

Study on Some Soil Physical and Chemical Properties on the Aroma of Jasmine Rice by Geographic Information System in Tung Kula Rong Hai Area.

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Abstract— Jasmine Rice in Thailand is likely to export growth and rising demand in the world market because rice is good taste and smell like pandanus. The aroma of rice caused by a combination of many essential nutrients but the smell is caused by a substance found in rice of 2-Acetyl-1-Pyrroline (2AP), a substance found in plant leaves (*Pandanus amaryllifolius* Rokb). The concentration of 2AP have been used as a benchmark to determine the price of rice, for example, aromatic jasmine rice in Tung Kula Rong Hai accuracy required dose of 0.1 micrograms per gram in 2AP up. For this reason, the study of some soil properties affecting the aroma of jasmine rice is necessary for consumers in order to obtain background information for use as a guide to decide selection jasmine rice quality further.

The results revealed that aromatic jasmine rice is the main effect of soil pH that has 55.49%, 28.57% and 6.60% aromatic area for low, medium and high the aroma of rice, respectively. For the soil texture, we found that the aroma of jasmine rice is the main effect of soil texture that has 68.80%, 19.96% and 3.55% aromatic area for medium, high and low the aroma of rice, respectively. However, that has moderately high variation in the soil pH is caused by a soil chemical activity of all times exchange has dependent on soil management is important for example, soil tillage, input soil fertilizer or soil amendment which is a possible for decrease aroma of rice. Therefore the planting of rice has very smell, it has to sandy loam or loamy sand for soils, weakly acid, low to moderately of soil salinity.

Keywords: 2-Acetyl-1-Pyrroline, Aroma of Jasmine Rice, Soil Texture, Soil pH, Tung Kula Rong Hai, Geographic Information System

1 INTRODUCTION

Jasmine rice is good quality and aroma rice was specifically made popular by consumers, both domestic and foreign countries. Rice, is grown in different areas of the country, will have a different fragrance because there are many factors that affect the aroma, vary in each area. Rice in Tung Kula Rong Hai area, the quality of aroma will be more than other areas. Tung Kula Rong Hai where covers five provinces include Roi-Et, Surin, Mahasarakham, Yasothon and Srisaket provinces. Bedrock beneath Kula Rong Hai is a Maha Sarakham rock formation consists of sedimentary rocks, shale and sandstone which Mahasarakham rock formation is found rock salt mixed. Rainfall in Tung Kula Rong Hai from the southwest monsoon and the rainy season starts in May to October but non rainfall in June to July in each year. However currently there are not confirmed reports that the factors which determine the aroma of jasmine rice. It has noted that non rainfall of period, salt content and most of sandy soil cause stress of rice with proline substance is caused by aroma of jasmine rice in 2-Acetyl-1-Pyrroline (2AP) and most active in the extraction of 2AP substances for jasmine rice.

Dissataporn et al. (2009) studied the response of the aroma and yield of KDM 105 rice in some soils, found that the factors affect the aroma include soil pH which low of fragrance rice to pH 5.13, very fragrance to pH 4.78 and soil properties will not affect aromatic rice, including organic matter, phosphorus, potassium, cation exchange capacity, calcium, magnesium and so on. It also found that the growth and yield is not correlated with the aroma of rice. Therefore, a presumption that non rainfall of period, soil pH and soil texture are important to create proline substance for fragrance of jasmine rice (2AP) is not. Therefore, for this study, about soil chemical and physical properties affecting on aroma of jasmine rice in Tung Kula Rong Hai using geographic information systems considering the main of soil pH and soil texture.

2. Materials and Methods

2.1) Materials

- Computers and GIS software
- In field surveys, such as the detection of the position (GPS)
- Soil sampling kits, etc.
- Topographic map scale 1: 50,000

2.2) Methods

1) Data Collection

To collect the relevant research data and to keep 67 field samples in depths of 0-30 cm, covering the areas of Tung Kula Rong Hai in 5 provinces namely Srisaket, Yasothon, Roi-Et, Surin and Mahasarakham, the area where rice is produced, with geographic coordinates. Soil samples were analyzed in

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laboratory to analyze physical and chemical soil properties such as soil pH and soil texture.

2) Selection Factors

- The Factors in the Soil pH

Dissataporn et al. (2009) studied the response fragrant of jasmine rice and yield in Tung Kula Rong Hai. Factors that affect the aroma of jasmine rice with different statistically significant (Table 1) such as soil pH, exchangeable sodium and soluble sodium. But the selection of some soil factors affecting to fragrant and consider only soil pH because exchangeable sodium and soluble sodium are indication of soil salinity, which soil salinity is sub factor increasing the aroma of rice only and not main factor because the soil is not salty, rice can be grown in sandy soil, it can make a higher aromatic than rice grown in the clayey soils. The results of the above study, it found that the rice is low fragrant, will be soil pH 5.13 and rice is very fragrant is soil pH 4.78, which is suitable of soil pH for jasmine rice. This showed that the idea is to bring pH of the soil is classification criteria relate to aroma of rice is three levels including, the pH 4.70-4.80 (aromatic rice have more), pH 4.90 - 5.00 (rice with the aroma medium) and pH \geq 5.10, pH $<$ 4.70 (aromatic rice is soft, etc.)

Table 1 Show some soil chemical properties that affect the aroma of jasmine rice in Tung Kula Rong Hai.

Soil Chemical Properties	Mean	Fragrant	Sig-nificant
Soil pH	5.13 ^a	Low	0.018*
	4.92 ^{ab}	Medium	
	4.78 ^b	High	
Extractable Potassium (mg/Kg soil)	18.72	Low	0.699 ^{ns}
	16.94	Medium	
	18.05	High	
Extractable Phosphorus (mg/Kg soil)	1.04	Low	0.467 ^{ns}
	12.33	Medium	
	11.48	High	
Exchangeable Sodium (cmol/kg soil)	0.58 ^a	Low	0.001**
	0.27 ^b	Medium	
	0.21 ^b	High	
Soluble Sodium (cmol/l)	8.68 ^a	Low	0.049*
	3.26 ^b	Medium	
	-	High	
Organic Matter (%)	0.95	Low	0.507 ^{ns}
	0.93	Medium	
	1.04	High	
Cation Exchange Capacity (cmol/kg soil)	4.87	Low	0.077 ^{ns}
	3.55	Medium	
	4.48	High	
Electrical Conductivity (dS/m)	0.59	Low	0.063 ^{ns}
	0.42	Medium	
	0.31	High	

Notice: Modified from Dissataporn et al. (2009)

- The factors in the Soil Texture

Jongkaewwattana et al. (2005) study content of aromatic 2AP in paddy field from grains to harvest in rainfed area for sandy soil and clayey soils with water logging, the field farmers Noen Maprang, Phitsanulok Province. Found that variations in content of aromatic 2AP grain at harvest of the second crop similarly, there is a higher dose 10 of day grain after that it start falling until maturity. However, sandy soil resulted a higher than clayey soils of fragrance that is clearly, say that after rice grains approximately 23-38 days to produce 2AP in content 1.90 -3.00 ppm for sandy soils in a higher than clayey soils content 1.00-1.50 ppm for the same period. (Figure 1) The results of this study that the factors affect to aromatic compounds in grain are different between sandy soils and clayey soils would be a main factor in soil texture because the soil is capable of water retention was different, that is sandy soils to water retention in less than clayey soils and the sandy soils is in a state of dehydration will be stress over the clayey soils in flooding. The rice under stress for a long time affect to product aromatic rice 2AP in high volumes. For this reason, rice is grown in the sandy soil will have to be more aromatic rice grown in the clayey soils and so on. The results of studies, the idea is to be a factor in soil texture for classification criteria in relate to aroma of rice are three levels, such as sandy (rice is very fragrant), loamy (rice with the medium) and clay. (aromatic rice is soft, etc.)

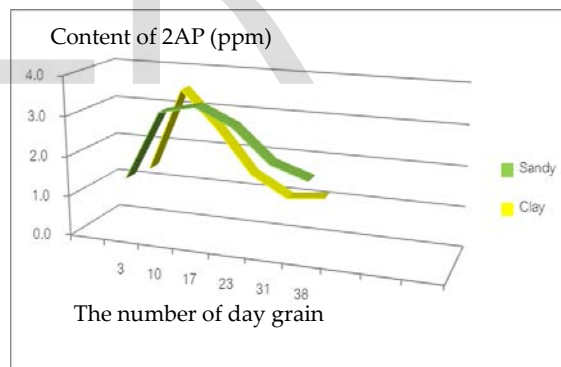


Figure 1 Content of 2-acetyl-1-pyrroline (2AP) in the spike for sandy soil and clayey soils.

Source: modified from Jongkaewwattana et al. (2005)

3) Factor Assessment

3.1) Data inputs of soil pH divided into three levels, soil pH \geq 5.10 and pH $<$ 4.70 for code 1 means of aromatic rice in low fragrance, soil pH 4.90-5.00 is code 2 refers to aroma of fragrant rice in the medium and soil pH 4.70-4.80 due to code 3 means to high fragrant and so on.

3.2) To take the data of soil texture were stratified into three levels: for clayey soils is code 1 means to low fragrance, loamy is code 2 refer to medium fragrant, and sandy soil is code 3 means to fragrant rice in the very fragrant.

4) Data Import

4.1) Evaluation of soil pH and soil texture according to the criteria affecting the aroma of jasmine rice has been established. After that, import data, data processing and analysis of geographic information systems to map the aroma of jasmine rice affected by soil texture and soil pH.

3. The Result

3.1) General data of Tung Kula Rong Hai

Tung Kula Rong Hai an area of 336,000 hectare. Topography is a wide pan around will be gradual high terrace to middle terrace (broad depression) almost area is flat, soil slope 0-2%, shaped length from west to east 50 kilometers and wide from north to south 50 kilometers located to the southeast of the Korat Plateau, Northeast of Thailand at the latitude 15° 14' N to 15° 44' N and longitude 103° 4' E to 104° 20' E. The territory covers 12 districts of five provinces Kaset Wisai, Pathum Rat, Suwannapoom, Phon Sai, and Nong Hee of Roi Et, Rasi Salai, and Sila Lat of Srisaket, Maha Chana Chai, and Kho Wang of Yasothon, Tha Tum and Chumphon Buri of Surin and Phayakkhaphum Phisai of Mahasarakham which 45.13% in Roi-Et, 29.93% in Surin, 13.74% in Srisaket, 8.42% in Mahasarakham, 2.71% in Yasothon.

3.2) Soil Sampling in Tung Kula Rong Hai

The field survey was soil samples at 0-30 cm of soil depth for 67 samples. The number of soil samples in the study area can be calculated by using the scale on a survey 1: 100,000, which is semi-detail survey (Keawruenrom, 1999), so the point of survey is calculated by method of Forbes et al. (1984.) is as follows.

$$\begin{aligned} \text{number of survey} &= (1/50) \times 10^{10} \times (\text{scale survey})^2 \\ &= (1/50) \times 10^{10} \times (1/100,000)^2 \\ &= 1 \text{ point per } 50 \text{ km}^2 \\ &= 62.70 \text{ points per } 3,136 \text{ km}^2 \end{aligned}$$

The result for soil sampling in Tung Kula Rong Hai we found that should be at least about 63 points, and this study was conducted on 67 samples. For soil sampling, the soil cover 12 districts and 5 provinces, namely Kaset Wisai, Pathum Rat Suwannapoom, Phon Sai, Nong Hee in Roi-Et Province, and Rasi Salai, Sila Lat in Srisaket Province, for Maha Chana Chai, Kho Wang in Yasothon Province, and Tha Tum, Chumphon Buri in Surin Province, and Phayakkhaphum Phisai in Mahasarakham Province. (Figure 2)

3.3) Soil Physical and Chemical Properties

The field survey was conducted to soil sample at 0-30 cm of soil depth which soil properties for checking such as soil pH and soil texture, from 67 samples in year 2016 found that most of soil texture will be sandy loam 20 samples (120,098.17 hectare) with 39.40% of total (304,783.69 hectare), followed by the loamy sand 11 samples (52,499.06 hectare) with 17.22% of total, and finally was silt loam 11 samples (32,510.18 hectare) with 10.67% of total. It also has a little on soil loamy, clay, silt

loam, clay loam, sandy, sandy clay loam and silt clay loam and so on. The pH of the soil is found in range 4.3 to 5.0 of 43 samples (137,932.75 hectare), representing 45.26 %, which is quite acidic soil reaction and found to be range 5.1 to 6.0 of 24 samples (138,431.25 hectare), representing 45.42% of the total weakly acid area.

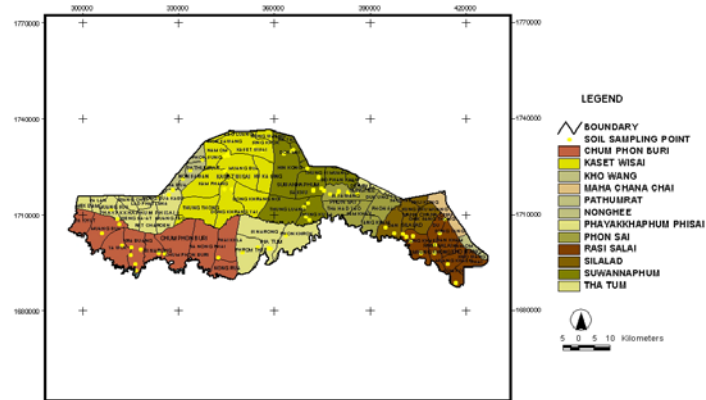


Figure 2 Map showing the soil sampling point in Tung Kula Rong Hai.

3.4) The Effect of Soil on Aroma

1) Soil pH

The study found that the aroma of jasmine rice that has been influenced by soil pH in Tung Kula Rong Hai are three levels together (Figure 3) is very fragrant, moderately and low fragrance. The area is mostly with aroma of fragrant rice in low 169,142.75 hectare, representing 55.49% of total (304,783.69 hectare), which soil pH in range ≥ 5.10 and pH < 4.70 and the next is aroma of fragrant rice in the medium 87,082.95 hectare or 28.57% of total, it mean that the range of soil pH 4.90 - 5.00. Finally aromatic jasmine rice in very fragrant have a little area 20,138.30 hectare or 6.60% of total, it mean that soil pH in range 4.70-4.80 and so on.

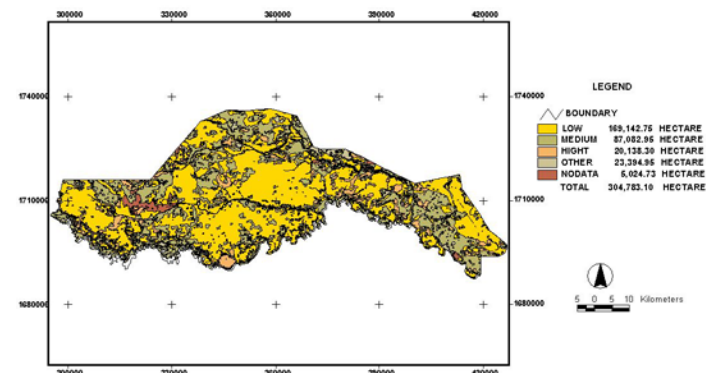


Figure 3 Map showing effect of soil on aroma in soil pH in Tung Kula Rong Hai.

2) Soil Texture

The study found that the aroma of jasmine rice, which is influenced by the soil texture in Tung Kula Rong Hai are three levels together (Figure 4) is very fragrant, aromatic intermediates and a little fragrance. Most of the areas with fragrant rice in the medium of about 209,708.80 hectare, representing 68.80 percent of total. (304,783.69 hectare), it mean loamy, clay loam, silty clay loam, silt loam and sandy loam, etc. The second is very fragrant has an area of 60,855.49 hectare or 19.96% of total, this means sandy soil and loamy sand. Finally, we have found low fragrant in a little area for 10,820.07 hectare or 3.55% of total, that is mean clayey soils.

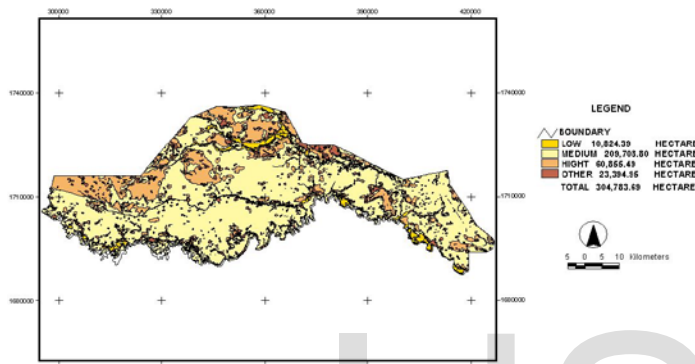


Figure 4 Map showing effect of soil on aroma in soil texture in Tung Kula Rong Hai.

4. Conclusion and Discussion

The physical and chemical properties of the soil, affecting some fragrant Hom Mali rice in Tung Kula Rong Hai using geographic information systems can be summarized as follows.

4.1) The aroma of rice that have been influenced by soil pH is mostly in small fragrant 55.49% of total. This means the soil in $\text{pH} \geq 5.10$ and $\text{pH} < 4.70$, that is, the soil is very acid or alkaline too much will cause the aroma of rice, down or no smell at all. Thus, the pH of soil conditions affecting the fragrant rice, must be optimum in range pH 4.70 - 5.00. It also found that the aroma of rice in medium and very fragrant to approximately 28.57% (pH 4.90 -5.00) and 6.60% (pH 4.70-4.80), respectively. The results suggest that the soil pH has changed over time, depending on soil management such as plowing before planting, chemical fertilizer applied to the soil, input organic matter, water management or crop production. These are a result reaction of the soil is not fixed or changed over time. So therefore, as a result the soil pH for increase or decrease rapidly.

4.2) Most areas with aroma of rice in the middle 68.80% of total, it mean loamy, clay loam, silty clay loam, silt loam and sandy loam, etc. The second is very fragrant has approximately 19.96% of total, this means sandy soil and loamy sand. Finally we have found low fragrant in a little area

for 3.55% of total, is mean that clayey soils only. The study suggests that the overall accuracy is the aroma of fragrant rice in the medium because almost of sandy soil has often dehydration with is moderately saline and drought stress resulting in a high level of proline synthesis for rice to adapt survive under water stress. Thus, rice has resulted in the synthesis of aromatic 2AP grain increased, it is the main substance that makes aromatic rice. In order to grow rice, fragrant rice, so the soil is sandy loam or loamy sand and slightly acidic or a moderate salinity or slightly salty, because soil salinity make to a state of dehydration than ever and high stress affect to rice production increased aromatic 2AP. So for this reason, it is probably the main reason that rice grown in Tung Kula Rong Hai has special fragrant compared with jasmine rice grown in other that fragrant less than.

5. Suggestion

5.1) This study found that the soil pH is relatively high of variance, is not suitable to be used as a factor in assessing the potential to produce aroma of rice, but the soil texture is important index that could be used to evaluate potential for production aromatic rice in Tung Kula Rong Hai better.

5.2) The further studies should focus on soil moisture for aromatic rice production in order to obtain baseline data to assess the potential for production of aromatic rice quality in Tung Kula Rong Hai.

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