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Cultivation of White Garlic Miner Subjected to Doses of Mixed Biofertilizer

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ABSTRACT: *The Maciço of Baturite region has potential for garlic production and studies on the management of this crop are important for local producers. In this sense, the study aimed to evaluate the effect of doses of mixed biofertilizer on growth and productivity of garlic, variety branco mineiro, in the region of Maciço of Baturite. The experiment was conducted at the experimental farm of Unilab. The experimental design was a randomized block design, with the application of five doses of mixed biofertilizer (0, 250, 500, 750 and 1000 ml plant-1 week-1) and three blocks. For growth analysis, we used a split plot scheme, with the evaluation times in the plots (15, 30, 45, 60, 75, 90, 105 and 120 dap) and doses of biofertilizer in the subplots. We analyzed the growth variables (plant height, number of leaves and pseudostem diameter) and production (plant mass, bulb diameter at harvest). Mass and diameter of the bulb after curing in the sun). For the growth variables, the highest values were observed between 76 and 93 dap. In the production characteristics, there was no significant influence of the application of mixed biofertilizer.*

Keywords: *Allium sativum L., biofertilization, growth and development*

I. INTRODUCTION

Garlic (Allium sativum L.) is a species in the group of vegetables quite rich in starch, has aromatic substances and phytotherapic action with several pharmacological properties (RESENDE et al., 2016). According to Freddo (2017), Brazil achieved prominence in garlic productivity of 102,232 t ha^{-1}, having occupied the 11th position in 2013 in the list of the world's largest producers of agricultural species.

The national planting of garlic is divided into two categories: noble and semi-noble garlic or also known as common garlic (RESENDE; GUERRA, 2012). Noble garlic cultivars need to go through the process of vernalization, produce bulbs of high commercial value, with white tunics and bulbs with intense purple color and number of bulbs ranging from 8 to 12 per bulb. Already common or semi-noble garlic, does not need to go through the process of vernalization, has the color of bulbs ranging from white to cream with the presence of anthocyanin streaks, presenting therefore a purplish aspect. Bulb bulbs have a white or pink film and produce an average of 15 bulbs per bulb and are basically cultivated by small family producers distributed in several regions of the country (RESENDE et al., 2011).

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The Baturité Massif, mainly the municipality of Aratuba-CE, was once one of the largest producers of common garlic in the state, however, currently cultivation is not common among producers in the region. A possible justification for this reality may be related to the insertion of noble garlic in the market, as it has larger and easier to peel bulbs, facilitating its handling and use, which limited production only for subsistence and part for local consumption and trade.

The biofertilizer is an organic fertilizer produced by materials available on the property, usually based on animal manure, charcoal ash, vegetable remains etc., which can be enriched or not with rock dust, effective microorganisms, among others, and produced Aerobic or anaerobic. According to Tesseroli Neto (2006), the use of biofertilizer can be an alternative to the conventional production system. The use of biofertilizer in soil fertilization is useful for the availability of nutrients necessary to maintain the metabolism and functioning of plants.

Considering the constant need to produce food in a healthy and sustainable way and increase garlic productivity in the Maciço de Baturité region, this work aimed to evaluate the effect of increasing doses of mixed biofertilizer on the growth and productivity of common garlic, variety White Mineiro.

II. MATERIALS and METHOD

The experiment was carried out at the Experimental Farm of the University of International Integration of Afro-Brazilian Lusophony (UNILAB), located at Sítio Piroás, municipality of Redenção-CE (04 ° 14'53 ”S; 38 ° 45'10” W; 340m) , in the Baturité Massif Region, from March to July 2017.

The design was in randomized blocks with five treatments and three blocks. The treatments were the mixed liquid biofertilizer doses (0, 250, 500, 750 and 1,000 mL plant-1 week-1), split and applied twice a week, manually. Each treatment had 5 useful plants, 25 experimental units per block and totaling 75 plants. The cultivar used was Branco Mineiro, acquired from producers in the municipality of Aratuba - CE.

The cultivation was carried out in pots with a capacity of 25L, in which a 5L layer of gravel was added, to facilitate the drainage of excess water and substrate composed of a mixture of local soil, with a sandy loam texture (EMBRAPA, 2013) and Sand in a 1: 2 ratio. Planting was carried out with bulbs weighing between 0.9 and 2.0 g.

The biofertilizer was produced at the Biofertilizer Station of UNILAB's Experimental Farm, in polyethylene water tanks with a production capacity of 500L. The following inputs were used to prepare the aerobic biofertilizer: 100 L of cattle manure, 30 L of chicken manure, 5 L of coal ash and 270 L of water. The application of biofertilizer treatments started 15 days after emergence.

The irrigation system used was of the type located by drip, with average flow of emitters of 6 L h^{-1}, and daily frequency. The irrigation time was calculated from the evaporation measured in the class "A" tank, installed in the vicinity of the experimental area. The water used in the irrigation came from a dam located in the property, with an average electrical conductivity of 0.4 dS m^{-1}.

Over the days after planting (15, 30, 45, 60, 75, 90, 105 and 120 DAP) growth evaluations were performed, measuring the variables plant height (PA), number of leaves (NF) and pseudostem diameter (CPD). Plant height was measured with a ruler graduated in centimeters and considering the vertical distance from the base of the plant in the soil to the end of the largest leaf of each plant. The number of leaves was measured by direct counting and the diameter of the pseudostem was measured at a height of approximately 5 cm from the plant in relation to the soil, with a digital caliper graduated in millimeters.

In the harvest of the plants, the average mass of the plants (PPcolheita) and the average diameter of the bulb (DBcolheita) were evaluated. The plants were weighed separately by treatment and the value expressed in grams per plant and the bulb diameter (DBcolheita) was measured with a digital caliper and the value expressed in millimeters.

After harvest, the plants went through the healing process, which was divided into two stages: initial curing in the sun (pre-cure) and healing in the shade. The pre-cure period was five days. After pre-curing, the roots of the bulbs and the shoot cut were performed, and the shoot weight (PPASol), the average mass of the bulb (PBSol) and the average diameter of the bulb (DBSol) were evaluated. Then, the bulbs were packed in paper bags (kraft) identified according to the treatment to be cured in the shade for a period of 30 days. The data for each variable were analyzed by classical descriptive statistics, and tests were applied to verify the normality of the data and later, through analysis of variance, the significance of the treatments was analyzed by the F test. When significant, the effect of treatments (and interactions) was submitted to regression analysis in order to adjust equations with biological meanings. In the regression analysis, the equations that best fit the data were chosen based on the significance of the regression coefficients at 1% (**) and 5% (*) probability by the F test and on the highest coefficient of determination (R2). For statistical analysis of these variables, a design was considered in subdivided plots, and the plots were the evaluation times and the subplots were biofertilizer doses.

III. RESULT and DISCUSSIONS

Table 1 presents the summary of variance analyses for plant height (AP), pseudostem diameter (SD) and number of leaves (NF) of garlic plants, cultivar Branco Mineiro, as a function of evaluation times and biofertilizer doses. It was verified that there was a significant difference due to the evaluation times and biofertilizer doses in all variables analyzed, with no significant interaction between treatments.

Table 1- Summary of plant height variance (AP), plant diameter (SD) and number of leaves (NF) of branco mineiro garlic, as a function of evaluation times and biofertilizer doses. Redemption, 2017

Source of Variation	GL	Middle square		
		AP (cm)	DP (mm)	NF
Block	2	8,26849^{ns}	4,32263*	6,68931*
Evaluation time	7	1214,95988**	15,62437**	52,36567**
Residue (a)	14	14,83202	0,84376	1,20684
Biofertilizer	4	77,88060*	5,11991**	3,35196*
Period x Bio	28	15,87163^{ns}	0,31693^{ns}	0,58986^{ns}
Residue (b))	64	22,54623	0,55985	0,47553
Total	119	-	-	-
CV – (time)		9,63	15,46	17,15
CV – (Biofertilizer)		11,88	12,60	10,77

** significant at the level of 1% probability (p <0.01); * significant at the 5% probability level (0.01 =<p <0.05); n not significant (p>= 0.05)

The values of the height of the garlic plants (AP) as a function of the evaluation times were adjusted to the quadratic polynomial model, with R2 of 0.92 (Figure 1). The plants reached a maximum height of 47.87 cm at 81 DAP. After this period there was a growth fall, caused by the maturation of maturation and senescence of the leaves, indicating already the point of harvest of the bulbs.

The cultivar Cateto Roxo, as well as Branco Mineiro (also known as Branco Mossoró), are garlicclassified as common and may present similar responses when compared to noble garlic. Determining the commercial characteristics of garlic cultivars in the region of Picos-PI Veloso et al (1999) verified that at 90 days the plants of white garlic Mineiro and Cateto Roxo reached an average height of 49.29 cm and 41.82 cm, respectively. In trials conducted in the state of Rio de Janeiro, Feitosa et al. (2009) verified that the variety Cateto Roxo presented shoot height of approximately 48.4 cm at 120 days after sowing, in an organic production system, a value similar to that found in this study.

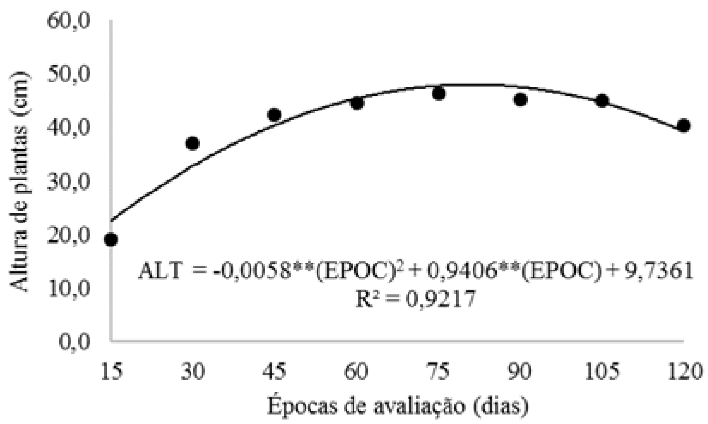

Figure 1 - Height of the garlic plant, variety Branco Mineiro, depending on the evaluation times. Redemption, 2017.

Figure 2 shows the response of plant height (AP) of the garlic cultivar Branco Mineiro as a function of mixed liquid biofertilizer doses. From the regression analysis it was verified that the data were adjusted to a quadratic polynomial model with R2 0.736, indicating that the biofertilizer dose of 485 mL plant-$^{-1}$ week^{-1} provided the highest plant height of 41.82 cm.

The lowest plant height values verified in the highest doses of biofertilizer may be related to high soil nutrient contents, inhibiting the nutritional effect of biofertilizer on garlic crop. Another point that can be considered is that, at the highest doses applied, the volume may have been excessive for the crop, providing hypoxia conditions (reduction of aecization). Thus, growth can be inhibited because the roots cannot fully exploit the volume of the soil, as in aenated conditions.as in aenated conditions.as in aenated conditions.

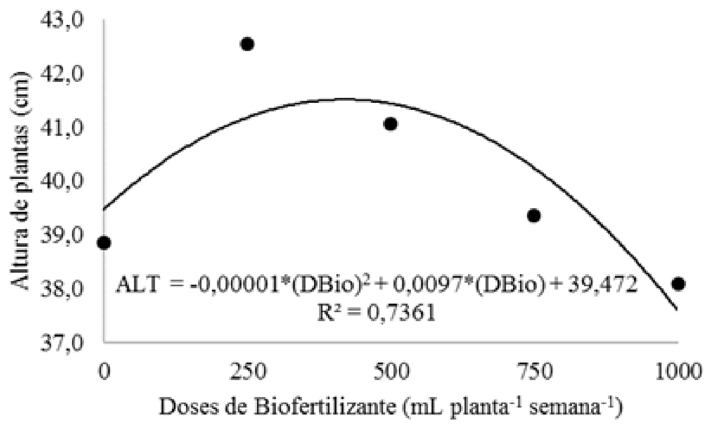

Figure 2 - Plant height as a function of the application of mixed biofertilizer doses. Redemption, 2017.

Arruda (2016) growing garlic, variety Cateto Roxo, in the edaphoclimatic conditions of the Baturité Massif, concluded that the plants reached a maximum height of 44.41 cm when fertilized with the mixed biofertilizer dose of 750 mL plant-1 week-1. Honorato et al. (2013) evaluated the agronomic performance of garlic cultivars in edaphoclimatic conditions in the municipality of Mossoró and verified better results, in plant height, in the varieties Branco Mossoró (38.5 cm) and BRS Hozan (37.25 cm), with values lower than that disclosed in this study (47.87 cm).

The adjustment of the pseudostem diameter (DP) garlic data as a function of the evaluation times throughout the crop cycle is shown in Figure 3. From the regression analysis, it was verified that the data were adjusted to a quadratic polynomial model, with R2 0.859. The maximization of the pseudostem diameter in 6.69 mm was obtained at 76 DAP. Similarly to plant height, the DP value decreased with the maturation of the plants and with the approximation of the garlic harvest period.

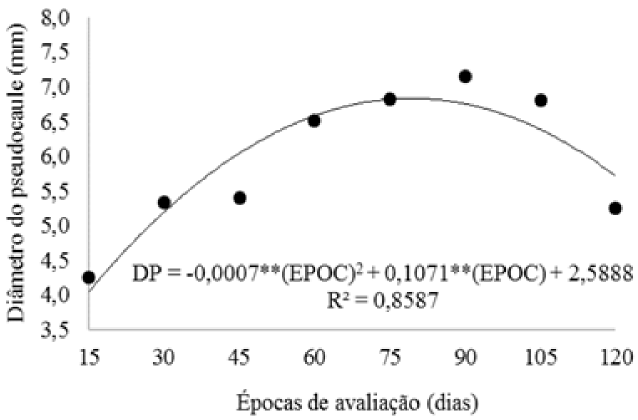

Figure 3 - Diameter of the garlic pseudostem variety Branco Mineiro as a function of the evaluation times. Redemption, 2017.

The pseudostem diameter value is an important indicator of photosynthetic dynamics and biomass accumulation in garlic cultivation and expresses values similar to bulb diameter, although it is not an organ of interest, it allows estimating bulb behavior before harvesting (WANG et al., 2014).

Arruda (2016) working with the cultivar Cateto Roxo, concluded that the largest diameters of the garlic pseudostem was 4.75 mm, evaluated at 74 DAP.

Pereira (2000) states that the increase in bulb diameter is related to the number of leaves and plant height allowing greater leaf area and, consequently, higher production of photoassimilates for bulb growth.

Figure 4 shows the response of the diameter of the pseudostem (DP) of garlic, as a function of mixed biofertilizer doses, with adjustment to the quadratic polynomial model. The dose of mixed liquid biofertilizer of 425 mL plant-1 week-1 was sufficient to maximize the SD in 6.35 mm. This response of PD as a function of biofertilizer doses is similar to plant height, where the lowest values were verified in the highest doses applied, demonstrating that garlic did not respond, in growth, to the increase in the doses of the insum. As mentioned above, the higher doses of biofertilizer may have provided hypoxia conditions.

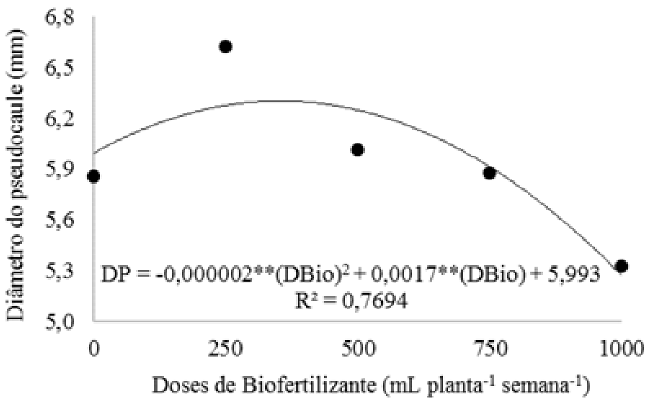

Figure 4 - Diameter of the pseudostem of branco mineiro garlic as a function of mixed biofertilizer doses. Redemption, 2017.

Plant hormones, mainly ethylene and abscisic acid (ABA) are linked to morphological and physiological changes in plants under water stress or hypoxia, increasing their levels in these conditions (SHARP, 2002). Dutra et al. (2012) mention that a larger diameter may be related to the production of hormones, especially ethylene, which leads to lower root growth.

Arruda (2016) verified a maximum pseudostem diameter of 4.55 mm in the cv. Purple Catheter for the dose of 1,000 mL plant-1 week-1, in the Baturité Massif. This difference between the doses applied for the same edaphoclimatic conditions may be related to the nutritional contents of each applied intake, since the chemical characteristics of the biofertilizer come from the manure used in the preparation of the biofertilizer.

For the variable number of leaves as a function of the evaluation times, the data followed a quadratic polynomial adjustment (Figure 5), in which at 93 DAP, the plant exhibited the maximum number of leaves (8.0).

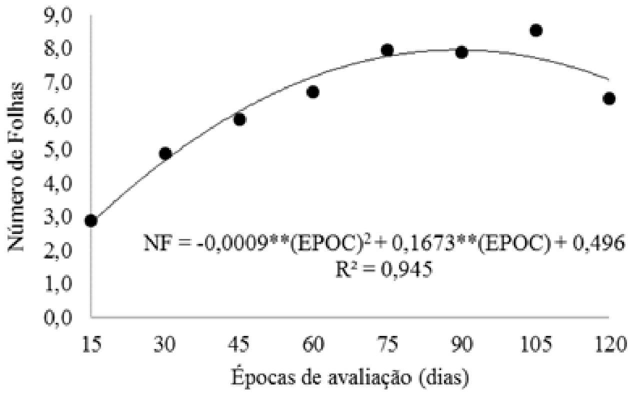

Figure 5 - Number of garlic leaves white miner variety as a function of the evaluation times. Redemption, 2017.

Garlic plants produce few leaves throughout the cycle, around eight leaves at their maximum activity around 90 DAP (MORAVČEVIĆ et al., 2011). As observed in Figure 5, after this period, the smallest number of leaves may be an indication that the plant is in the final phase of vegetative growth, being accompanied by gradual leaf senescence, by the paralyzing of plant growth in height and intensification of bulb growth. Information published by ARAÚJO (1991) apud SOARES (2013) states that leaves are the organs responsible for photoperiodic perception, and their number is therefore one of the factors to determine the productivity of a crop.

Figure 6 shows the adjustment of the number of leaves (NF) of the Branco Mineiro garlic variety as a function of biofertilizer doses. The data showed a decreasing linear trend, indicating that the number of leaves decreased with the increase of mixed biofertilizer doses. The number of leaves found in the experiment is in accordance with results published in the literature, as mentioned by MOTA et al. (2003). The authors evaluated the morphological characteristics of semi-noble garlic cultivars for the cultivar Cateto Roxo, and found an average number of 7.2 leaves. Arruda (2016) working with the cultivar Cateto Roxo verified that at 70 DAP, the plants produced the maximum number of 7.4 leaves for the maximum biofertilizer dose of 500 mL plant^{-1} week^{-1}.

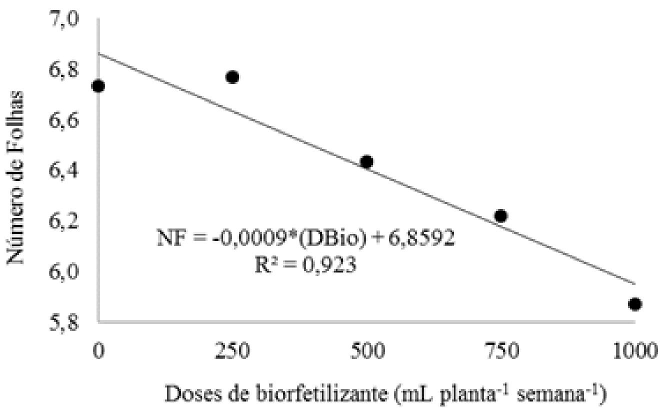

Figure 6 - Number of leaves of garlic variety Branco Mineiro as a function of biofertilizer doses. Redemption, 2017.

Table 2 presents the summary of variance analyses applied to garlic production data as a function of biofertilizer doses. According to the results presented, the application of differentiated doses of mixed liquid biofertilizer did not cause significant effect in the face of the analyzed variables.

Table 2- Summary of variance analyses for the average mass of the plant (PPcolheita), the diameter of the bulb (DBcolheita), the weight of the shoot after curing in the sun (PPASol), the average mass of the bulb after curing the sun (PBSol) and the diameter of the bulb after curing the sun (DBSol) of the white fruit garlic as a function of biofertilizer doses. Redemption, 2017

Source of Variation	GL	Middle square				
		------------ Harvest -----------		--------------- Cure in the sun -----------		
		$PP_{Harvest}$ (g)	$DB_{Harvest}$ (mm)	PPA_{sun} (g)	PB_{sun} (g)	DB_{sun} (mm)
Block	2	5,3452^{ns}	5,2885^{ns}	0,1222^{ns}	4,5151^{ns}	6,5989
Biofertilizer	4	31,8834^{ns}	3,0354^{ns}	0,4188^{ns}	5,2081^{ns}	3,0343
Residue	8	12,9124	2,5688	0,1635	2,5323	2,6284
Total	14	-	-	-	-	
CV		12,91	5,07	25,40	13,15	5,43

** significant at the level of 1% probability (p <0.01); * significant at the 5% probability level (0.01 =<p <0.05); n not significant (p>= 0.05)

Table 3 shows the mean values of the production variabl es of the Branco Mineiro garlic variety as a function of biofertilizer doses. The average mass of the plant obtained at harvest was 21.6 g and after curing in the sun, when the aerial part of the bulb was separated, this mean value was 1.59 and 12.10 g for the respective parts. In absolute terms, there was a dose trend of 250 mL plant-1 week-1 to present more developed bulbs. Soares et al. (2015), working with the cultivar Cateto Roxo, obtained an average value for the fresh mass of the plant of 9.17g, a value lower than the experimental average of this study.

The organ of commercial interest of garlic is the bulb and, to do so, the larger its size will be the amount paid for it (RESENDE et al., 2013). Therefore, to achieve a satisfactory productivity requires a high individual accumulation of biomass, because each plant produces only one bulb.

Table 3 – Average values of average plant mass (PPcolheita), bulb diameter (DBcolheita), shoot weight after sun curing (PPASol), average bulb mass after sun curing (PBSol) and bulb diameter after curing in the sun (DBSol) of branco mineiro garlic as a function of biofertilizer doses. Redemption, 2017.

Biofertilizer Doses (mL $plant^{-1}$ $week^{-1}$)	---------- Harvest ---------		------- Cure in the sun -----------		
	$PP_{Harvest}$ (g)	$DB_{Harvest}$ (mm)	PPA_{sun} (g)	PB_{sun} (g)	DB_{sun} (mm)
0	22,07	30,75	1,75	11,02	28,90
250	25,23	32,43	1,53	13,99	31,17
500	23,64	32,26	2,15	12,35	30,23
750	20,26	32,32	1,26	12,46	30,25
1.000	16,79	30,30	1,27	10,68	28,81
Average	21,60	31,61	1,59	12,10	29,87

The average mass and diameter of the bulb after sun cure verified in this experiment were 12.10 g and 29.87 mm, respectively. Honorato et al. (2013) found an average bul b mass of 9.90 g in cv. White Mossoró. For the cultivar Cateto Roxo, Oliveira et al (2010) in the region of Diamantina-MG and Arruda (2016) in Redenção-CE, they obtained values of average mass and bulb diameter of 16.81g and 35.25 mm and 4.77g 23.96 mm, respectively.

IV. CONCLUSIONS

The highest values for growth variables were found between 76 and 93 days after planting (DAP).
The mass and average diameter of the bulbs presented mean values of 12.10 g and 29.87 mm, respectively.
The application of mixed biofertilizer, in its different doses, did not provide increments in the postharvest characteristics of the Branco Mineiro garlic variety.

V. ACKNOWLEDGEMENT

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VI. REFERENCES

1. .ARRUDA, R. da S. Development of common garlic (purple cateto) subjected to different doses of biofertilizer. Monograph. University of International Integration of Afro-Brazilian Lusophony - UNILAB. Redemption-EC. 43p. 2016.
2. CHRISTIANSEN, J. E. Irrigation by sprinkling. Berkeley, University of California: Agricultural Experiment Station, 1942. 124p. (Bulletin, 670).
3. DUTRA, C.C.; et al. Development of sunflower plants under different water supply conditions. Semina. v.33, n.1, p.2657-2668, 2012.
4. EMBRAPA - Brazilian Agricultural Research Company. National Center for Soil Research. Manual of soil analysis methods. 2.ed. Rio de Janeiro: Embrapa Soils, 2011. 230p.
5. EMBRAPA - BRAZILIAN AGRICULTURAL RESEARCH COMPANY. Brazilian soil classification system. 3.ed. Brasilia, 2013. 353p.
6. FEITOSA, H. O.; et al. Evaluation of garlic cultivars in three regions of the State of Rio de Janeiro cultivated under organic system. Revista Brasileira de Ciências Agrárias, v. 4, n. 4, p.399-404, 2009.
7. HONORATO, A. R.F.; et al. Evaluation of garlic cultivars in the Mossoró region. Caatinga Magazine, v. 26, n. 3, p. 80-88, 2013.KELLER, J.; KARMELI, D. **Trickle irrigation design parameters.** Transactions of the ASAE, v.17, p.678-684, 1974.
8. K-PPEN, W. 1948. Climatologia: with a study of the earth's climates. Economic Culture Fund. Mexico. 479p.
9. MANTOVANI, E.C. Avalia: manual do usuário. Viosa: DEA/UFV–PNP&D/café Embrapa, 2002.
10. MORAV-EVI, D.; et al. Effect of plant density on the characteristics of photosynthetic apparatus of garlic (Allium sativum var. vulgare L.). African Journal of Biotechnology, v.10, n. 71, p. 15861-15868, 2011.
11. MOTA, J.H.; et al. Morphological and produtive characteristics of alho cultivars (Allium sativum L.) do semi-nobre group. 2003. Horticulture Brasileira, v. 21, n. 2, Julho, 2003 ñ Supplement CD.
12. OLIVEIRA F. L.; et al. Agronomic characteristics of alho em Diamantina cultivars. Horticulture Brasileira, v. 28, p.355-359, 2010.
13. PEREIRA, A. J. Desenvolvimento e producao de alho submeshed to different periods of vernalization and planting times. 2000. 66 f. Tese (Doutorado em Phytotechnics) - Universidade Federal de Lavras, Lavras, MG, 2000.
14. RESENDE, J. T. V.; et al. Morphological characterization, produtividade and commercial performance of alho cultivars. Horticulture Brasileira, v. 31, n. 1, p. 157-162, 2013.
15. SHARP, R. E. Interaction with ethylene: changing views on the role of abscisic acid in root and shoot growth responses to water stress. Plant Cell Environment, v.25, n.2, p.211-222, 2002.
16. SOARES, A. M. Avaliacao de cultivars of non-ammunition alho by Governador Dix-sept Rosado-RN. 2013. 104p. Dissertacao (Mestrado em Phytotecnia) – Universidade Federal Rural do Semiárido, Mossoró, RN, 2013.
17. SOARES, A.M.; et al. Avaliacao of non-ammunition alho cultivars from Governador Dix-sept Rosado-RN, Brazil. Online Agro@mbiente, v. 9, n. 4, p. 423-430, 2015.
18. VELOSO, E.C.; et al. Trading characteristics of alho em Picos, PI. Horticulture Brasileira, Brasília, v. 17, n. 3, p. 234-236, Nov. 1999.RESENDE, F.V.; et al. **Produção de alho semente**: parte I Nosso Alho, Brasília, DF, n. 24 p. 43-55, set. 2016.
19. FREDDO, A. R. L. F.; National Supply Company: Alho, Prop. prices mín., Brasília, v.2, n.1 Apr. 2017. P.10.
20. Available in: http://www.conab.gov.br. Accessed On Nov 7, 2017.
21. MEDEIRO, M. B.; LOPES, J. S. Liquid Biofertilizers and Agricultural Sustainability. Bahia Agricultural. Vol. 7, no. 3, 2006.
22. Meirelles, L.; Neto Bracagioli, A.; Meirelles, A.L.; Gonçalves, A; Guazzelli, J.J.; Volpato, C. & Bellé, N. Enriched biofertilizers: path of nutrition and plant protection. Ipê: Center for Ecological Agriculture, CAE Ipê. 1997. 12p.

23. LOPES W. AR; Slave. M.Z; Resende. F.V; Lucena. R RM; Soares. A.M; Silva. O. MP; Jf. J. F M. Garlic production submitted to periods of vernalization and planting times in a semi-arid climate region. Horticultura Brasileira, Mossoró-RN, Oct. 2012.