AN ASSESSMENT OF POSSIBLE INFLUENCE OF SOME WEATHER ELEMENTS ON THE GROWTH OF TOMATO IN BOSSO AND ITS ENVIRONS, NIGER STATE, NIGERIA

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Abstract

This study has investigated the effects of temperature, sunshine and relative humidity as elements of weather affecting the cultivation and growth of tomato with main objectives of assessing the growth rate of the tomatoes and relate them to the observed weather elements (temperature, relative humidity, sunshine hours), and assessing the weather element that is most essential for the growth of tomato amongst the weather elements studied. Twenty stands of tomato seedling were cultivated, five died away and the remaining fifteen are still growing. Measurements were based on the fifteen seedlings. The result of the analysis shows that relative humidity is the major weather element that serves as the main contributing factor to the growth of tomato in the study area. Based on the results, it is recommended that farmers in Bosso area should practice a cover crop method of farming to enable tomato crops stay healthy.

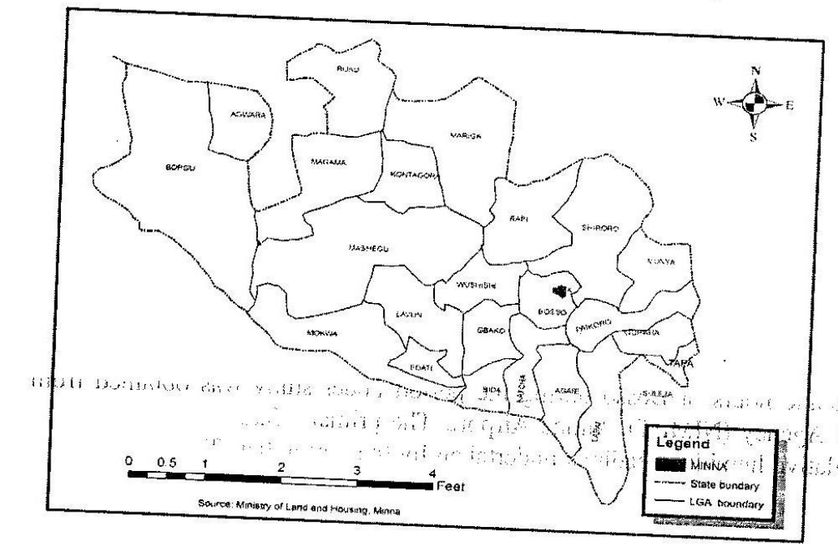
1.0.Introduction

Tomato is an important source of vitamins and an important cash crop for small holders and medium-scale commercial farmers. Tomatoes contribute to a healthy, well-balanced diet. Tomato is regarded as a fruit in some quarters and as vegetable in others but whichever way anyone look at it, tomato is a highly nutritious food ingredient used in the preparation of many foods (Afolami and Ayinde, 2002). Just like the human body requires optimum nutritional, environmental and various other optimum conditions for general well-being and growth, plants also need certain optimum conditions that promote their growth. Studies have shown that tomatoes grow well with seven hours of sunlight a day (Agbabiaje and Bodunde, 2002). Tomato (*Lycopersiconesculentum*) is one of the most cultivated vegetable in most regions of the world, ranking second in importance to potatoes (*solanumtuberusum*) in many countries. It is an important source of vitamins and an important cash crop for small holders and medium-scale commercial farmers. Tomatoes contribute to a healthy, well-balanced diet with its origin in the South American Andes. The cultivated tomato was brought to Europe by the Spanish conquistadors in the sixteenth century and later introduced from Europe to southern and eastern Asia, Africa and the Middle East. More recently, wild tomato has been distributed into other parts of South America and Mexico. Common names for tomato are: tomate (Spain, France), tomat (Indonesia), Faanke'e (China), Tomati (West Africa), Tomatl (Nahuatl), Jitomate (Mexico), Pomodoro (Italy), Nyanya (Swahili). Tomato fruit is consumed in diverse ways including raw, as an ingredient in many dishes and sauces, and in drinks. They are rich in minerals, vitamins, essential amino acids, sugars and dietary fibres. The fruit is also rich in lycopene which may have beneficial health effects (Hunter et al.,1991, Amans et al.,2008, Teasdale and Abdul-Baki, 1995). Tomato contains much vitamin B and C, iron and phosphorus. They can be processed into purées, juices and ketchu canned and dried tomatoes are economically important processed products.

Tomato is regarded as a fruit in some quarters and as vegetable in others but whichever way anyone look at it, tomato is highly nutritious food ingredient used in the preparation of many foods. Tomato is virtually used by every tribe in Nigeria (Anon, 2000). Tomato can be grown anywhere in southern Nigeria, but the best area is the Savannah zone because some diseases of tomatoes are less common in the Savannah (Ramalan, 1994). In agriculture, horticultural crops including vegetables have a significant place. These crops not only contribute to the share of agriculture in national economy, but possess a great potential and comparative advantage to compete in the liberalized economy (Hanson et al., 2001) Vegetables are not only important as protective food and highly beneficial for the maintenance of health and prevention of disease, but these are also a source of livelihood for small farmers and foreign exchange earner for the national economy (Ramalan et al., 1998). Vegetables are a source of income support as well as important for food security of the people.

Tomato is currently a popular fruit vegetable in Nigeria, however, its production in Nigeria is low compared with those of the temperate zones due to differences in crop environmental conditions, lack of high yielding varieties and cultural practices applied to the crop on the field (Rashidi et al., 2010). Tomato is one of the most important vegetable crops grown all over Nigeria. It is the world's largest vegetable crop after potato and sweet potato but it tops the list of canned vegetables. In Nigeria, tomato is regarded as the most important vegetable after onions and pepper (Fawusi, 1978). The broad aim of this work is to investigate the possible influence of some weather elements on the cultivation of tomato plant. The main objectives are to cultivate tomato seedlings, and to assess the growth rate of the tomatoes in relation to the observed weather elements (temperature, relative humidity and sunshine hours).To assess the weather element that is most essential for the growth of tomato amongst the weather element studied and to offer recommendations to tomato farmers in the study area regarding the best method of cultivating tomato plant.

This study is based on the weather variables that affect tomato (*Lycopersiconescolentum*), the weather variables considered in this study are temperature, relative humidity, and sunshine hours. This micro- climate is restricted to Bosso and its environs alone with available data from the weather observatory station, Department of Geography, Federal University of Technology Minna with other data obtained from other sources. Bosso is one of the local government councils in Niger State. Its headquarters is in Maikunkele. It has an area of 1592km^2 with a population of about 147,357 (2006 census), It is located in the (southern part of Minna, and environed by Tayi village, Bosso low coast, Bosso estate, Tudun Fulani, River Basin, RafinYashi, Maikunkele). It is located between latitude 09^0 39N and longitude 06^0 31E. (Fig. 1). The people are predominantly engaged in local trade and businesses. Among the dominant ethnic groups include Hausa, Gwari and Nupe tribes in which the Hausa language is the most widely spoken.



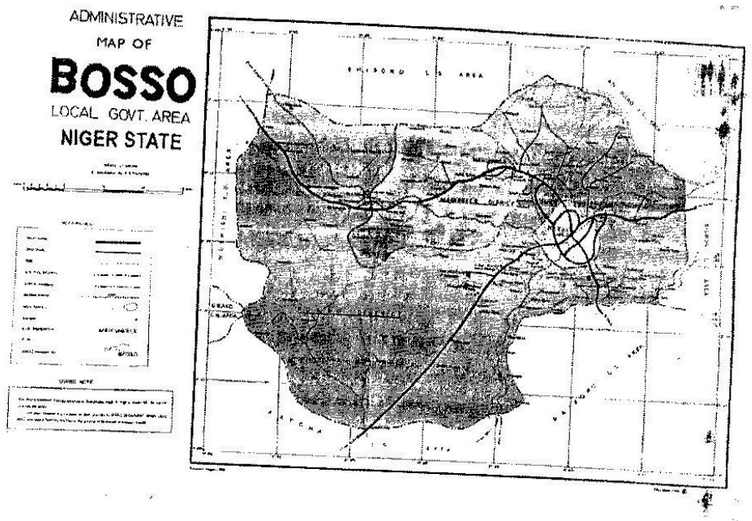


Fig. 1. The Study Area. (Source: Ministry of Land and Housing, Minna)

2.0. Research Methodology

The research methodologies adopted comprise at the first three weeks, the measurements were recorded in Mm, at the fourth week the seedlings were transplanted and the subsequent measurements were carried out in centimeters. Observation of temperature, relative humidity and sunshine was carried out. The readings commenced at the first day of planting. Air temperature reading is taken everyday using a maximum thermometer. Using the wet and dry bulb parameters, the relative humidity was obtained by computing using the humidity slide rule. The tabular method analyzes the summary of the weather variables data obtained and the growth rate of the

tomato plant. A bar chart was use to depict the trend and the level of contributor of these weather elements to tomato plant cultivation.

Inferential Statistics

Correlation: The correlation co-efficient is a measure of linear association. The influence of weather elements (temperature, relative humidity and sunshine) on the cultivation of tomato plant in Bosso and its environs can be analyze on this research work through the use of different data type, and the data are sourced through different method; to achieve the objectives of this research work, the data are analyzed through Statistical Techniques.

Types of data used

For this study, two set of data were used; primary and secondary data.

The mean monthly Sunshine hours of Bosso during the period under study was obtained from Nigerian Meteorological Agency (NIMET), Minna Airport. The primary data source consists of daily temperature and relative humidity readings undertaken by the researcher. Twenty stands of tomato seedling were cultivated, five died away and the remaining fifteen are still growing and the measurements are based on this fifteen seedlings. At the first three weeks, the measurements were recorded in Mm, at the fourth week the seedlings were transplanted and the subsequent measurements were carried out in centimeters. Observation of temperature, relative humidity and sunshine was carried out. The readings commenced at the first day of planting. Air temperature reading is taken everyday using a maximum thermometer. Using the wet and dry bulb parameters, the relative humidity was obtained by computing using the humidity slide rule. Secondary data: This is the statistical details of the Sunshine hours data obtained from the Nigerian Meteorological Agency (NIMET), Minna Airport. The data were obtained for a period of 3 months (i.e. June – August).

Method of Data analysis-Two methods of data analysis are used for this research work; Descriptive Statistics and Inferential Statistics.

Descriptive Statistics

1. Numerical measures : Finding the mean of all weather variables through the use of the following equation:

$$X=\frac{\sum x}{n}$$

Where;

x = Mean of the Temperature, Relative humidity and Sunshine.

n =Total number of weeks under study.

$\sum$ = Summation of all weather variables.

Between two variables, the linear association in the weather elements and tomato cultivation. The correlation co-efficient measured the relationship between independent variables and dependent variables. At the end of the analysis, this correlation method shows the percentage at which the tomato plants depend on these various weather elements for their growth.

3.0. Results and Discussion

The results of the analysis of the weather elements observed and growth rate of the tomatoes planted are shown on the tables below. At the first three weeks, the measurements were recorded in millimeter, at the fourth week the seedlings were transplanted and the subsequent measurements were carried out in centimeters.

Table 1. Descriptive analysis of weekly mean of temperature and growth rate of tomato

WEEKS	TEMPERATURE(^{0}C)	GROWTH RATE (cm)
1	27.72	23.85
2	26.72	60.8
3	26.23	77.1
4	26.30	9.4
5	26.15	18.47
6	25.57	30.54
7	24.71	41.94
8	25.71	64.54
9	24.57	65.54
10	24.43	69.14
11	24.71	69.14
12	24.29	69.14

Source: Author's Field Work (2012)

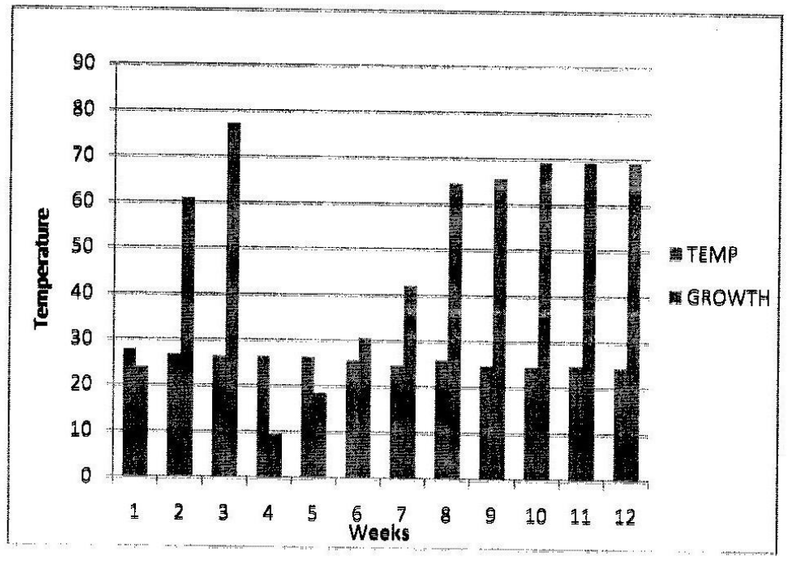


Fig. 2.The relationship between temperature and tomato growth rate

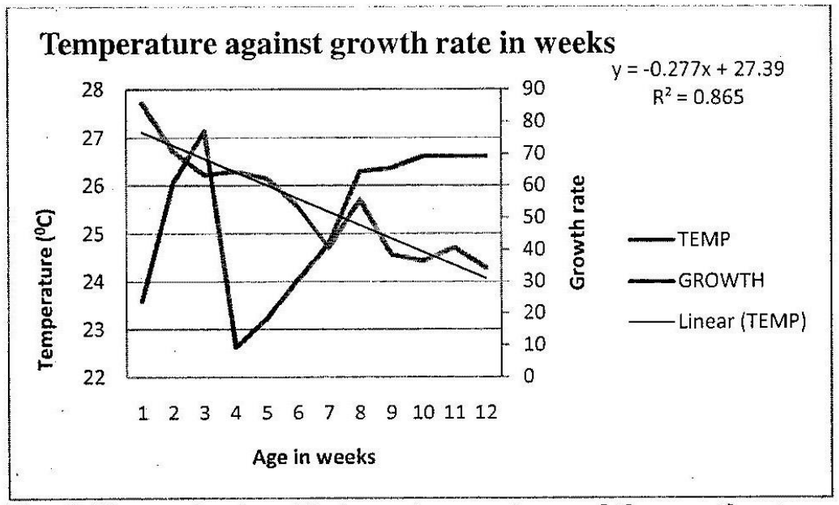


Fig . 3. The moving trend between temperature and the growth rate

Temperature and Growth rate:
Nursery: From result obtained (Fig.2) it was observed that growth increased as age of plants increased and peak in growth was observed at 3 weeks of nursery. Transplanted: From result obtained, growth increased with the age of transplanted seedlings (Fig.3) it was observed that plants started bearing fruits at 7 weeks after transplanting after which a uniform growth was observed for the remaining 2 weeks. A fairly constant mean temperature was observed as growth of plant increased.

Table 2: Descriptive analysis of weekly mean relative humidity and growth rate of tomato

WEEKS	RELATIVE HUMIDITY(%)	GROWTH RATE (cm)
1	86.86	23.85
2	83.29	60.8
3	82.15	77.1
4	79.0	9.4
5	79.71	18.47
6	84.43	30.54
7	88.85	41.94
8	87	64.54
9	89.14	65.54
10	91.57	69.14
11	85.85	69.14

12	88	69.14

Source: Author's Field Work (2012)

Relative humidity and growth rate:
Nursery: As age of plants increased; the relative humidity reduced (Fig.4) this implies that the amount of moisture present in the atmosphere reduced as growth increased. Therefore, plants require a minimum amount for optimum growth (Fig.5)

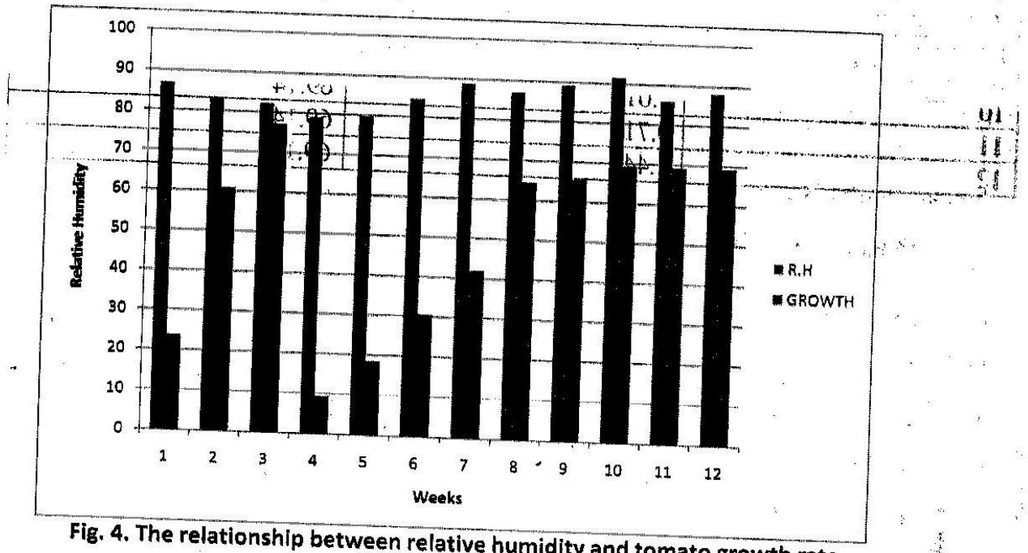


Fig. 4. The relationship between relative humidity and tomato growth rate

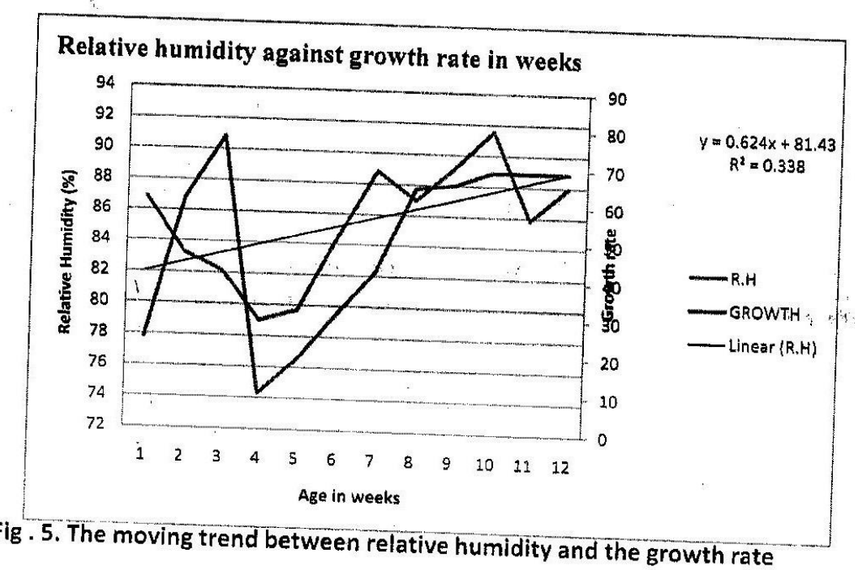


Fig . 5. The moving trend between relative humidity and the growth rate

Table 2: Descriptive analysis of weekly mean of sunshine hours and growth rate of tomato

WEEKS	SUNSHINE HOURS	GROWTH RATE (cm)
1	5.0	23.85
2	6.67	60.8
3	5.49	77.1
4	3.23	9.4
5	5.13	18.47
6	3.34	30.54
7	3.27	41.94
8	2.05	64.54
9	2.65	65.54
10	2.01	69.14
11	0.71	69.14
12	1.44	69.14

Source: Author's Field Work (2012)

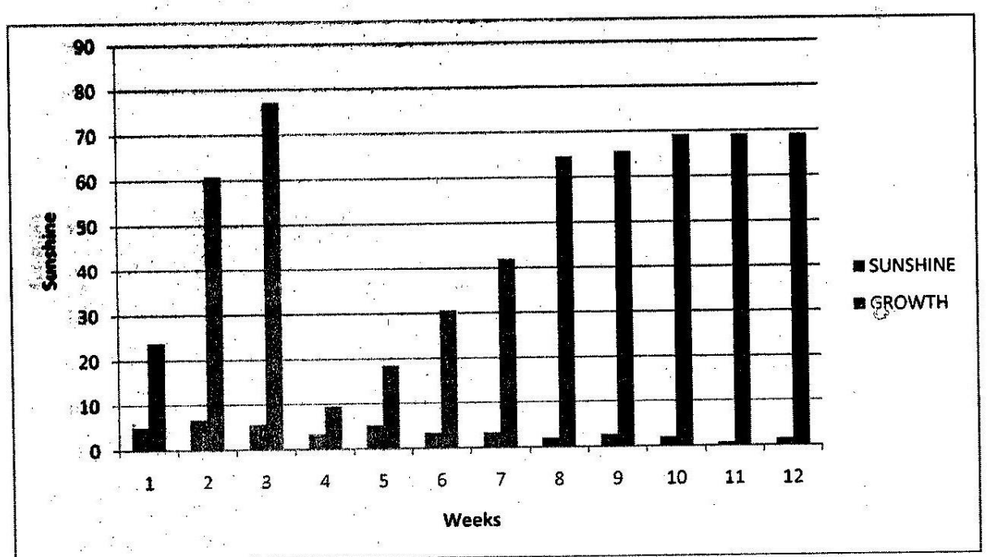


Fig. 6. The relationship between sunshine and tomato growth rate

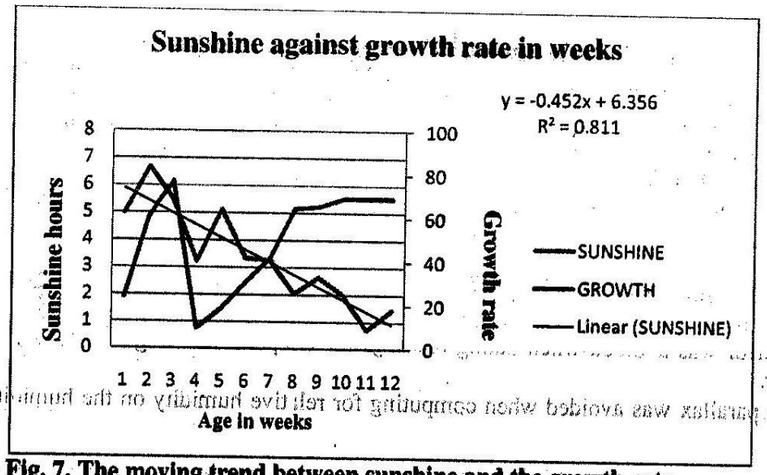


Fig. 7. The moving trend between sunshine and the growth rate

Sunshine hours and Growth rate:

Nursery: It was observed that as plant growth increased (Fig.6) sunshine is required for seed germination and photosynthesis. Transplanted: As age of plant increased (Fig.7) it was observed that the Sunshine hours reduced. This implies that the amount of Sunlight required for photosynthesis and fruit metamorphosis reduced. The result of the analysis shows the relationship between the observed weather elements (Temperature, Relative humidity, Sunshine hours) and the growth rate of Tomato plant and the exact weather element that the plant depend on most for their growth.

After the plants were transplanted, some of the plant could not survive; when the transplanting was done, there was no adequate moisture for the plant and irrigation was not practiced at least for the first week after the transplanting was done. The plants were transplanted in a shady place, so the required amount of Sunlight needed for their growth was not met.

Table 3:Correlation analysis of the weather elements and tomato growth rate

Variable Sunshine	Tomato growth	Temperature	Relative humidity	
Tomato growth	1	-.512	.535	-.301
Temperature .773		1	.583	
Relative humidity .524		-.583	1	-
Sunshine hours		.773	-.524	1

**. Correlation is significant at the 0.01 level (2-tailed). Matrix correlation analysis of the weather element (Temperature, Relative Humidity and Sunshine) and the Growth rate.

The table above shows the result of the Pearson moment correlation between Tomato plant and weather elements (Temperature, Relative Humidity and Sunshine). The moisture present in the atmosphere is very strong and has strong and positive impact of 53%, due to the fluctuation in Air temperature it made a negative impact of -51% on the growth rate of the plant and so is the Sunshine hours with its negative impact of -31% due to the rotation of the earth which brings about cloud cover which result in zero sunshine hours some days.

Precautions taken

The following are the precautions taken during the practical carried out

- Readings of plant height was taken parallel to the steel tape to obtain accurate result.
- Systematic error was avoided when taking readings for temperature using the maximum thermometer.
- Error due to parallax was avoided when computing for relative humidity on the humidity Slide rule

4.0. Conclusions

Plants depend on climatic elements for their growth. Some plant require more photosynthesis than others, to satisfy tomato's enormous energy needs; it requires full sunlight, maximizing sun exposures helps tomatoes stay healthy. Up to a point, the rate of photosynthesis increases with temperature. Above the optimum temperature for photosynthetic enzyme function, photosynthesis is inhibited or shut down completely. If the humidity surrounding a plant is low, the stomata will close to reduce water loss through transpiration. Closed stomata limit gas exchange and photosynthesis is slowed by a reduction in carbon dioxide availability. The study carried out on the influence of weather elements (temperature, relative humidity and sunshine) on the growth of tomato plants shows that relative humidity is the major weather element that serves as the main contributing factor to the growth of tomato in the study area. There are other weather elements like rainfall, wind, and pressure which were not tested. Based on these conclusions, it is recommended that:

- The farmers should consider the rainfall onset and cessation information from Nigerian Meteorological Agency (NIMET) to be able to know when to plant the tomato.
- The farmers should practice cover crops to enable the tomato plant stay healthy. Farmers benefit from cultivating cover crops as soil loss is reduced and physicochemical soil properties are improved.
- The use of local fertilizer (manure) should be avoided because it destroys the plants.
- Farmers should consider where to make ridges to avoid any form of erosion if the area is not a flat terrain.
- Since relative humidity is the major weather element that serves as the main contributing factor to the growth of tomato in the study area, adequate moisture is needed for the plant to survive, if there is a possibility of artificial moisture for the farmers to plant tomato successfully in the study area.

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