Study of climate and soil quality that affect biochemical composition of Trang pepper

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Abstract

The purpose of this research is to study the effects of climate and soil quality on biochemical constituents of Trang pepper and to compare the biochemical constituents of Trang pepper in Palian and Nayong districts, Trang. The researcher collected data by visiting study area of Mr. Charoon Siem Mai pepper plantation, Suso sub-district, Palian district and Miss Supinya Panrung pepper plantation, Lamor sub-district, Nayong district, Trang Province by collecting weather data and soil samples using GLOBE Protocol to analyze quality and correlation with piperine content percentage obtained from HPLC Chromatogram. According to studying results, the weather data of Palian District had an average rainfall between September 2022 to January 2023, more than Nayong District but the soil quality data of Palian District had lower soil moisture than Na Yong District because the soil texture of Palian District is clay loam. Sandy silty soil, which can drain well, therefore has lower moisture content in the soil than Na Yong District, which has a silty clay soil texture that can retain moisture in the soil better. It was found that Nayong district had higher soil nutrient (NPK) levels than Palian district. Therefore, the amount of rainfall stored in the form of moisture in the soil and the nutrient level in the soil resulted in the percentage of piperine in the two pepper plantations, There was a statistically significant difference. Nayong District had the percentage of piperine 3.10±0.20%, Palian District therefore contains the percentage of piperine 2.77±0.37% Nayong District had higher soil moisture content and soil mineral content than Palian District. As a result, the piperine content of Na Yong District was higher than that of Palian District. From the characteristics of soil texture and soil moisture above. The soil of the Nayong pepper garden is suitable for the growth of Trang pepper.

Keywords: Trang pepper, piperine, GI

Introduction

Trang pepper is an important local plant of Trang. "Trang Pepper" is a well-known product, which has been recognized by consumers in terms of quality and taste. Trang pepper is made from the local pepper variety, Palian pepper. It has a spicy taste and a unique pungent smell. For planting and processing in Trang Province, the Ministry of Intellectual Property has announced that Trang pepper is registered with geographical indication (GI) in Trang Province. In 2021, Trang Provincial Commercial Office will promote the implementation of GI standard control system to maintain product quality. (Trang Provincial Office, 2021)

In the past, Trang pepper has been an important economic crop in Trang Province for a long time, but as people turned to rubber planting, pepper planting has disappeared. At the present time, as the price of rubber has fallen, pepper planting has become a trend again. Therefore, people turn to pepper planting as a supplementary occupation. Continue to plant pepper in the village to let the public know (Taweesak Chairuangyos, 2021) According to the planting data, the best harvest period of Trang pepper is from January to April every year. Pepper is a subtropical plant that grows well in a tropical climate with relatively high temperature and humidity. The temperature for good growth is between 25-40 ℃, and the relative humidity is 65-95%. A large amount of uniform water is required. Therefore, the planting area should have rainfall throughout the year, especially in the dry season, and there must be sufficient water, 1200-2500 mm, suitable for planting pepper. It makes the local pepper varieties spicy and fragrant, different from other regions. (Intellectual Property Department of the Ministry of Commerce, 2021). According to the survey of pepper garden agriculture, if there is more rain in one year, the yield of pepper will be low. Pepper is a plant that can grow well in hot and humid weather. Because there are obvious differences in this area, the area is adjacent to the mountains. The Palin area is adjacent to the sea. Moreover, the soil in the two areas is different. Researchers are interested in studying the weather and soil quality that affect the biochemical composition of Trang pepper.

Research questions

1. Do weather conditions and soil quality affect the biochemical composition of Trang pepper?
2. Are the biochemical composition of Trang pepper in Palian District and Nayong District different?

Hypothesis of the study

1. Climate and soil quality affected biochemical composition of Trang pepper.
2. Biochemical composition of Trang pepper in Palian District and Na Yong District were different.

Materials and methods

1. Equipment

1.1 Thermometer
1.2 Infrared thermometer
1.3 Clear plastic bag
1.4 Rubber band
1.5 Shovel
1.6 Soil color measuring equipment
1.7 Soil color comparison book
1.8 Water sprayer
1.9 Soil texture inspection manual
1.10 Hot air oven
1.11 Steel tray
1.12 Scales
1.13 Universal paper
1.14 Permanent pen
1.15 Strainer with a mesh size of 0.55 mm.
1.16 Glassware
1.17 Soil fertility test kit with reagents to determine N, P and K of soil.
1.18 Water bowl
1.19 Brown bottle
1.20 Parafilm
1.21 0.45 micron filter paper
1.22 HPLC
1.23 Electric furnace

2. Chemicals

2.1 Distilled water
2.2 Acetonitrile
2.3 Acetic acid

3. Methodology

3.1 Study site

This research was conducted at Mr. Charoon Siemmai's pepper plantation, Suso Sub-district, Palian District, Trang Province, located at the coordinates of Latitude 7.243333 °N, Longitude 99.681389 °E (as shown in figure 1) and Miss Supinya Panrung's Pepper Plantation, Lamor Sub-district, Nayong District, Trang Province, located at latitude 7.575278 °N, longitude 99.711944 °E (as shown in figure 2).

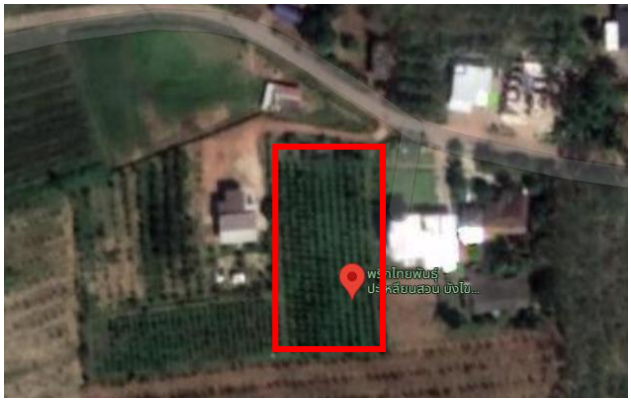


Figure 1 Pepper Garden, Palian District

Figure 2 Nayong District Pepper Garden

3.2 Weather data collecting

Collect weather information, including air temperature, relative humidity and rainfall, which the group has collected weather data for a period of 5 months from September 2022 - January 2023 by using daily average weather data in analysis. And send weather data to Globe Data Entry atmosphere

Figure 3 Weather station

3.3 Determination of the soil sampling point

The soil sample collection area is determined by dividing the soil sample into 5 points. 1, 2, 3 and 4 points are located in the four corners of the pepper plantation. The fifth point is in the middle of the pepper plantation, as shown in the figure 3 and 4.

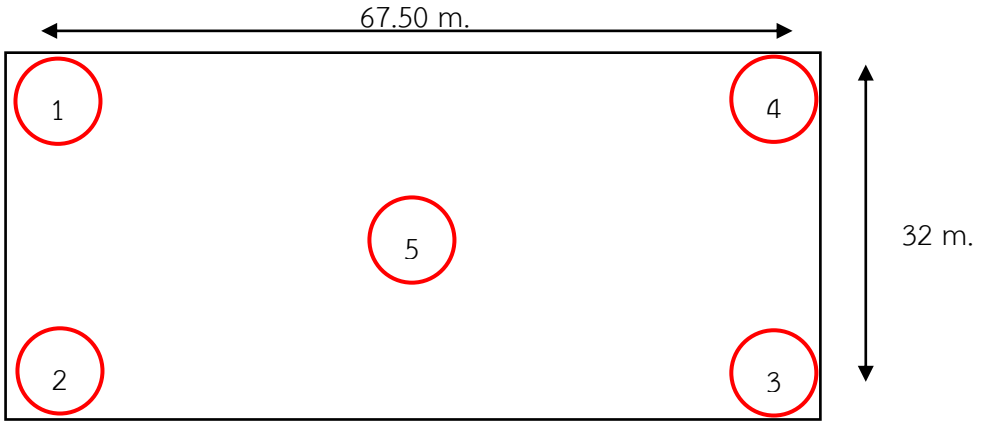


Figure 4 Palian District soil sampling point

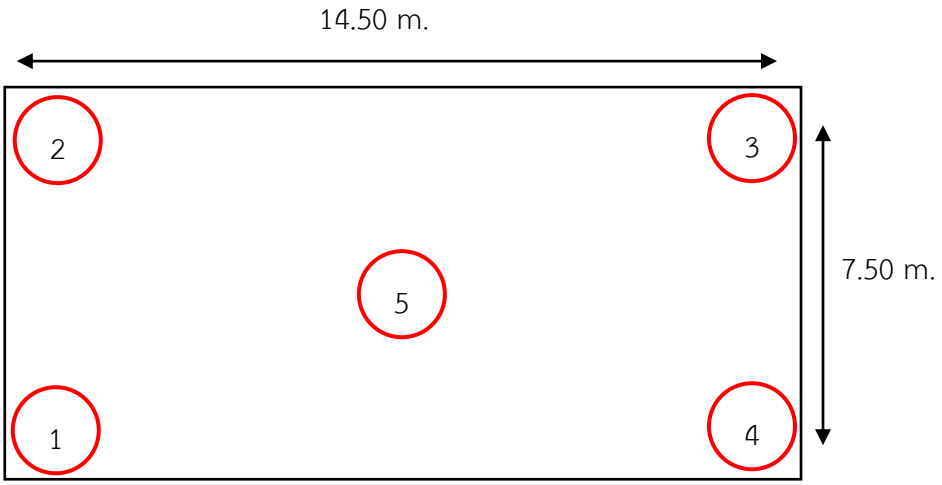


Figure 5 Nayong District soil sampling point

3.4 Soil quality sampling

3.4.1 Use infrared thermometer to measure soil surface temperature, and use thermometer to measure soil temperature with depth of 5cm.

3.4.2 Use a shovel to dig at least 10 cm deep and collect soil samples on the surface.

3.4.3 Measure soil color

1. Take the soil granules from each soil sample and observe and record on the data sheet whether the soil granules are dry or wet. If dry, slightly moisten the soil by spraying water from the prepared bottle.
2. Split the soil granules into 2 parts.
3. Stand with the sunlight shining through your shoulder to the soil color chart and the soil sample being measured.
4. Record the soil color value in the record sheet.

3.4.4 Classify the soil texture according to the on-site soil texture inspection manual, as shown in the figure 6.

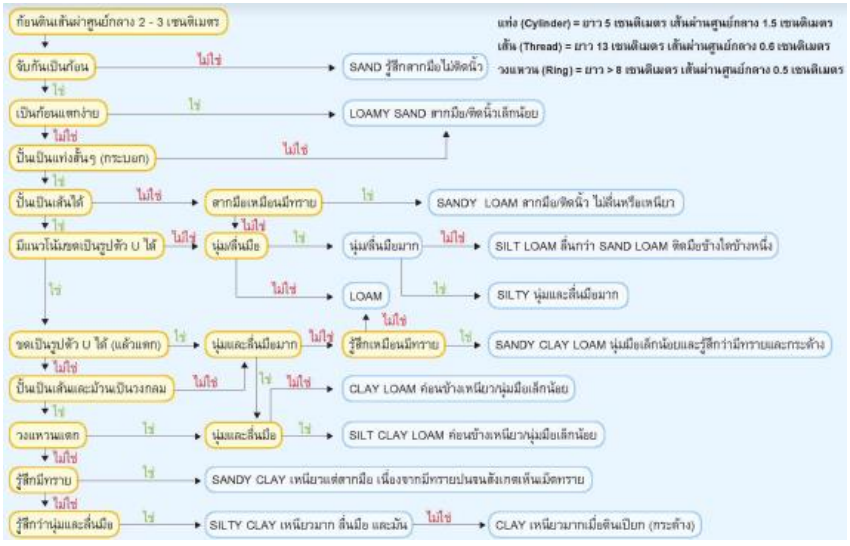


Figure 6 on-site soil texture inspection manual from GLOBE Thailand

3.4.5 Soil moisture measurement

1. Weigh soil samples before baking.
2. Bake soil samples at 95-105 ° C for 24 hours.
3. Weigh each soil sample, and then calculate the moisture according to the formula.

$$\frac{Wet\ mass - Dry\ mass}{Wet\ mass} \times 100$$

3.4.6 Determination of organic matter in the soil

1. Weigh dry soil.
2. Burn the soil at 450 ° C for 4 hours.
3. Weigh the calcined soil and calculate it as a percentage.

3.4.7 Soil pH measurement

1. Weigh 20 g of the sifted dry soil sample and pour into the beaker.
2. Add 100 ml of distilled water to the beaker.
3. Stir the soil with a glass rod for 30 seconds and let it rest for 3 minutes. Repeat 5 times.
4. Leave the soil in the beaker settles until you see clear water at the top.
5. Dip the universal paper into the clear water and read the pH.

3.4.8 Soil fertility measurement

Soil solution preparation

1. Weigh 20 g of sifted dry soil sample into a beaker.
2. Add 100ml distilled water into the beaker.
3. Stir the soil with a glass rod for 30 seconds and let stand for 3 minutes. Repeat 5 times.
4. Leave the soil in the beaker settles until you see clear water at the top.
5. Use a pipette to suck 2.5ml of soil solution into the test tube.

Soil fertility measurement with soil test kit (Nitrate (NO_3^-))

1. Use a pipette to suck 2.5 ml of soil solution into the test tube.
2. Add 1 sachet of HI 3895-N reagent to the soil solution.
3. Cover the test tube, shake it for about 30 seconds, and let the chemicals dissolve.
4. Then compare the pink color that occurs with the nitrate color plate.

Soil fertility measurement with soil test kit (phosphorus (P_2O_5) in soil)

1. Use a pipette to suck 2.5 ml of soil solution into the test tube.
2. Add 1 sachet of HI 3895-P reagent to the soil solution.
3. Cover the test tube and shake for 30 seconds to dissolve the reagent.
4. Then compare the blue color with the phosphorus colorimetric plate.

Soil fertility determination with soil test kit (potassium (K_2O) in soil)

1. Use a pipette to suck 0.5 ml of soil solution into a test tube.
2. Add distilled water to a total volume of 2.5 ml. Add HI 3895. 1 sachet of -K reagent into the soil solution.
3. Cover the test tube and shake for 30 seconds to dissolve the reagent.
4. Then compare the turbidity with the potassium calibration plate.

3.4.9 Send soil quality sampling data to Globe Data Entry Pedosphere.

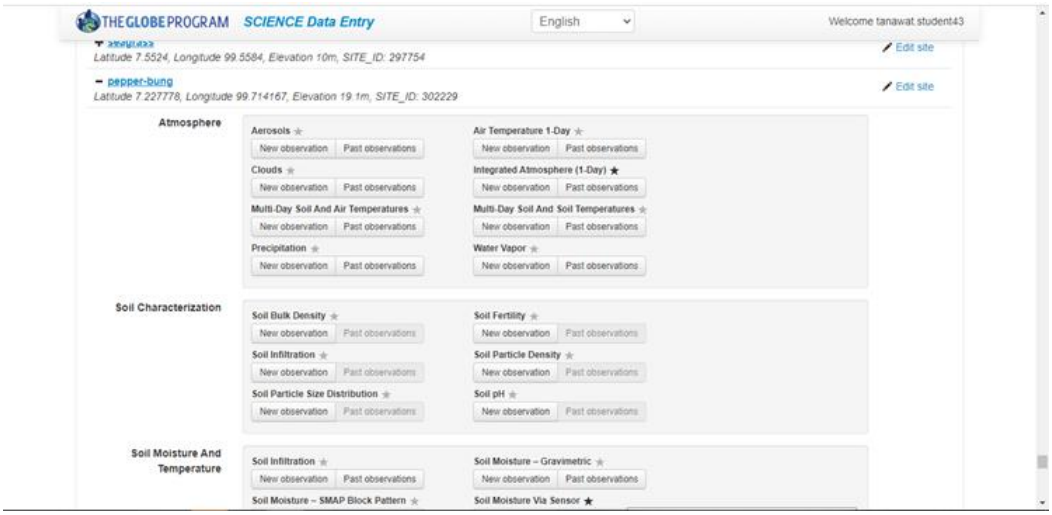
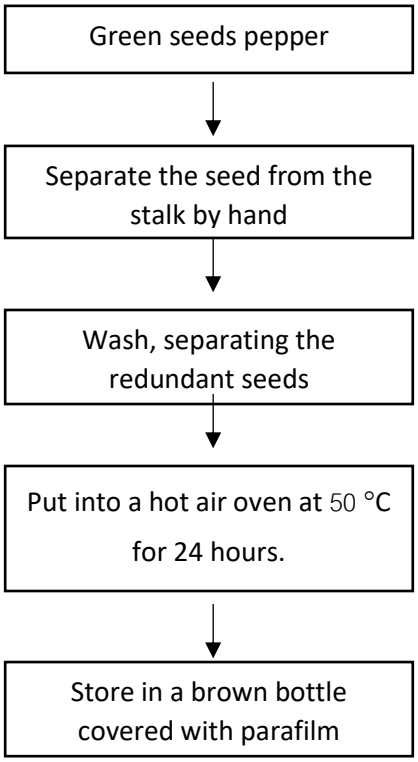


Figure 7 GLOBE data entry

3.5 Analysis of piperine content

Control the processing process of pepper seeds



The obtained pepper extract was filtered with 0.45 µm. filter paper and 20 µl. of the filtrate solution was injected by HPLC analysis using a HITACHI LaChrom C18 column (250 x 4.6 mm ID) containing 48% acetonitrile and 52% acetonitrile. 1% acetic acid as a mobile phase with a flow rate of 1.5 mL/min. The absorbance was measured at a wavelength of 343 nm and the content of piperine was determined from the pepper sample compared to the piperine standard solution.

Figure 8 pepper seed samples

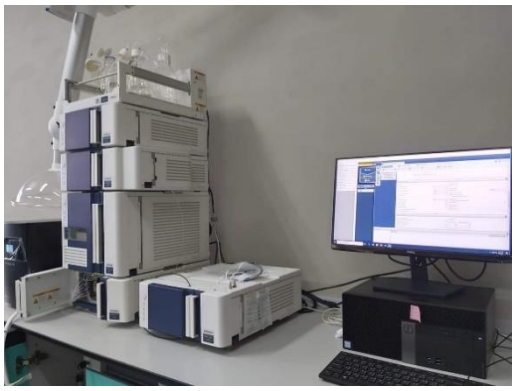


Figure 9 HPLC Chromatogram

3.6 Statistical analysis

1. Analyze the weather conditions, temperature, air humidity, rainfall using mean and standard deviation.

2. Analyze the quality of soil, temperature, Humidity, pH values, organic matter by using the mean and standard deviation.

3. Comparison, temperature, air humidity, rainfall, pH values, organic matter of using the t-test: Two-Sample Assuming Equal Variances.

4. Comparison of the percentage of piperine in two plantations of Trang pepper using the t-test: Two-Sample Assuming Equal Variances.

Results

The study on the effects of climate and soil quality on the biochemical composition of Trang pepper has the following results

Part 1 Study of climate and soil quality of pepper plantations in Palian and Nayong districts.

1. Results of the study of climate between Palian and Nayong districts.

From the analysis of weather data, including air temperature relative humidity and rainfall during September 2022 to January 2023. It was found that the two areas, Palian District and Na Yong District, had no difference in air temperature and relative humidity data, but different rainfall data, as shown in chart 1.

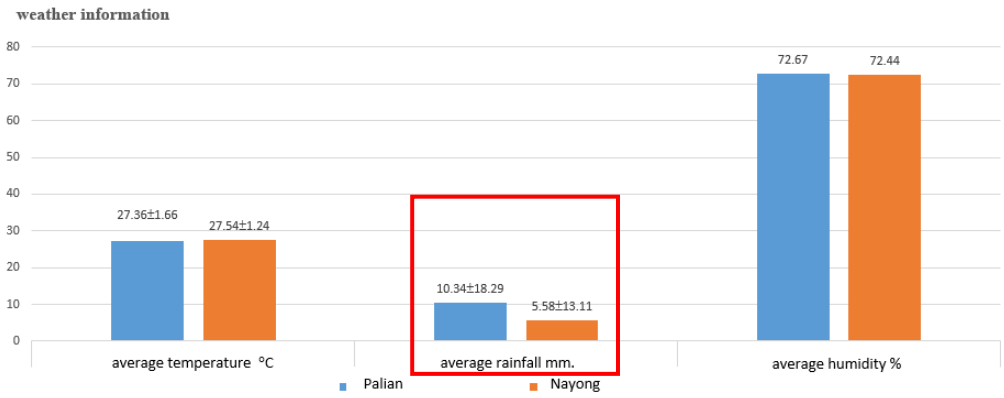


Chart 1 show difference of weather data between Palian district and Nayong district

2. Soil quality study results between Palian and Nayong districts

From the analysis of soil quality data, including soil color, soil characteristics, soil moisture, soil organic matter, soil surface temperature, soil temperature depth of 5 cm., soil pH and soil nutrient levels. It has the following information.

Table 1 show soil characteristics

Soil characteristics				Soil nutrient		
No.	**Color code**	**Color**	**Type soil**	**N**	**P**	**K**
Palian	10YR 4/2	Dk. Gy. Brown	Sandy loam	low	low	high
Nayong	2.5YR 4/6	Red	Silty clay loam	high	high	trace

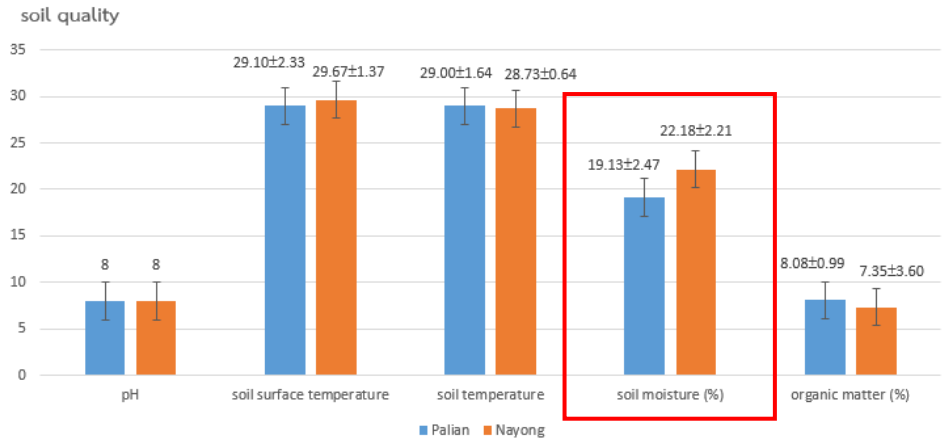


Chart 2 show soil quality

Part 2 Analysis of percentage content of piperine (Piperine)

1. Results of the study of percentage content of piperine in pepper plantations in Palian and Nayong districts.

The study found that the percentage of piperine in the Nayong pepper plantation was higher than that of the Palian pepper plantation.

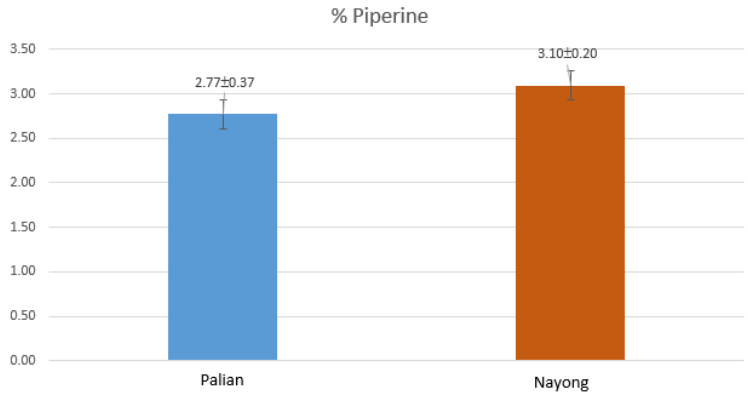


Chart 3 show % of piperine

Discussion

Results of a weather study using weather data of 2 areas, namely Palian District and Na Yong District, Trang Province. It was found that the weather data had no difference in temperature and relative humidity, but the rainfall data were different. The average rainfall between September 2022 and January 2023 in Palian District is equal to 10.34±18.29 mm. Na Yong District is equal to 5.58 ± 13.11 mm. Palian District has more rainfall than Na Yong District. As for the soil quality data, it was found that the two had different soil characteristics. The pepper plantation of Palian District is a brown sandy loam soil type. The soil of the pepper plantation in Nayong District was clayey, silty, red soil. Soil pH, soil surface temperature, soil temperature, and soil organic matter content of the two areas were not different, but the values were different. Soil moisture content was different with Palian District having soil moisture content of 19.13±2.47 % and Na Yong District having soil moisture content of 22.18±2.21%, which in Nayong District had a higher soil moisture value than Palian District. Both areas had different percentages of piperine. Nayong district had 3.10±0.20 % piperine content and Palian district had 2.77±0.37% piperine content. Na Yong had a higher percentage of piperine than in Palian District.

Conclusion

According to the study results, Weather conditions and soil quality affect the biochemical composition of Trang pepper. Nayong District had higher soil moisture and nutrient content (NPK) than Palian District, resulted in the percentage of piperine in the two pepper plantations, There was a statistically significant difference. in Trang pepper of Nayong District was higher than Palian District. Chemical composition of Trang pepper in Palian and Nayong districts There is a difference. Palian District, the percentage of piperrine was 2.77 ± 0.37% and Nayong District, the percentage of piperine was 3.10 ± 0.20%

Acknowledgments

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Badges

I AM A COLLABORATOR

Step 1: Topic thinking and event planning, there is collaboration between members within the team.

Step 2: Mr. Tanawat Rakson is the person who collects and collects weather data in Palian and Nayong districts, Trang province, and Ms. Suchanan Poon Pong is the soil measurement and soil sampler for quality analysis according to the principles of the GLOBE protocol.

Step 3: Ms. Suchanan Poonpong prepared the pepper seed samples and Mr. Thanawat Rakson was the person who tested the percentage of piperine by HPLC chromatogram method.

Step 4: Team members work together to analyze weather data. Soil quality and percentage content of piperine to bring answers to this research problem

Step 5: Mr. Thanawat Rakson is the author of the research report. Ms. Suchanan Poonpong prepared the presentation and team members together to create a video presentation of the research, throughout this research, teachers and scientists were advised throughout the work.

I AM AN IMPACT because this research is related to Trang pepper, which is an economic crop of Trang Province. Thailand for a long time a study was conducted on pepper plantations in Palian and Nayong districts to collect pepper information from farmers. From this research, know the weather conditions and soil quality that are suitable for growing pepper in order to obtain the desired pepper quality and disseminate research information to the community to maintain quality and increase value to Trang pepper. It is also to promote Trang pepper for general people to know more and conserve local plants of Trang province.

I AM A DATA SCIENTIST because the percentage content analysis of piperine, which is a biochemical component in Trang pepper HPLC Chromatogram and quantification of piperine from pepper samples. Compared with piperine standard solution, the obtained data was then correlated with weather data from the Meteorological Department of Trang Province and soil quality data obtained from fieldwork to answer research problems using GLOBE Protocol.

Visualize Data