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Agroclimatic aptitude for peanut in the West region of the state of Mato Grosso

Aptidão agroclimática para o amendoim na região oeste do Estado do Mato Grosso

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Abstract

Peanut crop (*Arachis hypogea* L.) has great food interest due to its high content of protein and oil, however, there is the need to observe its aptitude for a certain region where temperature and rainfall data provided by Instituto Nacional de Meteorologia (INMET) were used from 1961 to 2012. The production of peanut crop is highly influenced by weather conditions as well as all crops, thus this study aims at determining agroclimatic aptitude of the peanut crop in the municipalities of Campo Novo do Parecis, Cuiabá, Cáceres, Diamantino, São José do Rio Claro and Tangará da Serra all located at the state of Mato Grosso. The means of meteorological elements were ten-day calculated, totaling 36 ten-day periods for each climate variable and municipality. Based on the analysis of climate variables together to hydro and thermal crop requirements ranging from 500 to 700 mm and between 22 and 28 °C, respectively, it is concluded that peanut crop is considered suitable for the conditions found in the regions, considering that the thermal requirement of all ten-day periods were within or close to the ideal range of development. Rainfall is suitable by peanut crop from 13th to 26th of ten-days.

Additional keywords: (*Arachis hypogea* L.); climatic conditions; ten-day period.

Resumo

A cultura do amendoim (*Arachis hypogea* L.) possui grande interesse alimentar devido ao seu alto teor de proteína e óleo; para tanto, tem-se a necessidade de observar sua aptidão para determinada região, onde, neste trabalho, foram utilizados dados de temperatura e precipitação disponibilizados pelo Instituto Nacional de Meteorologia (INMET), no período de 1961 a 2012. A produção da cultura do amendoim é altamente influenciada pelas condições climáticas, assim como todas as culturas; portanto, este estudo visa a determinar a aptidão agroclimática nos municípios de Campo Novo do Parecis, Cuiabá, Cáceres, Diamantino, São José do Rio Claro e Tangará da Serra, todos pertencentes ao Estado de Mato Grosso. As médias dos elementos meteorológicos foram calculadas de forma decendial, totalizando 36 decêndios para cada variável climática e municípios. Com base nas análises das variáveis climáticas, conjuntamente às necessidades hídricas e térmicas da cultura que variam de 500 a 700 mm e entre 22 a 28 °C, respectivamente, conclui-se que o cultivo de amendoim é considerado apto para as condições encontradas nas regiões, considerando que as necessidades térmicas da cultura, em todos os decêndios, apresentaram-se dentro ou próximas da faixa ideal de desenvolvimento. A precipitação encontra-se tolerável pela cultura do 13^o ao 26^o decêndio.

Palavras-chave adicionais: (*Arachis hypogea* L.); condições climáticas; decêndio.

Introduction

Peanut (*Arachis hypogea* L.) is a species from *fabaceae* family characterized as one of the most important crop for human consumption due to its oil production characteristics (40 to 45%) and protein (20 to 28%) (Monteiro, 2007; Silveira, 2010). In addition to

fresh consumption, its oil can directly be used in food and in the paint, preserves and pharmaceuticals industries beyond its potential for biodiesel production (Godoy et al., 2005).

The peanut world production is in the range of 33.2 million tons of grain, 30% of this production is

intended for human consumption, both *in natura* and industrialized and the remaining 70% as edible oil.

In production terms, the production of Brazilian peanut comes from Southeast, on larger scale, followed by the Midwest and Northeast Brazil (Embrapa, 2006). The peanut is cultivated in more than 80 countries of two hemispheres, mainly in tropical regions in the range of latitude 30° N and S. Despite of this wide adaptability, productivity is strongly influenced by environmental factors, especially air temperature, water availability and solar radiation (Peixoto et al., 2008).

Adverse environmental conditions reduce differently plant growth depending on its stage - vegetative or reproductive (Santos et al., 2006). It can also change the cycle duration that ranges from 90 to 115 days for earlier cultivars and 120 to 140 days for late cultivars (Reichardt, 1987; Doorenbos & Kassam, 1994).

In studies Silva & Amaral (2008) state that crop allows a wide range of cultivation, from equatorial to temperate climates and a hot and humid season is needed, enough to allow plant vegetation, however it is very resistant to drought, favored by development of its root system to great depths allowing greater exploitation of soil moisture, on the other hand, culture is not suitable for areas with very prolonged humid season, because it favors the attack of fungi and incidence of diseases, in addition harming harvest and product quality.

According to Cunha & Assad (2001), climatic factors are the main cause of fluctuations on the

productivity of grains because temperature and rainfall, for example, cannot be controlled or modified by man on a large scale. Thus this study aims at determining the peanut crop aptitude for Campo Novo do Parecis, Cáceres, Cuiabá, Diamantino, São José do Rio Claro, and Tangará da Serra - MT, observing the ten-day climatic conditions of rainfall and air temperature determining one or more appropriate period to this plant cultivation.

Material and methods

The study was conducted in CPEDA – Centro de Pesquisas, Estudos e Desenvolvimento Agroambientais in the laboratory of Agrometeorology of Universidade do Estado de Mato Grosso – UNEMAT, Tangará da Serra Campus, rainfall and air temperature data recorded at weather stations from Instituto Nacional de Meteorologia (INMET) were used. After data acquisition, and analysis of the consistency and gap filling was performed using CLIMATE software (Faria et al., 2003), developed by the Instituto Agrônômico do Paraná (IAPAR), for the municipalities under study (Table 1).

Data were analyzed and compared to water requirements described by Sarr et al. (2004) and thermal by Nogueira & Távora (2005). Based on these requirements and considering the average crop cycle of 110 days, evaluations were carried out in ten-day periods totaling 11 periods of ten-days to complete its cycle.

Table 1 - Location of weather stations used in determining peanut crop agroclimatic aptitude.

Classification	Reference	Latitude	Longitude	Altitude	Period
Aw	Campo Novo do Parecis	13°38' S	58°17' W	596.0 m	2003 a 2012
Aw	Cáceres	16°03' S	57°41' W	118.0 m	1961 a 2012
Aw	Cuiabá	15°33' S	57°07' W	151.3 m	1961 a 2012
Aw	Diamantino	14°24' S	56°27' W	286.3 m	1961 a 2012
Aw	São José do Rio Claro	13°25' S	56°42' W	350.0 m	1996 a 2012
Aw	Tangará da Serra	14°39' S	57°25' W	321.5 m	2003 a 2012

Thus, areas were considered suitable for cultivation when the rainfall during the cycle, accounted between 500 and 700 mm and the average air temperature were between 22 and 28 °C. It is restricted when rainfall throughout cycle is greater than 700 mm and average air temperature during the 12 ten-day period is less than 22 °C or higher than 28 °C. The region that present rainfall below 500 mm and average air temperature lower 18 °C or greater than 33 °C is inapt, as proposed Assunção & Escobedo (2009).

Results and discussions

The municipality of Diamantino had the highest annual rainfall, with 1806.6 mm; the lowest

occurred in Cuiabá with 1493.5 mm (Figure 1). For all stations, annual historical averages exceeded 1400 mm distributed from October to March characterized as rainy season (Dallacort et al., 2011), and level considered suitable for cultivation of peanuts. The same variation was observed by Cardozo et al. (2010) in a study conducted in the state of São Paulo.

The annual average temperature (Figure 2) ranged from 24, 6 °C in the municipality of Campo Novo do Parecis to 26.8 °C in Cuiabá. Assunção & Escobedo (2009) proposed that the optimal range for crop development is between 22 to 28 °C, thus, the annual average air temperature is in the optimum range for all regions considered.

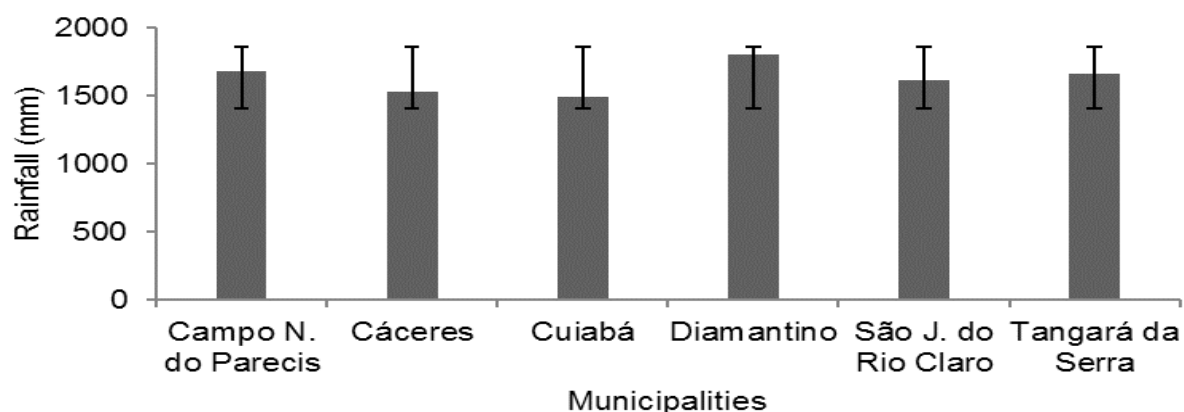


Figure 1 – Average annual rainfall and standard deviation in the municipalities of Middle North of Mato Grosso.

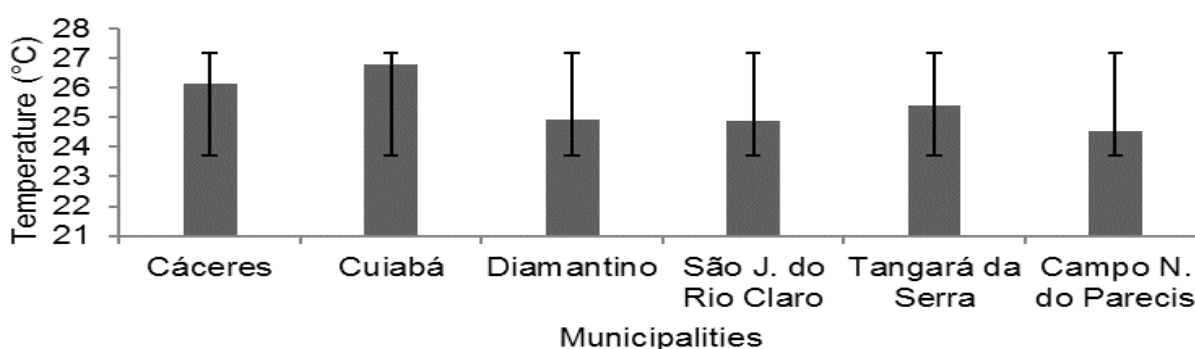


Figure 2 – Annual average temperature and standard deviation of the average in the municipalities of Middle North of Mato Grosso.

The ten-day distribution of rainfall and variations of average high, low and medium temperatures for the municipalities of Campo Novo do Parecis; Cáceres; Cuiabá; Diamantino; São José do Rio Claro and Tangará da Serra, indicate that regions have similar characteristics regarding rainfall distribution and variation in air temperature. By observing a rainy season from October to March with high temperatures and a dry period from April to September with mild temperatures, which according to Sousa (1998) is a characteristic pattern of cerrado region.

For the municipality of Campo Novo do Parecis is observed that the highest rainfall levels were recorded in periods of ten days 2; 3; 4 and 5 which respectively show 100.94; 109.87; 97.96 and 104.04 mm. The less rainy period is from 13-27 periods of ten-day ranging from 5 to 18 mm. The annual historical average rainfall for the municipality is 1682.33 mm. For temperature factor the annual average is 24.5 °C, with higher averages found in periods of ten-day 21-28 reaching 34.2 °C and lower average found in periods of ten-day 13-19 reaching 14.9 °C (Figures 3, 4, 5, 6, 7, 8).

Campo N. Parecis

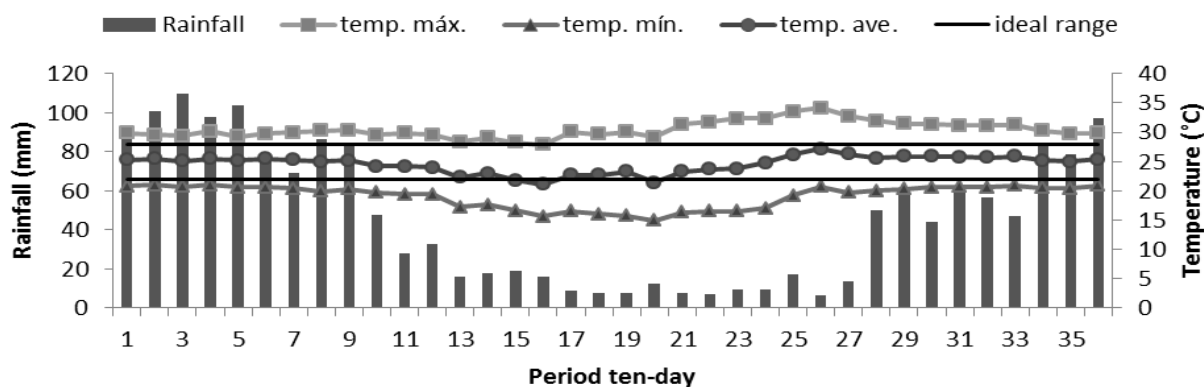


Figure 3 –Ten-day period rainfall distribution and average (ave.) maximum (máx.) and minimum (mín.) temperatures (temp.) in the municipality of Campo Novo Parecis - MT.

Cáceres

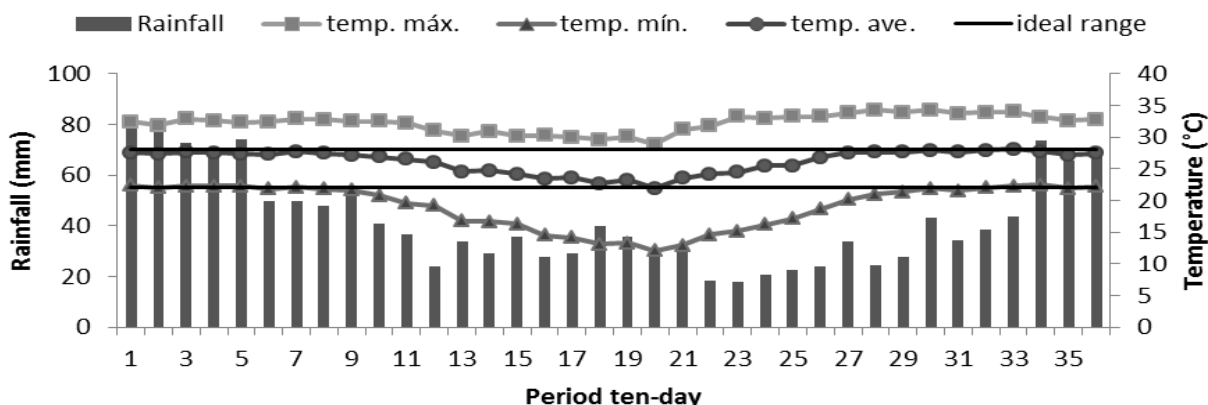


Figure 4 - Ten-day period rainfall distribution and average (ave.) maximum (máx.) and minimum (mín.) temperatures (temp.) in the municipality of Cáceres - MT.

Cuiabá

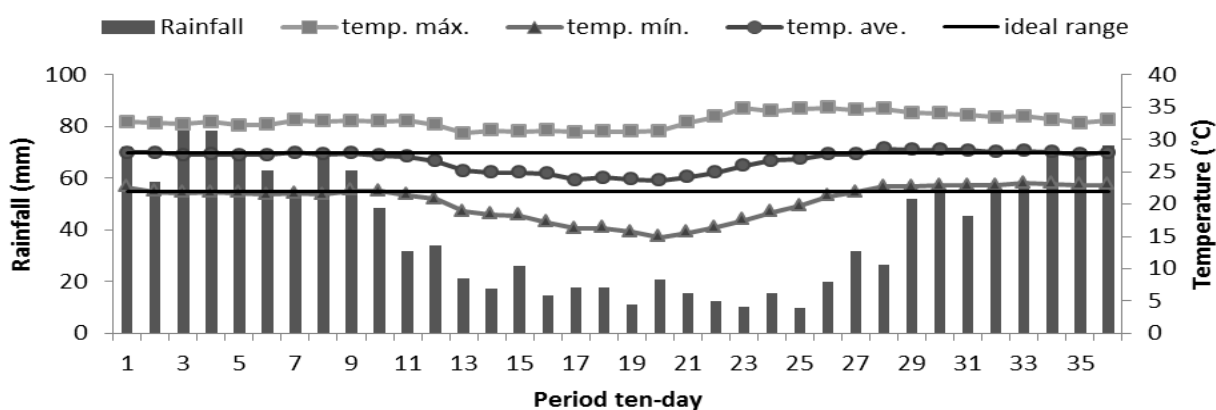


Figure 5 - Ten-day period rainfall distribution and average (ave.) maximum (máx.) and minimum (mín.) temperatures (temp.) in the municipality of Cuiabá - MT.

Diamantino

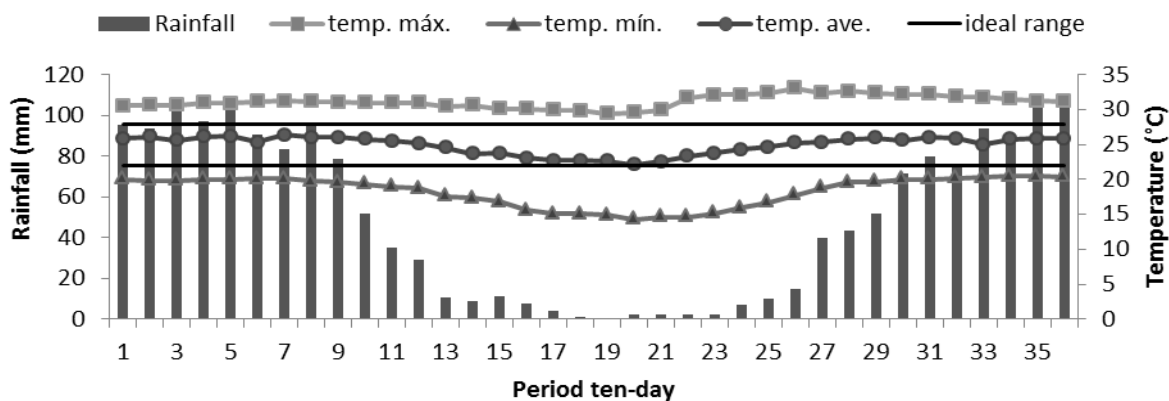


Figure 6 - Ten-day period rainfall distribution and average (ave.) maximum (máx.) and minimum (mín.) temperatures (temp.) in the municipality of Diamantino - MT.

São J. Rio Claro

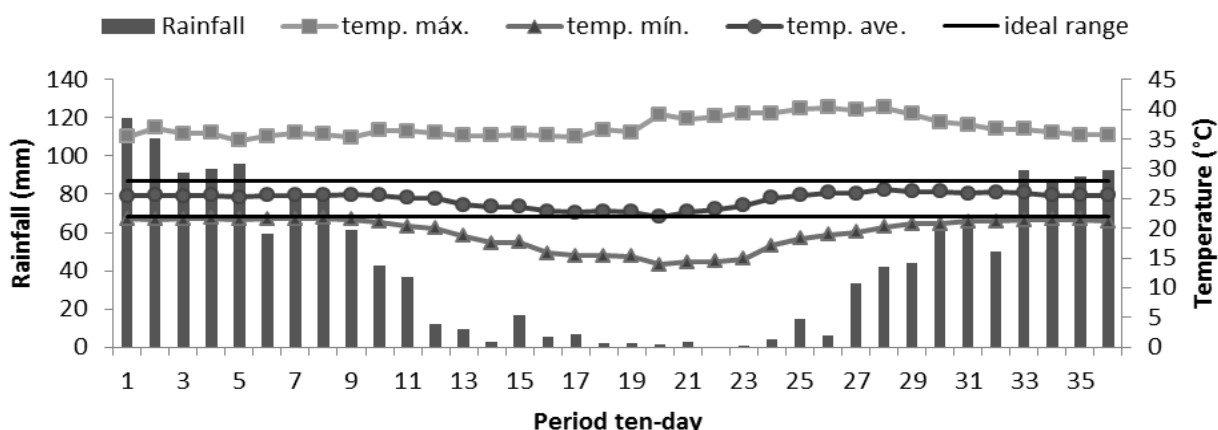


Figure 7 - Ten-day period rainfall distribution and average (ave.) maximum (máx.) and minimum (mín.) temperatures (temp.) in the municipality of São José do Rio Claro - MT.

Tangará da Serra

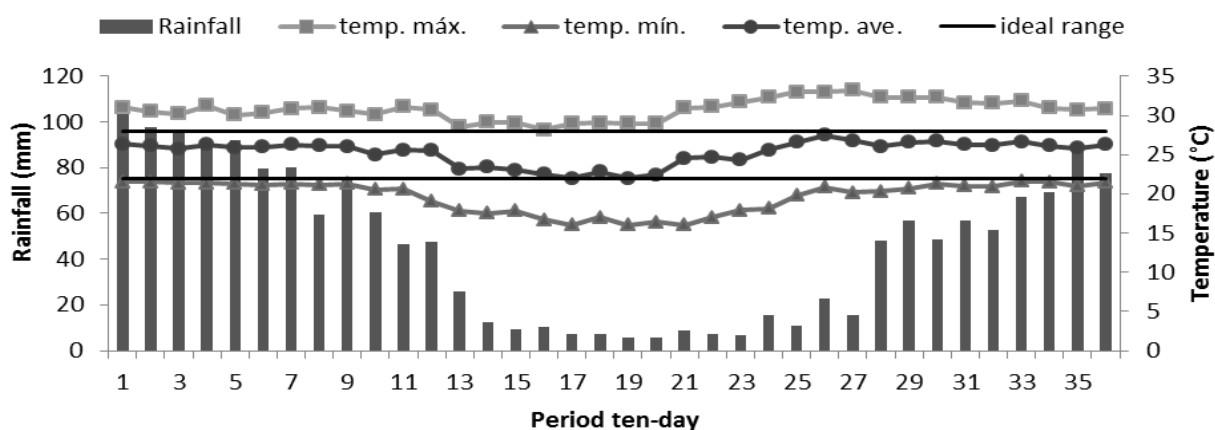


Figure 8 - Ten-day period rainfall distribution and average (ave.) maximum (máx.) and minimum (mín.) temperatures (temp.) in the municipality of Tangará da Serra - MT.

Thus, the region of Campo Novo do Parecis is characterized as being suitable for planting in periods of ten-days 34 to 5, restricted by excessive rain in 28 to 33 ten-day period, only take into account grain moisture at harvest, which according to Silveira (2010), could cause moisture problems at harvest and inapt for water deficit in the period of 10 to 27 ten-days. Regarding thermal aptitude, the ideal range of crop cycle remains suitable for the all seasons.

For the municipality of Cáceres has a total of 1533.9 mm with increase from 22 to 2 ten-day and reduction of ten-day 3 to 22; in Cuiabá is observed in a total of 1493.5 mm where ten-day growth begins from the 26 to 36 and decreases from 1 to 16; in Diamantino with 1806.6 mm, rainfall growth starts from 25 to 5 ten-day and decreases from 6 to 17; in São José do Rio Claro with 1614.6 mm, the growth is from 27 to 1, the ten-day period decreases to 14 and in Tangará da Serra with 1665.5 mm annual is observed growth from

23 to 1 and then it decreases from 2 until 18 of ten-days.

In the municipality of Cáceres, rain distribution during the year is more uniform than other municipalities due to the proximity to the Pantanal of Mato Grosso where rainfall occurs more frequently and with less intensity (Martins et al., 2011).

Regarding the monthly system temperature for each region (Figure 3 to 8), there are no large amplitude variation between the average of the warmest month to the coolest. In Campo Novo do Parecis, the month with the highest average temperature, is between 25 to 27 ten-day with 28.3 °C, once periods of ten-days from 16 to 20 are the coldest with an average of 21.4 °C. In other locations, such as Cáceres recorded temperatures of 28 °C in periods of ten days from 30 to 33 and 22 °C in ten-days 20; in Cuiabá, the 23 ten-day period was the hottest, with 35 °C and in 20 ten-day period the coolest with

24.3 °C. The same behavior was observed for Diamantino, with a maximum of 26.5 °C in periods of ten days 29 to 6 and 22 °C in periods of ten-days 17 to 21. São José do Rio Claro, the 20 ten-day period had the coolest with 22 °C and 28 ten-days period the warmer with 27 °C. For Tangará da Serra, 26 ten-days was hottest, averaging 28.5 °C, however the coolest ten-days for this location was the 17 and 19 ten-day period with average of 22 °C.

In accordance to Nogueira & Távora (2005) the average temperature of the region in all locations, this variable remains between the levels considered ideal for peanut development.

Given the climate analyzes and comparing them to the parameters proposed by Assunção & Escobedo (2009), it can define that the studied regions have full aptitude for peanut cultivation, since annual average temperature and rainfall are among the values considered satisfactory to the development and production of this oilseed, which suits to the planting of 34 to 5 ten-days considering an average cycle of 120 days and for the cycle end a hot and dry season to favor harvest.

Conclusion

For Tangará da Serra and the other municipalities in Western Mato Grosso, peanut cultivation can be considered suitable regarding rainfall in the period of the second crop, with sowing from December to February.

For its harvest dry and hot period is necessary, for temperature factor there was no restrictions for sowing and it could perform it at any time of year, if there is irrigation system suitable for the crop. This consideration fits for all studied regions, observing that the behavior of the regions follows the discussed by Köppen which was classified as tropical humid megathermal (Aw).

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