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Potential for lychee crop in Mata Norte Pernambucana - Brazil

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ABSTRACT

Lychee crops occurs mainly in South and Southeast regions of Brazil. In this study, the digital terrain modeling (DTM) of the micro-region Mata Norte Pernambucana, was designed to identify the districts that have potential for lychee crop, through the parameters of average altitude, precipitation and temperature. The districts analyzed were Aliança, Buenos Aires, Camutanga, Carpina, Condado, Ferreiros, Goiâna, Itambé, Itaquitinga, Lagoa do Carro, Lagoa do Itaenga, Macaparana, Nazaré da Mata, Paudalho, Timbaúba, Tracunhaém and Vicência. The analysis of climate, wind power and altitude in Mata Norte Pernambucana, has revealed that some districts of the micro-region have potential for lychee crops, which is a product with great financial return, and may contribute to increase economy and quality of life in the micro-region.

Keywords: Climatic aspects, *Litchi chinensis*, adaptability.

INTRODUCTION

The Sapindaceae family comprises about two thousand plant species, including four species with great commercial interest of its fruits, which are guarana, pitomba, rambutan and lychee. The lychee is one of the most important members of the Sapindaceae family (CAVALLARI, 2013; LOPES, 2014; Queiroz et al., 2015; SMARSI et al., 2011). The lychee (*Litchi chinensis* Sonn) is a large tree-sized plant, with a height of 10 to 15m, which initiate commercial production in the 5th year after planting the seedlings (CHAKRABORTY et al., 2014; GUIMARÃES, 2013; MATOS, 2012). The fruit is popularly known in Brazil as lychee, and has an attractive red pericarp, involving a translucent pulp white aril. This fruit has a high commercial value,

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being much appreciated because of its sweet taste and its great nutritional value (CAVALLARI, 2013; CHAKRABORTY et al., 2014; Lima et al., 2010; LOPES, 2014; QUEIROZ et al., 2012; QUEIROZ et al., 2015).

The lychee is a fruit native from Asia, specifically in Guangdong province in the subtropical zone of southern China, where it is grown for centuries (CHAKRABORTY et al., 2014; LIMA et al., 2010; LOPES, 2014; GUIMARÃES, 2013; PIRES, 2012; QUEIROZ et al., 2015; SMARSI et al, 2011). In Brazil, the first lychee trees were introduced around 1810, as a gift from the emperor of China to Pedro I, and planted in Rio de Janeiro Botanical Garden (LOPES, 2014;. SMARSI et al, 2011; SOUSA et al., 2012). Then, its cultivation has expanded to the Southeast (SMARSI et al., 2011). The lychee is commercially cultivated in the country since the 70s, more precisely in the state of São Paulo, which has achieved excellent yields and economic results. But the Lychee is still considered an exotic fruit in Brazil, in general, due to domestic production limited to small areas of the south and southeast (CAVALLARI, 2013; MATOS, 2012; SEBRAE, 2016; SOUSA et al., 2012; QUEIROZ et al., 2015). About 97% of domestic production is concentrated in the Andradina region, Tupã, Jaboticabal, Bauru, Jales and Mogi Mirim (CAVALLARI, 2013; PIRES, 2012; SMARSI et al., 2011), followed by the states of Paraná, Bahia and Minas Gerais, which together account for the remaining 3% (PIRES, 2012).

Because of the great nutritional importance and value in the retail market, the lychee is attracting interest and gaining great commercial prominence, as a good financial alternative to the problems that occur with traditional cultures (QUEIROZ, 2012; SILVA, 2012; SOUSA et al., 2012; WU et al., 2011). The climatic factors that should be considered for the implementation of a crop, such as lychee, are: seasons, temperature, precipitation, solar radiation, relative humidity and some others factors that will influence the quality and quantity of production and the development of lychee, that is a fruit of tropical and subtropical climate (PIRES, 2012; QUEIROZ et al., 2015). The lychee requires a dry climate and a cold winter before flowering, and hot and humid climate during the rest of the year. The optimal temperature range is between 20 and 35 °C, while a temperature below 15 or 16 °C paralyzes its vegetative activity. During the three months prior to flowering, the lychee requires low humidity temperatures, below 20 °C. The precipitation to lychee crops can vary between 1250 and 1700 mm (LINS, 2013; MATOS, 2012).

The most indicated characteristics of soil for the lychee's development is a deep, well-drained soil with a high concentration of organic matter, which can be replaced with proper fertilization, and with its pH ranging from 5, 5 and 6.5. The new leaves of the crop are sensitive to wind action, requiring the installation of windbreaks in the areas where they may occur (MATOS, 2012).

The production varies according to the season and the country (SEBRAE, 2016). The normal productivity of lychee is 30-45 kg / plant. However, in the Brazilian conditions and with the support of technologies, it may reach a productivity 200-300 kg / plant per year.

In the world, the largest lychee crop producers are: China, India, Thailand, Vietnam, Nepal, Bangladesh, Madagascar and South Africa There are still other countries with smaller productions such as Australia, Indonesia, Mauritius Islands, Israel, Spain, United States, Mexico and Brazil. It is

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estimated that the volume of fruit produced in the world for the years of great production is around 2 million tons (CAVALLARI, 2013; LOPES 2014; PIRES, 2012; QUEIROZ, 2012). Brazil is not considered as significant worldwide producer center, as other countries. However, it is considered a potential exporter, due to its different harvest times (LOPES 2014; PIRES, 2012; QUEIROZ, 2012). The lychee production is intended primarily as fresh fruits, and it may be used in condiments, sauces, canned food, wines, jelly, jams, juices, ice creams and yogurts, dried, pass type, in teas or as sweetener (QUEIROZ et al., 2012; LOPES, 2014).

Agriculture is largely linked to climatic factors, so, to study these related parameters is a good alternative to discover new agricultural frontiers (CALDAS, 2016; VERSLYPE & CALDAS, 2016; VERSLYPE et al., 2015).

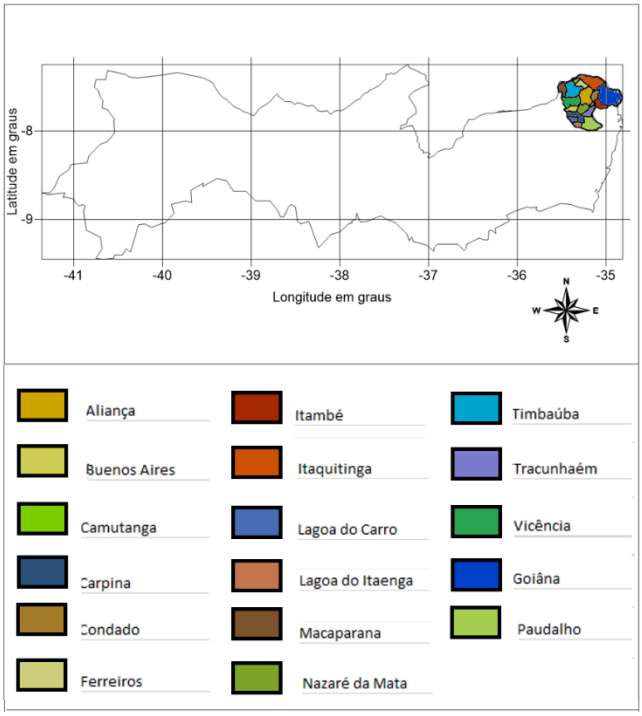
The aim of this study was to create the DTM for precipitation parameters, temperature and altitude of the districts of the micro-region of the Mata Norte Pernambucana, through the software Surfer 12, and analyze which districts have potential to lychee crop, improving the economic development of the region studied.

MATERIALS AND METHODS

The study was conducted from February to April 2016 in the laboratory of the Grupo Internacional de Pesquisa e Estudos de Topografia e Geotecnologias aplicadas à Agricultura e Preservação ambiental – GETAP, located in the Departamento de Tecnologia Rural – DTR, Universidade Federal Rural de Pernambuco - UFRPE.

The study area was the districts of the micro-region of the Mata Norte Pernambucana, in the state of Pernambuco (Figure 1). The center coordinates 262230.12 me (N) 9148504.70 m (E), zone 25, datum WGS84, which were used images Digital Globe, 2015 Google Earth Pro 7.1.4.1529 to obtain the limits of the districts of Aliança, Buenos Aires, Camutanga, Carpina, Condado, Ferreiros, Goiâna, Itambé, Itaquitinga, Lagoa do Carro, Lagoa do Itaenga, Macaparana, Nazaré da Mata, Paudalho, Timbaúba, Tracunhaém, Vicência and the micro-region were designed by DTM, digital terrain modeling, through the software Surfer 12.

Figura 1 – Representação da Microrregião Mata Setentrional Pernambucana e de seus municípios. Font: Verslype et al., 2016.



Data in census institutes and scientific articles were compared for discussion. Climate requirements of lychee were crossed with the parameters of precipitation and temperature collection with a period of 30 years, from January to December, of the micro-region of the Mata Norte Pernambucana, as wind speed data in a period of 10 years, because according to MATOS (2012), the new leaves of lychee crops are sensitive to wind, to verify the potential of the region for the lychee crop production (Figure 2), in the districts mentioned above. All data were

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designed to DTM to help visualization and discussed later.

Figure 2 – Lychee (*Litchi chinensis* Sonn.). Source: Revista Globo Rural, 2014.

RESULTS AND DISCUSSION

1. Characterization of the study area

The Mata Norte Pernambucana is a micro-region of Pernambuco State, which has an area of 3,200 km², which corresponds to 3.25% of the state. The districts of the Mata Norte Pernambucana are Aliança, Buenos Aires, Camutanga, Carpina, Condado, Ferreiros, Goiâna, Itambé, Itaquitinga, Lagoa do Carro, Lagoa do Itaenga, Macaparana, Nazaré da Mata, Paudalho, Timbaúba, Tracunhaém and Vicência (IBGE, 2011; MELO et al., 2010), which are inserted in the Mesoregion of Pernambuco Zona da Mata, that has an area of 8,738,000 km². This space is subdivided in three divisions: The humid forest, dry forest and mountainous forests, because of lush vegetation, which is influenced by humidity, and altitude, soil permeability and proximity of the caatinga area (CUENCA, 2013; LIMA, 2007;. MELO et al, 2010).

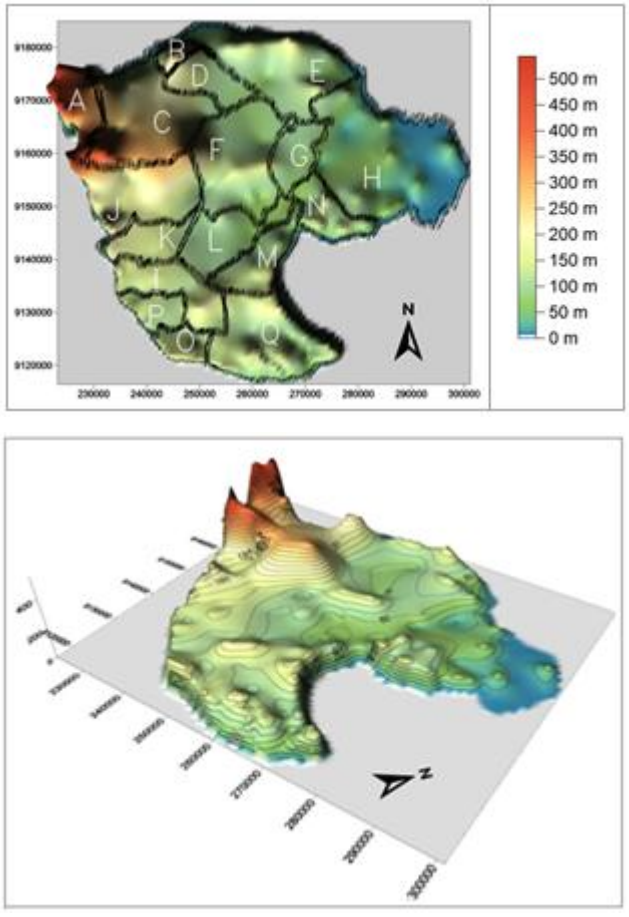
1.2. Altimetry and wind speed

According data from NASA (2005), at intervals of ten years, starting from July 1983 until June 1993, the Mata Norte Pernambucana micro-region winds have an average annual speed of 8.97 m / s at 50 m above surface of the earth. This speed is considered a weak breeze on the Beaufort scale, which can swing small trees (SANTANA, 2014).

The micro-region is characterized by having a slightly undulating relief (COSTA, 2014) and is located in the area of Morphoclimatic Domain of "Morros Seas" which has a wide range of soils due to the lithological and topographical differences, and, more discreetly, climate differences (JATOBÁ et al., 2014).

According CPRM data (2005), the district that has the highest altitudes is Macaparana, which has an altitude of 350 meters, while Goiana has an altitude of 13 meters, which demonstrates the difference among altitude of the districts of the micro- region. The DTM for altitude (Figure 3) of the micro-region was designed.

Figura 3 – Representação da altimetria dos municípios da Microrregião Mata Setentrional Pernambucana através de MDT. Em A - Macaparana, B - Camutanga, C - Timbaúba, D - Buenos Aires, E - Itaquitinga, F - Aliança, G – Condado, H - Goiâna, I - Carpina, J - Vicência, K - Ferreiros, L - Nazaré da Mata, M - Tracunhaém, N - Itambé, O- Lagoa do Itaenga, P - Lagoa do Carro, Q - Paudalho. Fonte: Verslype et al., 2016.



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1.3. Clima

The Mesorregião da Zona da Mata is a transition area between the coast, which has a high rainfall in winter and mild climate throughout the year, and the Agreste Pernambucano, which has a drier climate with less rainfall (Silva et al., 2003). The districts of Mata Norte Pernambucana Zone, have a hot and humid climate with a relative humidity between 70 and 95%.

The Mata Norte Pernambucana, in comparison to the southern forest zone, has less rainfall average, with the number of rainy days per year ranging between 150 and 210 (JATOBÁ et al, 2014;. LINS and COELHO, 2004). In this context, the districts of Mata Norte Pernambucana have an average annual rainfall ranging between 1561.8 and 431.8 mm, with hot and humid climate (Köppen) (COSTA, 2014; DCA, 2015; IBGE, 2011). Condado has the highest average annual rainfall index of Mata Norte Pernambucana(1561.8 mm), followed by the districts of Itambé (1407 mm), Goiâna (1271.6 mm), Vicência (1221.8 mm) Nazaré da Mata (1172.5 mm) Paudalho (1166.5 mm), Tracunhaém (1154 mm), Buenos Aires (1130.8 mm), Aliança (1129.9 mm), Itaquitinga (1111.1 mm), Ferreiros (1107 mm), Lagoa de Itaenga (1106.8 mm), Macaparana (1066 mm), Lagoa do Carro (989 mm), Carpina (967.9 mm), Timbaúba (770.3 mm) and Camutanga, which has the lowest average annual rainfall (431.8 mm) (DCA, 2015; IBGE, 2011). The DTM of the average annual rainfall in the micro-region of the Mata Norte Pernambucana is designed in (Figure 4). According LINS and COELHO (2004), the average annual temperature of the Mata Norte Pernambucana is 24.1 ° C. Aliança is the district that has the highest average annual temperature with 25.4 ° C, followed by the districts of Vicência (25.3 ºC), Camutanga (25.2 ºC), Itambé (25.1 ºC), Itaquitinga (25.1 ºC), Condado (25.0 ºC), Lagoa do Carro (25.0 ºC), Buenos Aires (24.9 ºC), Goiâna (24.9 ºC), Nazaré da Mata (24.9 ºC), Ferreiros (24.7 ºC), Paudalho (24.6 ºC), Timbaúba (24.6 ºC), Carpina (24.5 ºC), Tracunhaém (24.5 ºC), Lagoa do Itaenga (24.2 ºC). The district that has the lowest average annual temperature is é Macaparana (23.6 ºC). In (Figure 5) was designed in DTM the average annual temperature of the municipalities of the Mata Norte Pernambucana.

Figura 4 – Precipitação anual média dos municípios da Microrregião Mata Setentrional Pernambucana representada através de MDT. Fonte: Verslype et al., 2016.

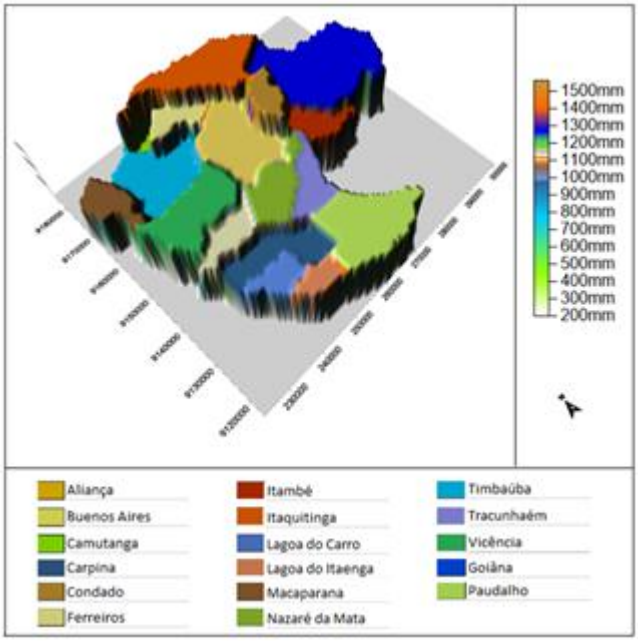

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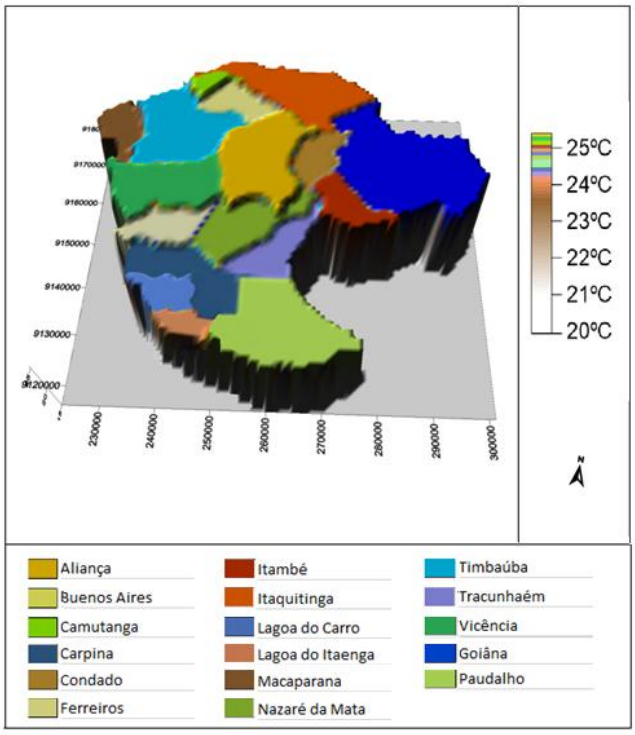
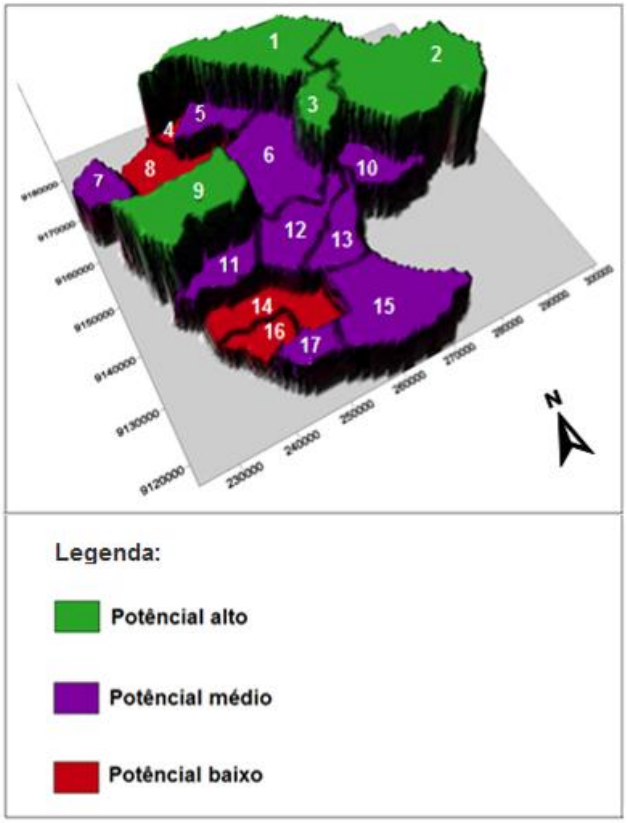
Figura 5 – Temperatura anual média dos municípios da Microrregião Mata Setentrional Pernambucana. Fonte: Verslype et al., 2016.



2. Farming potencial for lychee crops in the districts of Mata Norte Pernambucana

According data of climatic requirements of lychee crops, and agro-climatic and topographic characteristics of the Mata Norte Pernambucana, only four districts of the region have high potential for farming lychee crops, with parameters of rainfall and average annual temperature ideal for the development of lychee, between 20 and 35 ° C and an average annual rainfall ranging between 1250 and 1,700 mm, according to Matos (2012). These districts are: Goiâna, Itambé, Itaquitinga and Vicência. The districts of Lagoa do Carro, Carpina, Timbaúba and Camutanga have low potencial for lychee crops, because its rainfall rates far below the ideal range required by the lychee crops. Condado, Buenos Aires, Aliança, Macaparana, Ferreiros, Nazaré da Mata, Tracunhaém, Paudalho and Lagoa do Itaenga, have medium potencial, with an annual average rainfall of 1000 e 1250 mm. The DTM for farming potential of lychee crops in Mata Norte Pernambucana was designed in (Figure 6).

Figura 6 – Potêncial dos municípios da Microrregião Mata Setentrional Pernambucana para o clultivo da lichiera através de MDT. Em 1 - Itaquitinga, 2 - Goiâna, 3 – Condado, 4 - Camutanga, 5 - Buenos Aires, 6 - Aliança, 7 - Macaparana, 8 - Timbaúba, 9 - Vicência, 10 - Itambé, 11 - Ferreiros, 12 - Nazaré da Mata, 13 - Tracunhaém, 14 - Carpina, 15 - Paudalho, 16 - Lagoa do Carro, 17- Lagoa do Itaenga. Fonte: Verslype et al., 2016.



However, the districts that have medium and low potential due to low rainfall, could use the integrated irrigation, such as drip system, to compensate the problem of water shortage. Encourage the development of lychee crops may increase the economy of the region.

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REFERENCES

CONDEPE/FIDEM. Agência Estadual de Planejamento e Pesquisas de Pernambuco. *Perfil Fisiográfico das Bacias Hidrográficas de Pernambuco*, 2006. Disponível em: www.condepefidem.pe.gov.br/. Acesso em: 20 fev 2016.

CALDAS, R. M., & VERSLYPE, N. I. Pitaia: potencial de cultivo na microrregião Sertão do Moxotó através de Modelo Digital do Terrreno| Pitaya/dragon fruit: farming potential in the Sertão of Moxotó through Digital Terrain Model. Revista Geama, v. 4, n. 1, p. 15-21, 2016.

CAVALLARI, L. L. *Raleio de frutos em variedades de lichieira.* 2013. xii, 47 p. Tese (doutorado) - Universidade Estadual Paulista Júlio de Mesquita Filho, Faculdade de Ciências Agrárias e Veterinárias de Jaboticabal, 2013.

CHAKRABORTY, K.; SAHA, J.; RAYCHAUDHURI, U.; CHAKRABORTY, R. *Tropical fruit wines: A mini review*. Natural Products: An Indian Journal, vol. 10, no 7, p. 219-228, 2014.

COSTA, D. B. *Adubação fosfatada em cana planta e soca em argissolos do nordeste de diferentes texturas*. Revista Caatinga, Mossoró, v. 27, n. 4, p. 47 – 56, 2014.

CPRM. Serviço Geológico Do Brasil. *Diagnóstico dos municípios da Microrregião Mata Setentrional Pernambucana.* Projeto cadastro de fontes de abastecimento por água subterrânea. Recife: CPRM/PRODEEM, 2005. Disponível em: http://www.cprm.gov.br/publique/Hidrologia/Mapas-e-Publicacoes/Pernambuco---Atlas-Digital-dos Recursos-Hidricos-Subterraneos-325.html. Acesso em: 07 mar 2016.

CUENCA, M. A. G.; ALBUQUERQUE-RANGEL, J. H.; ARAÚJO, H. R. Effect of cassava productivity in Pernambuco over the production gross value between 1977 and 2009. *Revista Raízes e Amidos Tropicais*, v. 9, n. 1, p. 01-10, 2013.

DCA. Departamento De Ciências Atmosféricas. *Dados climáticos do estado de Pernambuco.* Disponível em: < http://www.dca.ufcg.edu.br/clima/dadospe.htm>. Acesso em: 07 fev. 2016.

GUIMARÃES, J. E. R. et al. *Ácido cítrico e quitosana na conservação de lichias 'Bengal'. Revista Brasileira de Fruticultura.* Sociedade Brasileira de Fruticultura, v. 35, n. 3, p. 730-737, 2013.

IBGE. Instituto Brasileiro de Geografia e Estatística. *Dados climáticos.* 2011. Disponível em: http://cidades.ibge.gov.br/ . Acesso em: 20 fev 2016.

IBGE. Instituto Brasileiro de Geografia e Estatística. *IBGE - @cidades.* 2014. Disponível em: http://cidades.ibge.gov.br/xtras/uf.php?lang=&coduf =26&search=pernambuco. Acesso em: 04 fev 2016.

JATOBÁ, L.; SILVA, A. F.; GOMES, A. L. L. Relevo e solos no dominío morfoclimático dos "mares de morros" em pernambuco. *Revista Equador,* v. 3, n. 2, p. 2-18, 2014.

Received: May 12, 2016 | Approved: June 01, 2016.

LIMA, D. A. *Estudos fitogeográficos de pernambuco*. Anais da Academia Pernambucana de Ciência Agronômica (Online), vol. 4, p.243-274, 2007.

LINS, L. C. R. D. *Propagação da lichieira por alporquia em diferentes substratos e épocas do ano*. 2013. Dissertação (mestrado) - Universidade Federal de Viçosa, 2013.

LOPES, M. O. *Litchi chinensis* Sonn.*: estudos microbiológicos e fitoquímicos.* 2014. Dissertação (Mestrado em Ciências Farmacêuticas) - Universidade Federal de Alfenas, Alfenas, MG, 2014.

MATOS, E. H. S. F. *Cultivo de Lichia*. Centro de Apoio ao Desenvolvimento Tecnológico - CDT/UnB, 2012.

MARTINS, I. C. F.; CAVALLARI, L.; HADDAD, G. Q.; AUGUSTO, T.; CIVIDANES, F. J.; MARTINS, A. B. G. Grupos de insetos visitantes florais da lichieira (Litchi chinensis Sonn.) em Jaboticabal, estado de São Paulo, Brasil. *Acta Agronómica*, v. 62, n. 1, p. 1-6, 2013.

MELO, P. C. S.; SANTOS, V. F.; SILVA, L. S.; SANTOS, I. F.; MELO, M. R. C. S. *Teste de genótipos de arroz em casa de vegetação para cultivo de sequeiro na zona da mata de Pernambuco.* Anais da Academia Pernambucana de Ciência Agronômica, Recife, v. 7, p. 305-311, 2010.

NASA. National Aeronautics and Space Administration. *Surface meteorology and Solar Energy: Global Data Sets*, 2005. Disponível em: http://eosweb.larc.nasa.gov/sse/. Acesso em: 09 fev 2016.

PIRES, M. C. *Efeito do anelamento e do paclobutrazol no florescimento e frutificação, sobrenxertia e análise sazonal de macro e micronutrientes em (Litchi chinensis Sonn).* Brasília: Faculdade de Agronomia e Medicina Veterinária, Universidade de Brasília, 115p. Tese (Doutorado em Agronomia). 2012.

QUEIROZ, E. R.; ABREU, C. M. P.; SANTOS, C. M.; SIMAO, A. A. *Composição química e fitoquímica das farinhas da casca e da semente de lichias (Litchi chinensis Sonn) cultivar 'Bengal'.* Cienc. Rural [online]. vol.45, n.2, pp.329-334. 2015.

QUEIROZ, E. R. *Frações de lichia : caracterização química e avaliação de compostos bioativos.* Dissertação (mestrado) – Universidade Federal de Lavras, 2012.

QUEIROZ, E. R.; ABREU, C. M. P.; OLIVEIRA, K. S. *Constituintes químicos das frações de lichia in natura e submetidas à secagem: potencial nutricional dos subprodutos.* Rev. Bras. Frutic. [online]. Jaboticabal - SP, vol.34, n.4, pp.1174-1179. 2012.

SANTANA, L. V. R. *Análise do comportamento da velocidade do vento na região Nordeste do Brasil utilizando dados da ERA-40*. 2014. 46 f. Dissertação (Mestrado em Biometria e Estatística Aplicada) – Universidade Federal Rural de Pernambuco, Recife, 2014.

 Received: May 12, 2016 | Approved: June 01, 2016.

SEBRAE. Serviço Brasileiro de Apoio às Micro e Pequenas Empresas. *O cultivo e o mercado da lichia. Sebrae Nacional*. 2016. Disponível em: http://www.sebrae.com.br/sites/PortalSebrae/artigos/O-cultivo-e-o-mercado-da-lichia. so em: 10 fev 2016.

SILVA, D. F. P.; LINS, L. C. R.; CABRINI, E. C., BRASILEIRO, B. G.; SALOMÃO, L. C. C. *Influence of the use of acids and films in post-harvest lychee conservation.* Ceres, v. 59, n. 6, v., p. 745-750, 2012.

SILVA, A. V.; CUNHA, L. P.; MEIRELES, L. R.; GOTTSCHALK, L.; MOTA, R. A.; LANGONI, H. *Toxoplasmose em ovinos e caprinos: estudo soroepidemiológico em duas regiões do Estado de Pernambuco.* Brasil. Ciência Rural, Santa Maria, v.33, n.1, jan-fev, p.115-119, 2003.

SMARSI, R.C.; OLIVEIRA, G. F.; REIS, L. L.; CHAGAS, E. A.; PIO, R.; MENDONCA, V.; CHAGAS, P.; CURI, P. Efeito da adubação nitrogenada na produção de mudas de lichieira. *Rev. Ceres*, Viçosa, v. 58, n.1, p. 129-131, jan/fev, 2011.

SOUSA, P. B.; SILVA, E. F.; LIMA, M. A.; MONÇÃO, E. C.; SILVA, M. J. M.; NASCIMENTO, V. L. V. *Avaliação físico-química de lichias (Litchi chinensis Sonn.) comercializadas em Teresina - Piauí.* VII CONNEPI, Palmas – Tocantins, 2012.

VERSLYPE, N. I., & CALDAS, R. M. Potencial para o cultivo do caquizeiro na Microrregião do Vale do Ipanema através do modelo digital do terreno. *Revista Geama*, v. 4, n. 1, p. 22-29, 2016.

VERSYPLE, N. I., CALDAS, R. M. S., JÚNIOR, J. M. C., & ANDRADE, J. S. Potencial para o cultivo do girassol na Microrregião do Pajeú através do modelo digital do terreno| Potential for sunflower crop in the Microrregião do Pajeú through the digital terrain model. *Revista geama*, v. 2, n. 2, 2015.

WU, B.; LI, X.; HU, H.; LIU, A.; CHEN, W. Effect of chlorine dioxide on the control of postharvest diseases and quality of litchi fruit. *African Journal of Biotechnology*, vol. 10, no 32, p. 6030-6039, 2011.

Received: May 12, 2016 | Approved: June 01, 2016.