomic performance of leafy vegetables, found a rocket plant height of 18.4 cm plant^{-1} with the application of 15.6 t ha^{-1} of hairy woodrose on a dry basis incorporated into the soil, similar to the aforementioned research.

The height of arugula plants is greatly influenced by nitrogen, an essential element for plant development and which is part of the composition of hairy woodrose (*Merremia aegyptia* L.), which was applied as topdressing at a concentration of 23.0 g kg^{-1} in dry matter.

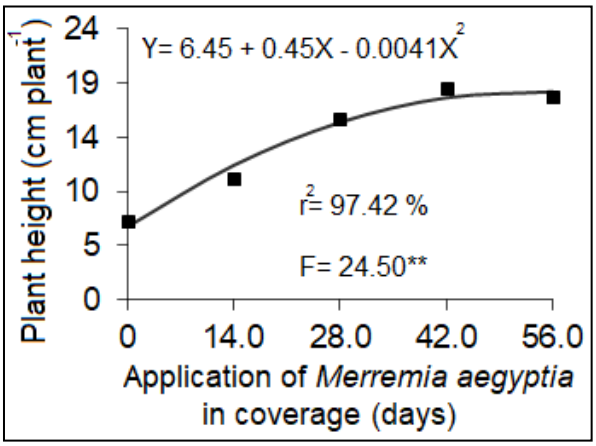

Figure 2 Height plant of arugula function of days of application of *Merremia aegyptia* in coverage.

3.2. Leaves of arugula

Between the application periods of hairy woodrose (*Merremia aegyptia* L.) as topdressing, there was an increase of 5.9 leaf units per plant, with a maximum value of 10.9 units per plant in the period 56 days before planting arugula (Figure 3). The number of leaves is of paramount importance in the crop, considering that it is the edible part. Salles et al. (2017), evaluating the response of arugula to organic fertilization with different organic compounds, found number of 6.0 leaves

per plant, lower than the aforementioned research. Similar behavior was observed by Santos et al. (2023), evaluating the productivity of arugula and coriander intercropping fertilized with a mixture of carnauba straw (*Copernicia prunifera*) and bovine manure, found 10.8 leaf units/plant. Oliveira et al. (2010), evaluating the productivity of lettuce and arugula in an intercropping system under organic and mineral fertilization, found a leaf count of 7.9 units plant^{-1}, higher than the aforementioned research.

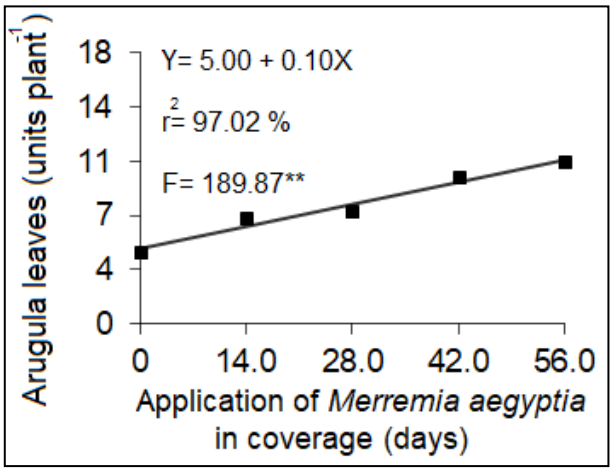

Figure 3 Leaves of arugula function of days of application of *Merremia aegyptia* in coverage.

3.3. Yield of arugula

For arugula yield, there was an increase between the shortest application period of hairy woodrose (*Merremia aegyptia* L.) as topdressing and the longest period (56 days before planting, with a maximum value of 1,109.32 g m^{-2}). (Figure 4). The increase in arugula yield is probably due to improved soil conditions in terms of better soil structure and fertility. Because arugula is a leafy crop, it is quite demanding in nitrogen, and benefits from the application of hairy woodrose (*Merremia aegyptia* L.), a spontaneous species of the semi-arid region, rich in nitrogen, with a concentration above 20 g kg^{-1} in dry matter. Melo et al. (2024), studying the agronomic efficiency of hairy woodrose (*Merremia aegyptia* L.) as an organic fertilizer in mint-arugula intercropping, obtained a yield of 150.42 kg/100 m^2, equivalent to 1,504.2 g m^{-2}, which is higher than the aforementioned research.

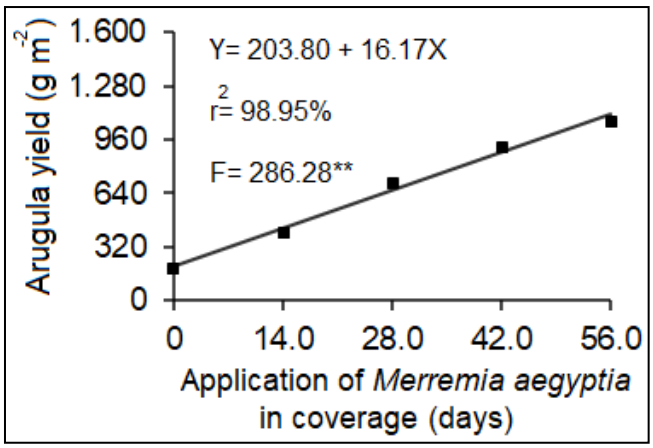

Figure 4 Yield arugula function of days of application of *Merremia aegyptia* in coverage.

Santos et al. (2023), evaluating the productivity of arugula-coriander intercropping fertilized with a mixture of carnauba straw (*Copernicia prunifera*) and bovine manure, found an arugula yield of 713 g m^{-2} in monoculture, lower than the aforementioned research. This lower yield is probably due to the quality of the fertilizer used in terms of nitrogen concentration, considering that arugula is quite demanding in this chemical element. Linhares (2009), studying spontaneous vegetation as green manure in the agroeconomic performance of leafy vegetables, found a yield of 28.85 t ha^{-1}, equivalent to 2,885 g m^{-2}, with the application of 15.6 t ha^{-1}, which was higher than the aforementioned research.

Galinha et al. (2026) studying organic fertilization as a strategy to increase productivity and reduce losses of arugula found an arugula yield of 2,106.00 g m^{-2}, higher than the aforementioned research.

3.4. Dry mass of arugula

There was an accumulation of dry matter of arugula, as a function of the different application periods of hairy woodrose (*Merremia aegyptia* L.), with a maximum value of 114.0 g m^{-2} (Figure 5). Dry matter is a characteristic of paramount importance, considering that it reflects plant growth. With the increase in the availability periods of hairy woodrose (*Merremia aegyptia* L.) as a cover crop, there was an increase in plant development in the vegetative aspect, contributing to a greater accumulation of dry matter. According to Taiz & Zieger (2017), approximately 90% of plant dry mass originates directly from the photosynthetic assimilation of carbon through photosynthesis. Oliveira et al. (2010), evaluating the productivity of lettuce and arugula in an intercropping system under organic and mineral fertilization, found 190 g m^{-2}, lower than the aforementioned research. Santos et al. (2023), studying the productivity of arugula-coriander intercropping fertilized with a mixture of carnauba straw (*Copernicia prunifera*) and bovine manure, found 352.8 g m^{-2} in a quantity of 3.0 kg m^{-2}, higher than the aforementioned research.

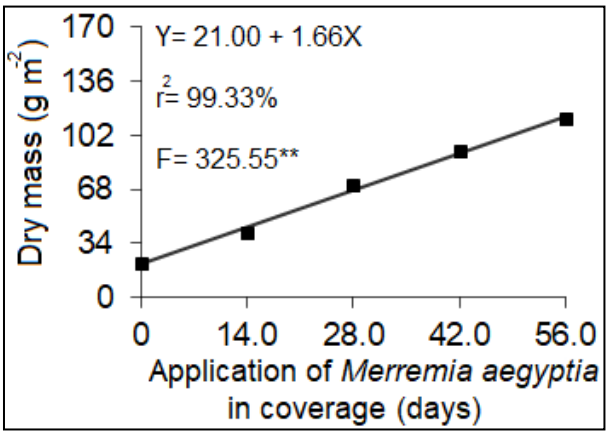

Figure 5 Dry mass of arugula function of days of application of *Merremia aegyptia* in coverage

4. Conclusion

Application of hairy woodrose (*Merremia aegyptia* L.) as top dressing provided an increase in all agronomic characteristics of arugula, with a maximum yield of 1,109.32 g m^{-2}, 56 days before planting the crop.

The use of fertilizers present in agricultural areas is of paramount importance for horticultural plant farmers.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Altieri M. 2002. Agroecology: scientific basis for sustainable agriculture. Guaíba: Agropecuária. 592 p.

[2] Kader, M.A., Senge, M., Mojid, M.A., Ito, K. Recent advances in mulching materials and methodsm for modifying soil environment. Soil and Tillage Research, v. 168, p. 155–166, 2017. DOI: https://doi.org/10.1016/j.still.2017.01.001

[3] Salomão, P.E.A., Kriebel, W., Santos, A.A., Martins, A.C.E. The importance of no-till farming for soil restructuring and organic matter restoration. Research, Society and Development, Vargem Grande Paulista, v. 9, n.1, e154911870, 2020. DOI: http://dx.doi.org/10.33448/rsdv9i1.1870

[4] Linhares, P. C. F., Maracajá, P. B., Liberalino Filho, J., Assis, J. P., Sousa, R. P., & Medeiros, A. C. (2021). Jitirana (Merremia aegyptia L. Urban) [e-book]: Potential use as a spontaneous species in the semi-arid region for green manure of vegetables. Linhares, P.C.F., Cunha, L.M.M., Silva, N.V., Neves, A.M., Medeiros, B.B.M., and Paiva, A.C. Green and dry phytomass, levels and accumulation of macronutrients of hairy woodrose, 24-45 DOI:10.46420/9786588319901 Link: https://www.editorapantanal.com.br/ebooks.php?ebook_id=jitirana-merremia-aegyptia-l-urban-potencialidade-de-uso-como-especie-espontanea-do-semiarido-na-adubacao-verde-de-hortalicas&ebook_ano=2021&ebook_caps=1&ebook_org=1

[5] Rêgo, L.G.S., Martins, C.M., Silva, E.F., Silva, J.J.A., Lima, R.N.S. Pedogenesis and soil classification of an experimental farm in Mossoró, Rio Grande do Norte, Brazil. Revista Caatinga. 29(4):1036-1042, 2016.

[6] Kottek, M, Grieser, J, Rudolf, B, Rubel, F. Updated world map of the Köppen-Geiger climate classification. Meteorologische Zeitschrift, 15(2):259-263, 2006.

[7] Kronka, S.N, and Banzato, D. A. Estat. system for statistical analysis. 2. 3.ed. Jaboticabal: Funep, 243 p. 1995.

[8] Barbosa, J.C, Malheiros, E.B, Banzatto, D.A. ESTAT: A system for statistical analysis of agronomic trials. Jaboticabal: Unesp, Version 2.0. 1992.

[9] Assis, J.P, Sousa, R.P, and Linhares, P.C.F. Statistical hypothesis testing. EdUFERSA. 2020. https://livraria.ufersa.edu.br/wp-content/uploads/sites/165/2020/08/testes-de-hipoteses-estatisticas-edufersa.pdf

[10] Assis, J.P. Simple linear regression, simple linear correlation, multiple linear regression and multiple linear correlation. EdUFERSA, 310p. 2013. https://livraria.ufersa.edu.br/regressao-e-correlacao-linear-simples-e-multipla/

[11] dos Santos, M. D. F. A., Linhares, P. C. F., de Souza Alves, L., da Silva Carlos, K. G., da Silva, U. L., de Almeida Cardoso, E., & de Sousa, R. P. (2023). Productivity of the intercropping of arugula with coriander with the mixture of carnauba straw (Copernicia prunifera) plus bovine manure. Brazilian Journal of Animal and Environmental Research, 6(2), 1727-1743. https://doi.org/10.34188/bjaerv6n2-063.

[12] Melo, W. F., Linhares, P. C. F., do Nascimento, J. W. B., de Lima, A. G. B., Formiga, J. A., Rolim, F. D., ... & Maracajá, P. B. (2024). Agronomic efficiency of jitirana as organic fertilizer in mint-arugula intercropping. Caderno Pedagógico, 21(7), e5851-e5851. https://doi.org/10.54033/cadpedv21n7-170

[13] Linhares, P. C. F. (2009). Spontaneous vegetation as green manure in the agroeconomic performance of leafy vegetables. Department of Agronomic and Forestry Sciences of the Federal Rural University of the Semi-arid Region (Thesis), Mossoró. 109p. DOI:10.13140/RG.2.2.28503.04004

[14] Salles, J.S., Steiner, F., Abaker, J.E.P., Ferreira, T.S., Martins, G.L.M. Response of arugula to organic fertilization with different organic compounds. Revista de Agricultura Neotropical, 4(2):35-40, 2017.

[15] Oliveira, E.Q., Souza, R.J., Cruz, M.C.M., Marques, V.B., França, A.C. Productivity of lettuce and arugula in an intercropping system under organic and mineral fertilization. Horticultura Brasileira, 28(3): 36-40, 2010.

[16] Melo, W. F., Linhares, P. C. F., do Nascimento, J. W. B., de Lima, A. G. B., Formiga, J. A., Rolim, F. D., & Maracajá, P. B. (2024). Agronomic efficiency of Hairy woodrose as an organic fertilizer in mint-arugula intercropping. Caderno Pedagógico, 21(7), e5851-e5851. https://doi.org/10.54033/cadpedv21n7-170

[17] Galina, F.C.M., Maia, R.C.L., Souza, F.G.S., Silva, A.M., Mota, B.B., Freitas, I.Z.G.S., Araújo Neto, S.E. Organic fertilization as a strategy to increase productivity and reduce losses in arugula. ARACÊ, 8(3):e12557, 2026. DOI: 10.56238/arev8n3-083.

[18] Taiz, L.; Zeiger, E. Plant physiology. Porto Alegre: Artmed, p, 818, 2017.