Sys Rev Pharm 2020;11(2):736-748
A multifaceted review journal in the field of pharmacy

Improvement of Soil Salinity with Local Different Organic Materials for Soil Quality Suitable through Agricultural Plant Growth

1Somsanguan Passago, 1Sapphasit Kaewhao, 1Chedchai Sombatyota, 1Wannapa Leamsingkorn, 2Jurairat Kurukod, & 3Toansakul Tony Santiboon

[1]Department of Environmental Science, Faculty of Science and Technology, Rajabhat Mahasarakham University, Mahasarakham, Thailand
[2]Department of Environmental Science, Faculty of Science, Mahasarakham University, Mahasarakham, Thailand
[3]Science, Mathematics, and Technology Education Center (SMEC), Curtin University of Technology, Perth, WA, Australia

Corresponding author e-mail: toansakul35@yahoo.com.au

ABSTRACT

To design the research procedures using the survey and experimental research methods for solving improvement problems and comparisons with the true soil differentiated variables of the different local organic materials; rice husk, cow dung, rice straw and mixed of four soil conversions as experimental variables, and the 1st controlling variable with the original salinity soil in two years were improved and compared. Using the *Africa Sesbania Rostrata*, fresh fertilizer growth plant was randomized, and suitability parameters; pH, EC, soil salinity, organic matter, nitrogen, phosphorus, and potassium mineral qualities before and after 60 days. The four treatments indicated that the plants grew suitability color like dark brown; the rice husks were improved on pH value was near the most neutral (6.57); the EC had 544.00 µs/cm; soil salinity as 5.44 ds/m; organic matter (2.09%); and nitrogen mineral (0.68%). The cow dung had the most beneficial phosphorus (37.89 ppm) and potassium (754.05 ppm). The controlling and experimental variables set into 5 original soil conversion groups as follow: soil controlling group; soil improved with the rice husk, soil improved with the cow dung, soil improved with the rice straw, and soil improved with the mixture of cow manure, rice husk, and rice straw are randomly assigned into one of four groups are differentiated. Improvement of soil salinity with the rice husk organic material for soil quality suitable through agricultural plants has fresh green leaves and the best growth, differently.

Keywords: Comparisons between the plant growths, different organic materials, experimental research design, improving soil salinity, local different organic materials, paddy local agriculture, and research and development

Correspondence:
Somsanguan Passago
[1]Department of Environmental Science, Faculty of Science and Technology, Rajabhat Mahasarakham University, Mahasarakham, Thailand
Corresponding author e-mail: toansakul35@yahoo.com.au

INTRODUCTION

Soil is one of the most important natural resources for human life. Most people use soil for agriculture whereas agriculture (Yuwaniyom, 2003). Soil consists of a solid phase of minerals and organic matter (the soil matrix), as well as a porous phase that holds gases (the soil atmosphere) and water (the soil solution) (Chesworth, 2008). Accordingly, soils are often treated as a three-state system of solids, liquids, and gases (McCarthy, 2006). The order or suborder classification is hardly used; the mostly used classification is the great soil group and downward (Thai Land Development Department, 2013) (Figure 1).

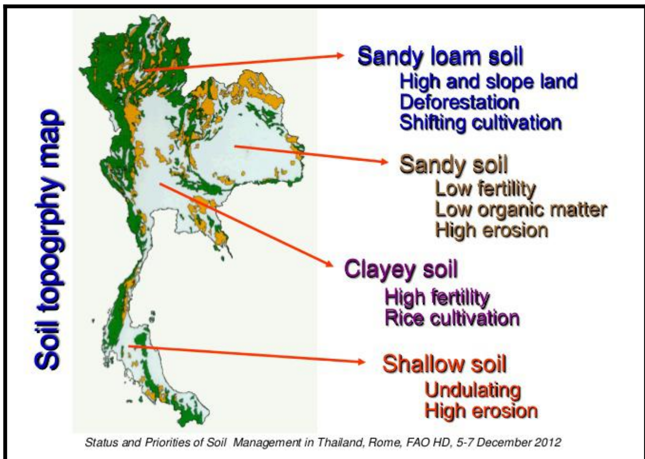

Fig. 1: Map of the status and properties of soil management in Thailand
Source: Potichan (2013)

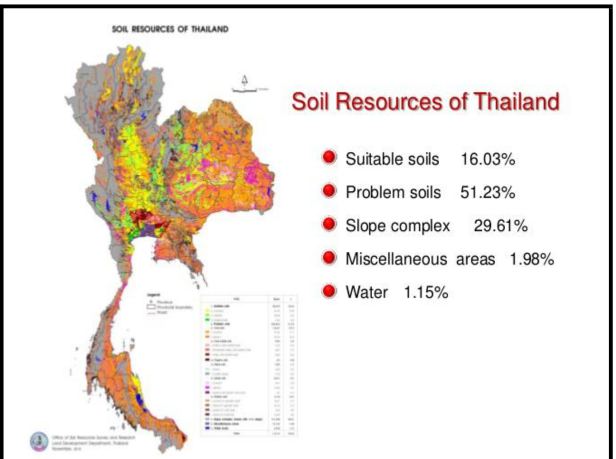

Fig. 2: Map of soil resources of Thailand
Source: Limtong (2012)

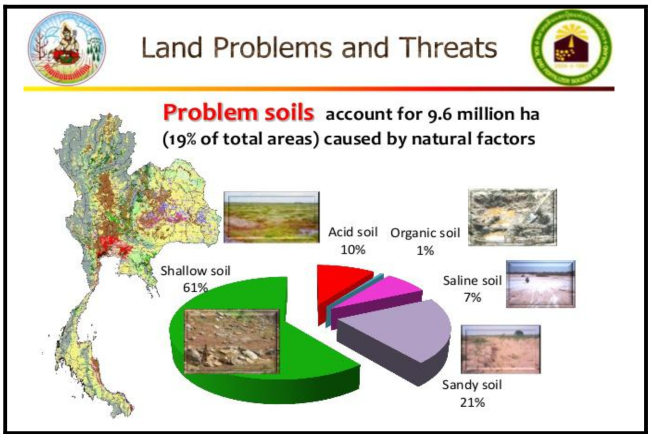

Fig. 3: Graphic of problem soils in Thailand
Sources: Hongprayoon *et al*., (2015)

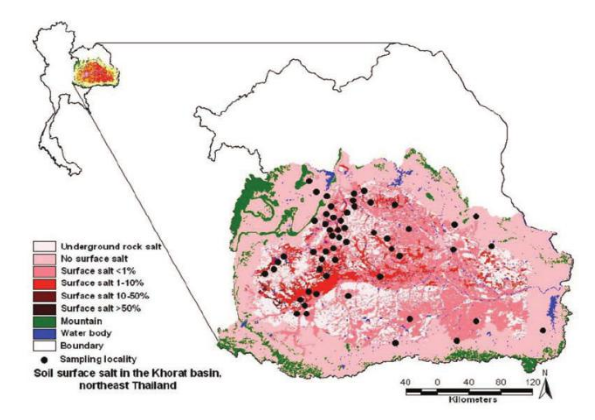

Fig. 4: Map of the Northeast Thailand showing 56 sampling localities
Soucre: Suwannatrai *et al*., (2011)

In Thailand, the soil feature is brown or brownish red, but it is possibly to be found in yellow, red dark or gray. Most of the arable soils in Northeast Thailand are sandy, acidic and infertile. Their primary and secondary minerals are mainly quartz and kaolinite (Wada, 2011). Based on these facts and other information, the following tentative theory was proposed for salinization in Northeast Thailand (Khoyama and Subhasaram, 1993), especially in the plateau reservoir area, Borabue District, Maha Sarakham Province (Fig. 2).

Efficient resource management and crop/livestock improvement for evolving better breeds can help to overcome salinity stress (Shrivastava & Kumar, 2015). Therefore, saline soil problems are a major obstacle to the development of the northeastern region with a soil salinity area of approximately 17.81 million rai and the soil that has the opportunity to become soil salinity for approximately 19.40 million rai (Passago et al., 2012) (Fig. 3).

Saline areas in the central and northern part of Northeast Thailand were investigated. These were classified into three major types on the basis of their topographic and geologic settings: hill, valley, and basin. A major source of salt wherever it is exposed or lies close to the surface is the Rock Salt Member of the Maha Sarakham Formation, which consists mainly of rock salts (Fig. 4).

These are the Upper Classic Member of the Maha Sarakham Formation and the Plio-Pleistocene Formation, which have recently been reported to contain traces of salts such as gypsum, sulfate, and carbonate, which replace halite. The mechanism of salinization in this region is short-distance interflow of brine in source layers together with capillary rise. Salt that is weathered and eroded from salt-sources is transported either by surface water or by groundwater to low-lying lands (Wongsomsak, 2010). It is necessary to continue to improve the soil to alleviate saline soil problems in some parts only but still experiencing saline soil problems and distribution of saline soil areas in the present (Figure 5).

Fig. 5: Prediction model of the goniomphalos density and distribution based on the prediction index in the Khorat basin, northeast Thailand. The triangles mark the location of 30 model validation localities.
Source: Land Development Department (2009)

Research and development of saline soil improvement at this time, the improvement of saline soil at the area of especially the Nong Bo Reservoir, Borabue District, Maha Sarakham Province and saline soil was developed. Suggestions that, the benefits of this research study are gained to the local community knowledge, modify, and adapt for solving-problems to concrete and economical guidelines.

Materials and Methods

Soil sample collection

Soil sample collection for analysis of physical and chemical properties would analyze on soil properties before and after soil amendments with rice husk; cow straw; and mixture between cow manure, rice husk, and rice straw and mixture between cow manure, rice husk, and rice straw.

Collecting soil samples

Soil samples were collected to be represented by Zig Zag (Land Development Department, 2009), each of soil conversion composed of 7 points per plot. Each point collected 20 grams of soil and mixed together to represent each plot; the experiment would be repeated in the three times in order to analyze of soil properties in each parameter. Each soil sampling conversion dried in the shade without dust, and the soil is dried, then make a fine by using mortar to crush the soil, and glide through the 2 mm diameter basket, collected the specimen in a plastic bag with a closed seal.

Phase I: Methods of measuring and analyzing soil properties

Soil color comparison by Munsell Code Book:

Clay tablets into 2 parts. Stand to let the sunlight shine through the shoulder to the soil color book and soil samples that are measuring soil color. Compare the color of the soil as any color in the earth color book Record the readable value.

pH analysis of soil

1. Soil: Water ratio 1: 1, Equipment and tools; 50ml beaker, Glass rods, 10 ml measuring cup, and pH meter was compared.

2. Chemical solution and preparation method: Distilled water, Standard buffer solution, and Standard pH 4 buffer solution and standard pH 7 buffer solution for adjusting pH meter.

3. Analysis method: weighing 10 grams of soil sample into a 50 ml beaker, adding 10 ml of distilled water, use a glass stick, stirring well several times, and taking the soil solution to measure pH using standard buffer solution pH 7 and pH 4, adjust the pH first.

Electrical conductivity (EC)

1. Analysis of electrical conductivity methods: water ratio 1: 5 with the equipment and tools, which composed of; 125 ml Erlenmeyer flask, Cone, Filter paper number 5, Filtering flask 500 ml., 50ml beaker, Thermometer, and Conductivity meter (Conductivity meter).

2. Chemical solution and preparation method: Standard Potassium Chloride (KCl) 0.01 N solution, dissolving potassium chloride (KCl) 0.7456 grams that is dried in distilled water, resulting in a volume of 1 liter, adjusting conductivity meter or using standard calibration solution 12.9 mS / cm 7230ppm NaCl , 0.1000 M ± 0.005 M KCl in machine adjustment, and distilled water.

3. Conductivity measurement method: Warm up the electrical conductivity meter for 15 minutes at 25 ° C. Adjust the machine using Standard Calibration 12.9 mS/cm 7230 ppm NaCl, 0.1000 M. 0.005 M KCl. measuring the electrical conductivity of the solution with conductivity meter. The value that can be read from the machine is in milliseconds per cm (mS / cm) at 25 °C = dS / m.

Soil salinity measurement

In the laboratory, soil salinity is usually assessed by determining either the total soluble salts by evaporation of soil water extract (TSS), or by determining the electrical conductivity (EC) of either a 1:5 distilled water: soil dilution, or a saturated paste extract. The electrical conductivity or EC of a soil sample is influenced by the concentration and composition of dissolved salts.

Organic Matter; OM Method

1. Chemical solution and preparation method; Potassium dichromate solution 1 N Potassium Dichromate ($K_2Cr_2O_7$) baked at 105.8^{0}C, 98.0 g, dissolved in distilled water resulting in a volume of 2 liters, Ferrous Ammonium Sulfate solution 0.5, Ferrous Ammonium Sulfate [Fe $(NH_4)_2(SO_4)2.6H_2O$] 400 grams, dissolved in sufficiently distilled water, add 50 ml of concentrated sulfuric acid to a volume of 2 liters. O-phenanthroline trope indicators solution (0.025 M), Ferrous Sulfate ($FeSO_4.7H_2O$) 0.7 g and O-phenanthroline 1.48 grams dissolved in distilled water, making it 100 ml volume, and concentrated sulfuric acid (conc.H_2SO_4).

2. Analysis method weighing 1 g of soil sample in a 250 ml flat bottom glass bottle, Pipette, 1 N10 ml potassium dichromate solution 15 ml of concentrated sulfuric acid Shake the glass lightly for 1-2 minutes. Set aside for 30 minutes add about 50 ml of distilled water leave to cool. Drop the indicator 5 drops of orthophonics, titrate with ferrous ammonia sulfate 0.5 to determine the amount of potassium dichromate left over from the reaction until the color of the soil solution changes from green to reddish brown at the end point. Record the amount of potassium dichromate and ferrous ammonium sulfate used, and made blank, same as soil analysis method.

% Organic carbon = % Organic carbon x 1.724

Total nitrogen determination in soil (Total N)

1. Mixed indicator: Weighed methyl red 0.066 grams and green 0.099 grams, dissolved with 100 ml ethanol, stored in a sealed bottle, 2% H_3BO_3 - indicator solution; H_3BO_3 20 grams weighing 500 ml beaker, add about 300 distilled water on the hot plate. Let the H_3BO_3 completely dissolve (the person with a glass stick is periodically heated) and leave to cool; insert 1000 ml volumetric flask, add 500 ml of distilled water (by using the beaker to wash the H_3BO_3 in small increments), add mixed indicator 20 ml (use graduate pipette), shake well, adjust the color of this solution by 0.1 N NaOH by adding it in small increments (use graduate pipette) until dissolved into magenta (pH of solution approximately 5.0).

2. Catalyst mixture: Mixing K_2SO_4 (or Na_2SO_4): $CuSO_4.5H_2O$: Se in the ratio of 100: 10: 1, and 40% NaOH 400 grams by weighing 400 grams of NaOH, put in a 1000-ml beaker, dissolved with distilled water (prepared in a fume hood), stirred with a glass rod to dissolve NaOH, adjust the volume to 1 liter, store the solution in a plastic bottle, and Std. 0.005 N H_2SO_4.

3. Removing the distilled solution in the Erlenmeyer flask to titrate with std. 0.005 N H_2SO_4 at the end point. The solution would be purple red. Note the volume of std. 0.005 N H_2SO_4 using titrate to calculate Total N.

Total N (%) = (ml std. H_2SO_4 Sample – ml std. H_2SO_4 Blank) x N std.H_2SO_4 x 0.014 x

Final volume (ml) x100

aliq. (ml) x wt.of soil (g)

Beneficial amounting Phosphorous (P) mineral in soils (BPM)

Prepare a series of standard solutions and banks (Use distilled water instead) to measure light absorption, same as the extract, calculation

Phosphorus absorbed in soil phase ⇌ P in soil solution ⇌ Precipitated P

Phosphorus content in soil = $(W_b \times (0.25) \times (0.43))/W_s$ ppm

When soil sample weight = W_s gram

Bray no. = W_b grams

Values read from the standard graph = 0.43 ppm

Dilution ratio = 1:5

Beneficial amounting Potassium (K) mineral in soils (BKM)

Useful Potassium = (DxCxB)/A ppm

When

A = weight of soil sample (g)

B = volume of ammonium acetate solution used for extraction (ml)

C = Dilution factor (times)

D = potassium concentration compared to standard concentration (ppm)

Phase III: Selected experimental materials

The *African Sesbania Rostrata* tree was selected, properties of the soil studied included physical properties; soil color; chemical properties included pH, salty, electrical conductivity, organic matter in the soil, and main nutrient.

Preparation before the experiment

Preparation of soil conversions before planting; the 1st-3rd soil conversions (Original 1) were the controlling experimental sample, which don't crop. The 4th-15th soil conversions (Original No. 2-5) were a soil conversion with the *African Sesbania Rostrata*.

Plant preparation

Prepare the Sesbania seeds by weighing 15 kilograms of *African Sesbania* seeds and leaving the seeds soaked for 1 night.

Cropping

The 1st-3rd soil conversions were the controlling soil conversions and wouldn't grow any crops at all. The 4th-15th, were grown with the *African Sesbania Rostrata* by planting *African Sesbania Rostrata* into the experiment guideline in a row to thoroughly convert, using 1 kg of *African Sesbania Rostrata* seeds, wet weight (about 10 minutes to remove the seeds before draining), which planting would begin to be planted in June 2013.

Chopping

When the *African Sesbania Rostrata* grows for 60 days, then chopping plant into the soil by giving the soil about 10 centimeters thick was selected. After that, let the decomposition of the plant for 60 days and collect soil samples for analysis of each parameter.

Soil sample collection

Soil sample collection for analysis of physical and chemical properties would analyze soil properties before planting and after soil quality improvement with green manure for the soil conversions in each plot of 7 points, each point collects 500 grams of soil and then mix together to represent each plot. The experiment would be repeated in 3 times, in order to analyze soil properties in each parameter.

Soil sample analysis

Soil sample analysis was collected at each time would be analyzed for the properties of the soil according to the parameters set, namely; soil color by the Munsell color code book, acidity – alkalinity with the pH meter, electrical conductivity and salinity of soil were measured by the with the Electrical Conductivity Meter, the organic matter and main nutrient was analyzed by the Walkley - Black Method, and the main nutrients, such as; totalized nitrogen, beneficial phosphorus and potassium was tested by the Atomic Absorption and Spectrophotometer, using the technique of Kjeldahl Distillation and Colorimetric Methods were analyzed. Statistically significant was analyzed with mean and standard deviation.

Results

To integrate of the conducting physical and chemical soil quality studies including soil color, pH value, electrical conductivity value, salinity value, organic matter, total nitrogen content, beneficial phosphorus and potassium content that were divided the experiment set into 5 original as follows:

Original 1: soil control unit

Original 2: soil, improved with the rice husk (RH)

Original 3: soil improved with the cow dung (CD)

Original 4: soil improved with the rice straw (RS)

Original 5: soil improved with the mixture of cow manure, rice husk, and rice straw (RH, CD, and RS)

Soil colors

The characteristics or properties as determined to be classified for soil colors in the same group for the convenience in the application and simple to remember with the objectives.

1. To compile various knowledge about soil characteristics in groups or classes.
2. To show the relation of various kinds of soil and to promote the more understanding about various kinds of soil and learn the new principle and relation about the soil.
3. To be able to remember various characteristics of soil easier.
4. To distribute the soil kinds reasonably into groups or classes and it is useful for the soil behavior forecast, determination the most appropriate utilization of a soil.

Soil classification cane is divided into 2 categories

The soil classification system used in the survey to make the soil as follows:

National soil classification system

Using the coefficient of determination, denoted R^2 and pronounced "R squared", is a number that indicates the proportion of the variance in the dependent variable (Rating Growth Plant: *African Sesbania Rostrata* plant) that is predictable from the 4-independent variables (Typing Different Materials: RH; CD; RS; and mixed material of RH, CD, and RS). It provides a measure of how well improved outcomes are replicated by the experimental research method.

Table 1. Soil color before improvement and after soil improvement with organic matter for the 1st year

Soil conversion	Soil color before improvement		Soil after improvement with organic matter	
	Color	Color code	Color	Color code
No. 1 (controlled)	Light brown soil	7.5YR8/4	Light brown soil	7.5YR8/4
No. 2 (the RH)	Light brown soil	7.5YR8/4	Yellow-brown soil	7.5YR7/6
No. 3 (the CD)	Light brown soil	7.5YR8/4	Dark brown soil	7.5YR6/6
No.4 (the RS)	Light brown soil	7.5YR8/4	Yellow-brown soil	7.5YR7/6
No. 5 (the mixtures)	Light brown soil	7.5YR8/4	Yellow-brown soil	7.5YR7/6

Table 2. Soil color before improvement and after soil improvement with organic matter for the 2nd year

Soil conversion	Soil color before improvement		Soil after improvement with organic matter	
	Color	Color code	Color	Color code
No. 1 (controlled)	Light brown soil	7.5YR8/4	Light brown soil	7.5YR8/4
No. 2 (the RH)	Yellow-brown soil	7.5YR8/6	Dark brown soil	7.5YR5/6
No. 3 (the CD)	Yellow-brown soil	7.5YR8/6	Dark yellow-brown soil	7.5YR6/8
No.4 (the RS)	Yellow-brown soil	7.5YR8/6	Dark brown soil	7.5YR5/6
No. 5 (the mixtures)	Yellow-brown soil	7.5YR8/6	Dark brown soil	7.5YR5/6

Table 1 and Table 2 show the soil colors' results that have compared between the experimental samples indicated that of timing experiments (before, and after past of 60 days were improved) in the 1st and 2nd year.

pH values

Table 3 reported for the pH values on each soil conversions of the on the controlling and experimental samples of soils that their statuses as before improvement and after 60 days' improvements were compared. The controlled soil set (No.1) has an average pH value of 4.64 ± 0.05, and after 60 days of experimentation, the pH value still has an average of 4.65 ± 0.04. The RH soil conversion (No.2), the average pH value was 4.63 ± 0.04 and after 60 days of experiment, the average pH was 6.57 ± 0.04. Similarly, No.3 (the CD), No, 4 (the RS), and No. 5 (the mixtures of materials) were responded through before and after improvements of the pH values as 4.59±0.02 and 5.53±0.03; 4.50 ± 0.01 and 6.25 ± 0.03; and 4.62±0.04 and 5.91±0.01, respectively for the 1st year.

Table 3. Comparisons between the pH values of the five soil conversions in the 1st and the 2nd year with mean averages indicates of before and after of soil experimental improvement

Soil conversion	Before soil improvement			
	Mean average ($\bar{X}$)		Mean average ($\bar{X}$)	
	the 1st year	the 2nd year	the 1st year	the 2nd year
No. 1 (controlled)	4.64	4.62	4.65	4.62
No. 2 (the RH)	4.63	6.51	6.57	7.04
No. 3 (the CD)	4.59	5.53	5.53	6.81
No. 4 (the RS)	4.59	6.26	6.25	7.30
No. 5 (the mixtures)	4.62	5.92	5.91	7.51

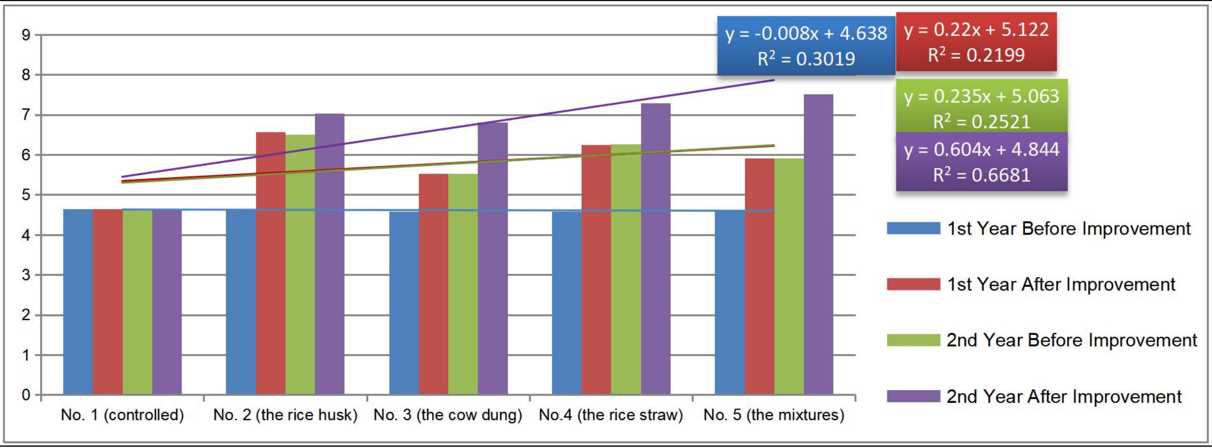

Fig. 6: Significant differences on five conversions in terms of before and after improvement in the 1st and 2nd years for soil's pH

In the 2nd year, Table 3 reported of the pH value indicated that of 4.62±0.01, 6.51±0.17, 5.53±0.04, 6.26±0.03, and 5.92±0.01 for the soil qualities before improvement; and indicated that of 4.62±0.00, 7.04±0.55, 6.81±0.01, 7.30±0.01, and 7.51±0.01 for the soil qualities after improvement of the five soil conversions, respectively. The *African Sesbania Rostrata* plant for using *RH*, *CD*, *RS*, and mixing the *RH, CD RS* materials for improving sanity soil were tested in two years, increasingly.

Electrical conductivity values: EC

The electrical conductivity values in the control soil, the RH, the CD, the RS, and the mixture of material series before soil improvement were EC equal to 847 ± 1.73 µs / cm, 847±1.00 µs/cm, 850±1.73 µs/cm, 847±0.57 µs/cm, and 848± 1.100 µs/cm; and after 60 days of experimentation, the EC values were 815.50 ± 4.41 µs/cm, 544.00±2.39 µs/cm, 737.11±2.42 µs/cm, 692.11±1.36 µs/cm, and 848± 1.100 µs/cm, respectively as details in Table 4.

Table 4. Comparisons between the EC values of the five soil conversions in the 1st and the 2nd year with mean averages indicates of before and after of soil experimental improvement

Soil conversion	Electrical conductivity values (µs/cm)			
	Before soil improvement		After soil improvement in 60 days	
	Mean average ($\bar{X}$)		Mean average ($\bar{X}$)	
	the 1st year	the 2nd year	the 1st year	the 2nd year
No. 1 (controlled)	847	846.22	815.50	847.66
No. 2 (the RH)	847	547.33	544.00	520.22
No. 3 (the CD)	850	740.44	737.11	711.88
No. 4 (the RS)	847	693.33	692.11	647.77
No. 5 (the mixtures)	848	674.66	673.77	636.66

In the 2nd year, the EC values indicated that of 846.22±1.20, 547.33±1.73, 740.44±-3.08, 693±1.65, and 693±1.65 µs/cm for the soil qualities before improvement; and indicated that of 847.66±3.35, 520.22±1.30, 711.88±2.08, 647.77±2.63, and 636.66± 1.11µs/cm for the soil qualities after improvement of the five soil conversions, respectively. The *African Sesbania Rostrata* plant for using *RH*, *CD*, *RS*, and mixing the *RH, CD RS* materials, the EC value in two years were decreased.

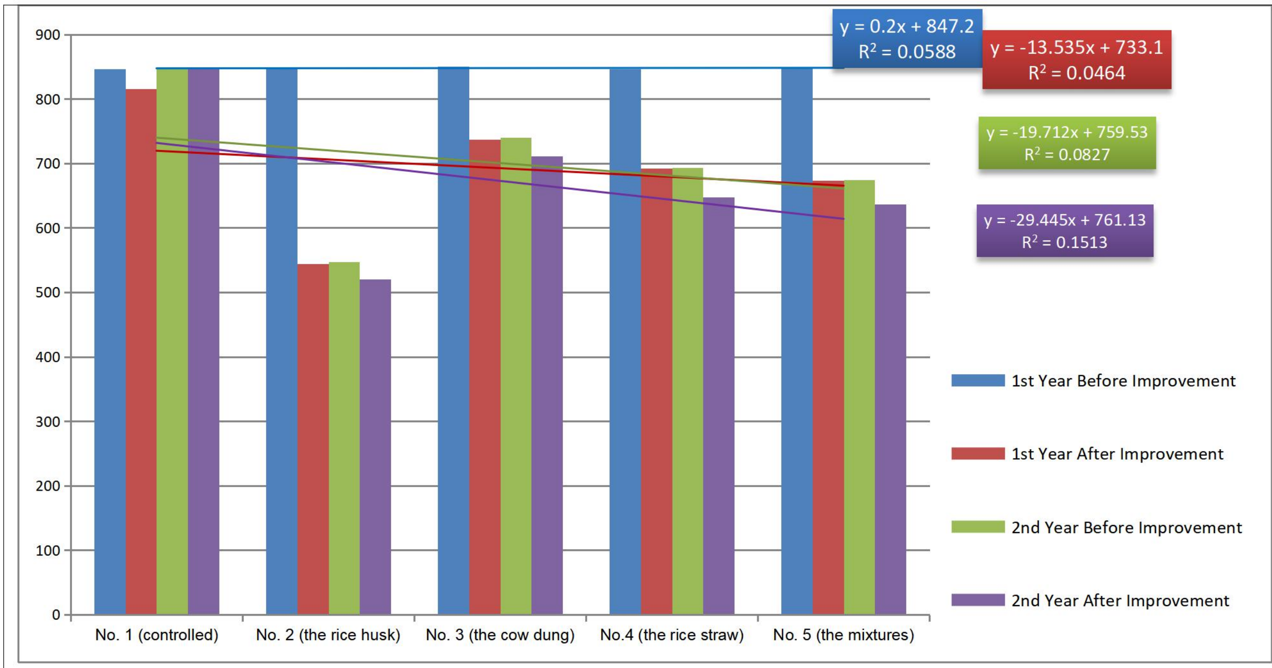

Figure 7. Significant differences in five conversions in terms of before and after improvement in the 1st and 2nd years for the EC of soils

Soil salinity values (SS)

The soil salinity results were measured on the soil conversion number as 1st, 2nd, 3rd, 4th, and 5th indicated that of the soil salinity values before the soil improvement as 8.47 ± 0.01, 8.47±0.01, 8.50±0.01, 8.47±0.00, and 8.48±0.01 dS/m, and on after 60 days of experiment for improving the soils, the average salinity was 8.45 ± 0.01, 5.44±0.02, 7.37±0.02, 6.92±0.01, and 6.84±0.33 dS/m, respectively for the firth yea.

Table 5. Comparisons between the SS values of the five soil conversions in the 1st and the 2nd year with mean averages indicates of before and after of soil experimental improvement

Soil conversion	Soil salinity values (dS/m)				
	Before soil improvement			After soil improvement in 60 days	
	Mean average ($\bar{X}$)			Mean average ($\bar{X}$)	
	the 1st year	the 2nd year		the 1st year	the 2nd year
No. 1 (controlled)	8.47	8.46		8.45	8.47
No. 2 (the RH)	8.47	5.47		5.44	5.21
No. 3 (the CD)	8.50	7.39		7.37	7.11
No. 4 (the RS)	8.47	6.93		6.92	6.47
No. 5 (the mixtures)	8.48	6.47		6.84	6.36

Table 5 reported the soil salinity values in the 2nd year, the SS values indicated that of 8.46±0.01, 5.47±0.01, 7.39±0.01, 6.93±0.01, and 6.74±0.02 dS/m for the soil qualities before improvement; and indicated that of 8.47±0.03, 5.21±0.02, 7.11±0.02, 6.47±0.02, and 6.36±0.01 dS/m for the soil qualities after improvement of the five soil conversions in before and after improvement (B&A.I), respectively.

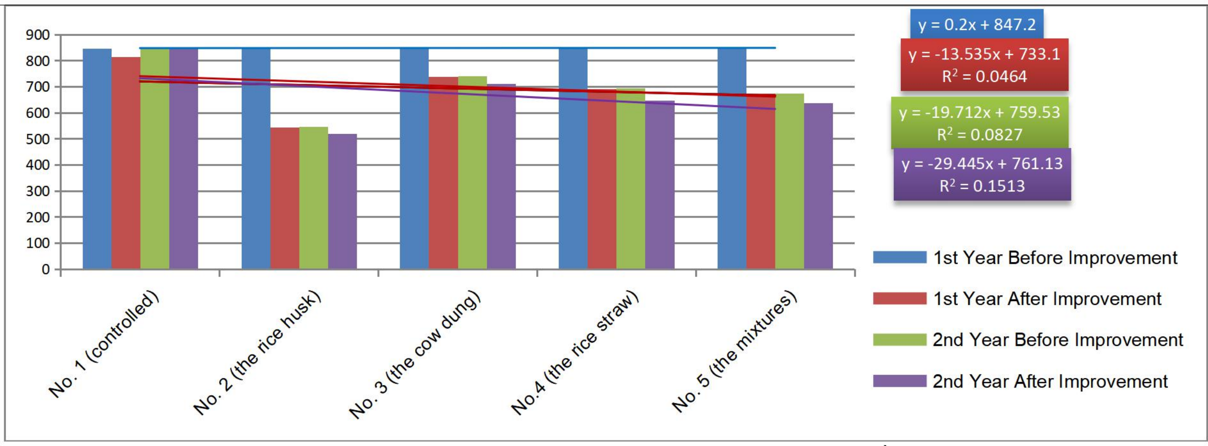

Figure. 8: Significant differences in five conversions in terms of B&A.I,in the 1st and 2nd years for the SS

Organic matter in the soil (OMS)

The organic matter in the soil results were measured on the soil conversion number as 1st, 2nd, 3rd, 4th, and 5th indicated that of the organic matter in the soil before the soil improvement as 0.54±0.01%, 0.54±0.01%, 0.54±0.01%, 0.54±0.01%, and 0.54±0.01%, and after 60 days of experiment for improving the soils, the mean average of the organic matter in soils revealed that of 0.54±0.01%, 2.09±0.01%, 1.21±0.02%, 1.39±0.01%, and 1.25±0.01%, respectively.

Table 6. Comparisons between the OMS values of the five soil conversions in the 1st and the 2nd year with mean averages indicates of before and after of soil experimental improvement

Soil conversion	Organic matter in the soil values (%)			
	Before soil improvement		After soil improvement in 60 days	
	Mean average (X̄)		Mean average (X̄)	
	the 1st year	the 2nd year	the 1st year	the 2nd year
No. 1 (controlled)	0.54	0.53	0.54	0.52
No. 2 (the RH)	0.54	2.05	2.09	2.38
No. 3 (the CD)	0.54	1.21	1.21	1.50
No. 4 (the RS)	0.54	1.39	1.39	1.62
No. 5 (the mixtures)	0.54	1.52	1.25	1.42

Table 6 reported the organic matter in the soil values in the 2nd year, the OMS values indicated that of 0.53±0.00%, 2.05±0.00%, 1.21±0.01%, 1.39±0.01%, and 1.25±0.01% for the soil qualities before improvement; and indicated that of 0.52±0.04%, 2.38±0.01%, 1.50±0.00%, 1.62±0.00%, and 1.42±0.01% for the soil qualities after improvement of the five soil conversions, respectively.

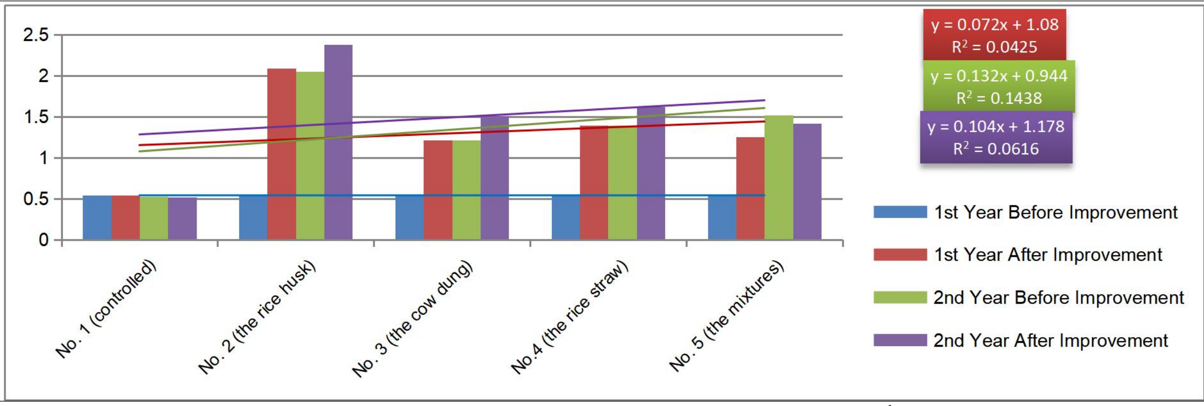

Figure 9: Significant differences in five conversions in terms of B&A. I, in the 1st and 2nd years for the OMS values of soils

Amount of Nitrogen mineral (N) in soils (NM)

The results of the amount of Nitrogen mineral in soils were measured on the soil conversion number as 1st, 2nd, 3rd, 4th, and 5th indicated that of the amount of Nitrogen mineral in soils before the soil improvement with the mean averages as 0.01±0.00%, 0.01±0.00%, 0.01±0.00%, 0.01±0.00%, and 0.01±0.00%, and after 60 days of experiment for improving the soils, the mean average of 0.01±0.00%, 0.68±0.00%, 0.13±0.00%, 0.04±0.00%, and 0.22±0.01%, respectively. These results were reported in Table 7.

Table 7. Comparisons between the NM values of the five soil conversions in the 1st and the 2nd year with mean averages indicates of before and after of soil experimental improvement

Soil conversion	Before soil improvement		After soil improvement in 60 days	
	Mean average ($\bar{X}$)		Mean average ($\bar{X}$)	
	the 1st year	the 2nd year	the 1st year	the 2nd year
No. 1 (controlled)	0.01	0.11	0.01	0.11
No. 2 (the RH)	0.01	0.68	0.68	0.71
No. 3 (the CD)	0.01	0.42	0.13	0.62
No. 4 (the RS)	0.01	0.43	0.04	0.60
No. 5 (the mixtures)	0.01	0.23	0.22	0.46

Table 7 reported the NM in the soil values in the 2nd year, the NM values indicated that of 0.11±0.01%, 0.68±0.00%, 0.42±0.01%, 0.43±0.01%, and 0.23±0.00% for the soil qualities before improvement; and indicated that of 0.11±0.01%, 0.71±0.01%, 0.62±0.01%, 0.60±0.01%, and 0.23±0.00% for the soil qualities after improvement of the five soil conversions, respectively.

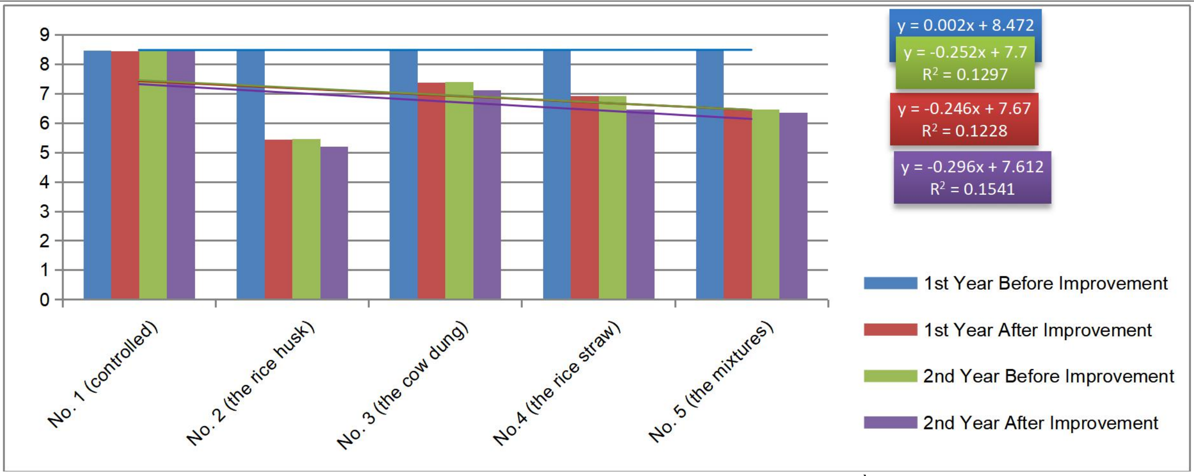

Fig. 10: Significant differences in five conversions in terms of B&A.I, in the 1st and 2nd years for the Nitrogen mineral (N) in soils

Beneficial amounting Phosphorous (P) mineral in soils (BPM)

The results of the beneficial amounting Phosphorous mineral in soils were measured on the soil conversion number as 1st, 2nd, 3rd, 4th, and 5th indicated that of the beneficial amounting Phosphorous mineral in soils before the soil improvement with the mean averages as 1.10±0.01, 1.10±0.01, 1.10±0.01, 1.10±0.01, and 1.10±0.01 ppm, and after 60 days of experiment for improving the soils, the mean average of 1.16±0.01, 22.19±0.00, 37.89±0.01, 15.49±0.01, and 28.21±0.02 ppm, respectively.

Table 8. Comparisons between the BPM values of the five soil conversions in the 1st and the 2nd year with mean averages indicates of before and after of soil experimental improvement

Soil conversion	Before soil improvement		After soil improvement in 60 days	
	Mean average ($\bar{X}$)		Mean average ($\bar{X}$)	
	the 1st year	the 2nd year	the 1st year	the 2nd year
No. 1 (controlled)	1.10	2.09	1.16	2.10
No. 2 (the RH)	1.10	22.32	22.18	26.49
No. 3 (the CD)	1.10	38.11	37.89	46.12
No. 4 (the RS)	1.10	15.49	15.49	18.68
No. 5 (the mixtures)	1.10	28.21	28.21	32.75

Table 8 reported the BPM in the soil values in the 2nd year, the NM values indicated that of 2.09±0.01, 22.32±0.02, 38.11±0.10, 15.49±0.00, and 28.21±0.01 ppm for the soil qualities before improvement; and indicated that of 2.10±0.02, 26.49±0.03, 46.12±0.02, 18.68±0.05, and 32.75±0.11 ppm for the soil qualities after improvement of the five soil conversions, respectively.

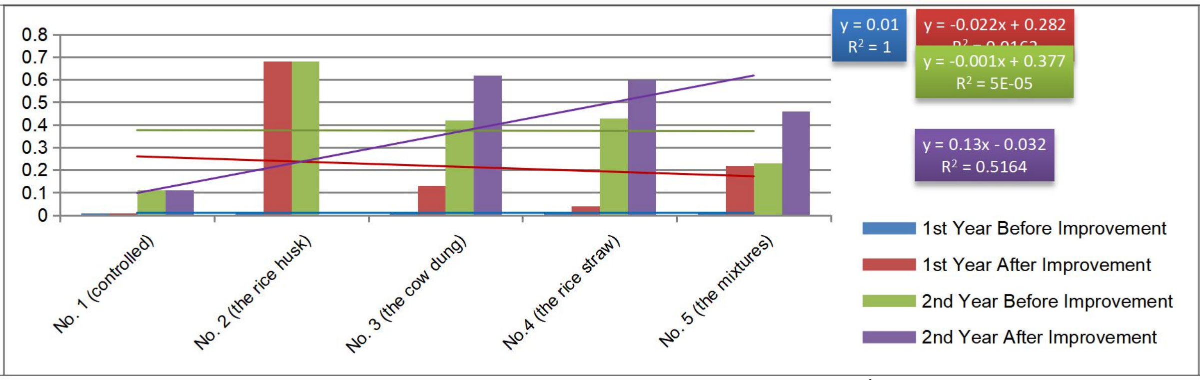

Fig. 11: Significant differences in five conversions in terms of B&A. I, in the 1st and 2nd years for the Phosphorous (P) mineral in soils

Beneficial amounting Potassium (K) mineral in soils (BKM)

The results of the beneficial amounting Potassium mineral in soils were measured indicated that of the beneficial amounting Potassium mineral in soils before the soil improvement with the mean averages as 155.72±0.11, 155.72±0.11, 155.72±0.11, 155.72±0.11, and 155.72±0.11 ppm; and after 60 days of experiment for improving the soils, the mean average of 155.67±0.09, 714.61±0.49, 754.05±0.63, 444.22±0.83, and 334.11±1.61 ppm, respectively.

Table 9. Comparisons between the BKM values of the five soil conversions in the 1st and the 2nd year with mean averages indicates of before and after of soil experimental improvement

Soil conversion				
	Before soil improvement		After soil improvement in 60 days	
	Mean average ($\bar{X}$)		Mean average ($\bar{X}$)	
	the 1st year	the 2nd year	the 1st year	the 2nd year
No. 1 (controlled)	155.72	155.62	155.67	155.61
No. 2 (the RH)	155.72	713.53	714.61	724.74
No. 3 (the CD)	155.72	754.50	754.05	767.96
No. 4 (the RS)	155.72	445.02	444.22	472.04
No. 5 (the mixtures)	155.72	333.96	334.11	361.54

Table 9 reported the BKM in the soil values in the 2nd year, the BKM values indicated that of 155.2±0.06, 713.53±1.49, 754.50±0.32, 445.02±0.81, and 333.96±1.20 ppm for the soil qualities before improvement; and indicated that of 155.61±0.19, 724.74±0.84, 767.96±1.09, 472.04±0.97, and 361.54±0.70 ppm for the soil qualities after improvement of the five soil conversions, respectively. Testing the beneficial amounting Potassium (K) mineral in soils (BKM) values in two years on one of four variables, increasingly

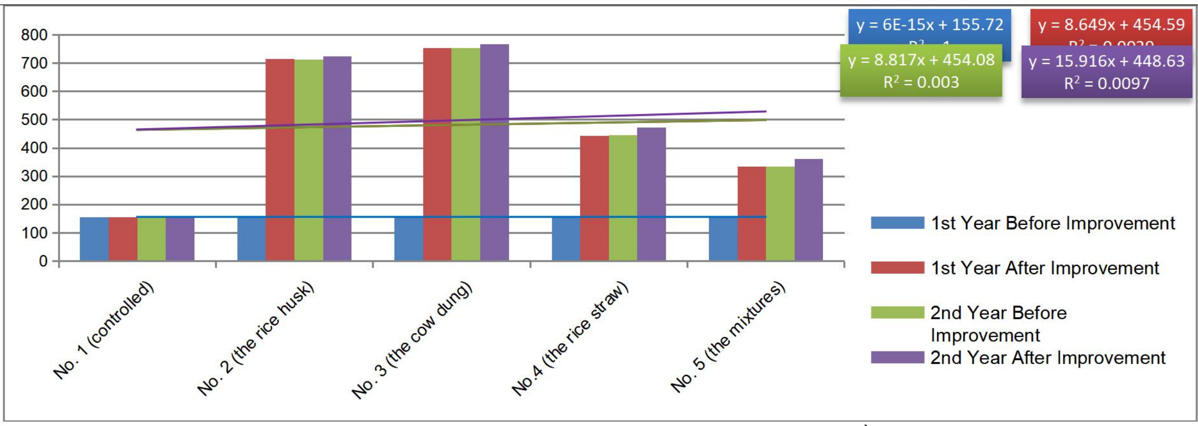

Fig. 12: Significant differences in five conversions in terms of B&A.I, in the 1st and 2nd years for the Potassium (K) mineral in soils

Comparison of saline soil quality B&A.Iwith organic matte

The presence of more variation of the parameters were tested for with the five soil conversions (No. 1: controlled soil, No. 2: the RH, No. 3: the CD, No. 4: the RS, No. 5: the mixtures with the RH, the CD, and the RS) in terms of soil improvements in before and after 60 days of experimental improvements of the soils with the mean average scores were compared in the 1st year were compared, differently.

The finding also further supports previous related research in that in that a variety of studies has indicated that soil salinity properties, which they are improved with the four material are used and analyzed of this experimental research method with the sources of variation, comparative test of average pairs (Post Hoe test) with LSD (LSD: Least significant difference), and F-test. Table 10 reported of the analyzing results were differentiated (Table 10).

Table 10. Sources of variation, Mean average ($\bar{X}$), and F-test were compared of the five materials to improve the experimental soil salinity in two years

Parameter	Sources of variation		Mean average (($\bar{X}$)										F-test
	Between groups	Within Groups	Controlled		RH		CD		RS		Mixed		
			BFY	ASY	BFY	ASY	BFY	ASY	BFY	ASY	BFY	ASY	
pH	26.42	0.07	4.64	4.62	4.63	7.04	4.59	6.81	4.59	7.30	4.62	7.51	4131***
EC (µs/cm)	3.98x10^{6}	1.20x10^{5}	847	848	847	520	850	712	847	648	848	637	35.6***
SS (dS/m)	48.48	0.93	8.47	8.47	8.47	5.21	8.50	7.11	8.47	6.47	8.48	6.36	560***
OMS (%)	12.68	0.006	0.54	0.52	0.54	2.38	0.54	1.50	2.54	1.62	0.54	1.42	2385***
NM (%)	2.79	0.002	0.01	0.11	0.01	0.71	0.01	0.62	0.01	0.60	0.01	0.46	1296***
BPM (ppm)	8.04x10^{3}	0.003	1.10	2.10	1.10	26.5	1.10	46.1	1.10	18.7	1.10	32.8	2529***
BKM (ppm)	2.62x10^{5}	31.73	156	157	156	725	156	768	156	472	156	362	8868***

**differently significant at .05 level, **at .01 level, ***at .001 level*
BFY: Before the 1st year for soil improvement
ASY: After the 2nd year for soil improvement

The results as above indicated that of the comparisons between the efficiency of RH; CH; RS; and mixed of the RH, CH, and RS mixture showed that the pH, EC, SS, OMS, NMQ, BPM, and BNM values were tested and measured with the experimental research method. To provide the controlling variable with the 1st soil conversional plot, it called the Original 1: soil control unit, and experimental variables were set into four original soil conversion groups were improved the RH, CD, RS, and the mixed of the RH, CD, RS materials were randomly assigned (Figure 13, 14, 15, and 16).

Fig. 13: The growth of the *African Sesbania Rostrata* trees in the experimental improvement with the RH

Fig. 14: The growth of *African Sesbania Rostrata* trees in the experimental improvement with the CD

Fig. 15: The growth of *African Sesbania Rostrata* trees in the experimental improvement with the CD

Fig. 16: The growth of African Sesbania trees in experimental improvement with 3 ingredients (RH, CD, and RS)

All of the originals showed the statistically significant differences at the level of .05. The values of the original EC improved with CD and the original that is improved with RS has no significant difference at the level of .05 for the pH, EC, SS, OMS, NM, beneficial of PM and KM. As for the EC value that was improved with CD and the original that was improved with RS, there were no significant differences at the level of .05. Because the RH, when decomposed, will insert in the soil for a long time, and causing the soil to have high salt leaching and the decomposition of other soil improvement materials causing the soil to have more organic matter that resulting better than physical properties of the soil. Especially, plants can absorb nutrients in the soil to use and proper the pH reaction with suitability.

Discussions

The 7-parameter, such as pH, EC, SS, OMS, NM, PM, KM mineral qualities also were found that summarized as followed:

Soil color: Soil color before soil improvement is brown. The soil was improved with cow dung was darker than the four original soil conversion experiments.

pH value: The soil was improved with rice husk has an increase in pH until near the most neutral (pH = 6.57).

Electrical conductivity (EC): The original soil was improved with rice husk has the highest electrical conductivity value (EC = 544.00 µs/cm).

Soil salinity value: The soil that has been improved with rice husk has the highest decreasing soil salinity (Soil Salinity = 5.44 ds / m).

Organic material value in soil: The soil that was improved with rice husk has the highest organic material value (Organic material = 2.09%)

Total Nitrogen mineral in soils: The soil that has been improved with rice husk has the highest total nitrogen content (N = 0.68%).

Beneficial Phosphate Mineral Quality: The soil that has been improved with cow dung has the most beneficial phosphorus quality (P = 37.89 ppm).

Beneficial Potassium Mineral Quality: The soil that has been improved with cow dung has the most beneficial potassium quality (K = 754.05 ppm)

Generally, standardized recognizing soil properties relevant to plant growth and protection suitability, the color is black or very dark brown colors. Soil pH may also affect the availability of plant nutrients in the optimum

5.5 to 7.5 range. Soil-EC ranges 450 to 700 µS/cm, the standard soil texture class is loamy, and the primary macronutrients, such as N, P, and K quantities as 0.2% to 4.0% by dry weight. The results are consistent with the standardized recognizing soil properties relevant to plant growth and protection suitability, significantly.

Conclusions

This experimental research study was integrated the conducting physical and chemical soil quality studies including soil color, pH value, EC value, SS value, OMS, NM, beneficial PM & KM that were divided the controlling and experimental set into 5 original soil conversion groups follows: Original 1: soil control unit as the controlling group; Original 2: soil, improved with the RH, Original 3: soil improved with the CD, Original 4: soil improved with the RS, and Original 5: soil improved with the mixture of RH, CD, and RS are randomly assigned into one of four groups.

Using the determination predictive efficiency (R^2) values indicate that of 30%, 22%, 25%, and 69% for the pH value; 0%, 4%, 14%, and 6% for the OMS values; 0%, 2%, 0%, and 52% for the BPM values; 0%, 0%, 0%, and 1% for the BKM values of the variances in the rating growth of the *African Sesbania Rostrata* plant for using the *RH*, *CD*, *RS*, and mixing the *RH*, *CD*, *RS* materials for improving sanity soil were attributable environments with testing the pH value in two years, increasingly.

The determination predictive efficiency (R^2) values indicate that 9%, 5%, 8%, and 16% for the EC values; 9%, 5%, 8%, and 15% for the SS values; 6%, 12%, 13%, and 15% for NM values of the variances in the rating growth of the *African Sesbania Rostrata* plant for using *Rice Husk*, *Cow Dung*, *Rice Straw*, and mixing the *Rice Husk, Cow Dung Rice Straw* materials for improving sanity soil were attributable environments with testing the EC value in two years, decreasingly.

REFERENCES

1. Chesworth, W. (2008). Encyclopedia of soil science (PDF). Dordrecht, the Netherlands: Springer. ISBN 978-1402039942. Available on 17 December 2017.
2. Hewitt, A. (2004). Soil properties relevant to plant growth: a guide to recognizing soil properties relevant to plant growth and protection. Lincoln, N.Z.: Manaaki Whenua Press. Landcare Research Science Series, ISSN 1172-269X; No. 26).
3. International Trade Center. (2012). Country profile Thailand. Available from http://www.intracen.org/exporters/organic-products/country-focus/Country-Profile-Thailand/
4. Kohyama, K. and Subhasaram, T. (1993). Salt-affected Soils in Northeast Thailand: Their Salinization and Amelioration. Technical Paper No.12. Agricultural Development Research Center in Northeast, Khon Kaen Province, Thailand.
5. Land Development Department. (2009). Provincial soil salinity map 1:100,000 scale. Soil Survey Division, Land Development Department, Ministry of Agriculture and Cooperatives.
6. McCarthy, D. F. (2006). Essentials of soil mechanics and foundations: basic geotechnics (7th ed.). Upper Saddle River, New Jersey: Prentice Hall. ISBN 978-0131145603.
7. Mitsuchi, M., Wichaidit, P., & Jeungnijnirund, S. (1986). Outline of soils of the Northeast plateau Thailand. Technical. Paper No. 1, ADRC.
8. Moncharoen, P., & Wiensil, T. (2001). Carbon in soils of Thailand. Soil Analysis Division, Land Development Department, Ministry of Agriculture and Cooperatives. Bangkok. Thailand.
9. Mongkolsawat C., &Thirangoon, P. (1990). A Practical application of remote sensing and GIS for soil salinity potential mapping in Korat Basin, Northeast Thailand. Khon Kaen University. (PDF) GIS Application to Spatial Distribution of Soil Salinity Potential in Northeast Thailand. Available from: https://www.researchgate.net/publication/266473819_GIS_Application_to_Spatial_Distribution_of_Soil_Salinity_Potential_in_Northeast_Thailand [accessed Dec 26, 2018].
10. Potichan, A. (2013). Soil maps and soil information of Thailand. Land Development Department, Ministry of Agriculture and Cooperatives, Bangkok, Thailand Available from http://library.wur.nl/isric/fulltext/isricu_i34282_001.pdf
11. Shrivastava, P. & Kumar, R. (2015). Soil salinity: A serious environmental issue and plant growth promoting bacteria as one of the tools for its alleviation. Saudi Journal of Biological Science, 22(2): 123–131. doi: 10.1016/j.sjbs.2014.12.001
12. Thai Land Development Department. (2013). Classification and kind of soil. Available from http://www.ldd.go.th/ldd_en/en-US/classification-and-kinds-of-soil/
13. Wada, H. (2011). Managing sandy soils in northeast Thailand. Formally of CSIRO Land and Water, Davies Laboratory, Townsville Australia now with International Water Management Institute, Bangkok Thailand.
14. Wongsomsak, S. 2010. Salinization in Northeast Thailand (Problem soils in Southeast Asia). Research Gate. Available from https://www.researchgate.net/publication/32159844_Salinization_in_Northeast_Thailand_Problem_Soils_in_Southeast_Asia
15. Yuwaniyom, A. (2003). Soil salinity management in the Northeast of Thailand. Soil Salinity Research and Development Section. Institute to Prevent Desertification and Warning Land Development, Ministry of Agriculture and Cooperatives. Available from http://www.sri.cmu.ac.th/~environment/Download/050505.pdf