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Soil Practices with relation to Soil Fertilities

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Abstract: Soil organic matter is often realized as an indicator of soil fertility, however, agricultural practices are expected to cause changed. This study was conduct to evaluate the relationship of soil practices and organic matter content. Fifty-eight plots were sampled (0- to 30-cm depth) from three different study areas. These are included two areas from high performance cropping system, and the remainder from low intensive practices. The soil management, including tillage, fertilizer and pesticide application, was also considered. To compare the difference of organic matter levels among three areas, together with fertilizer, pesticide and tillage practices, one-way ANOVA and the independent t-test were performed. The means of organic matter do differ significantly among three study areas ($P<0.05$) whereas these values do not differ significantly among the other factors considered in this research ($P>0.05$). Basic agricultural practices show the highest levels of organic matter. Evidence regarding intensive soil performance to obtain high economic yield is raised with result of this study.

Keywords Soil Organic Matter (SOM), agricultural practices, Thailand

Introduction

Organic substance in soil serves two main functions, namely, active organic fraction and resistant or stable fraction. The active fraction is more reliable indicator of soil fertility. There are many factors which directly influenced on soil organic matter (SOM), as cited by many experts (see Pouyat, Yesilonis and Nowak, 2006; Woodbury, Heath and Smith, 2006; Zach, Tiessen and Noellemefer, 2006). In cultivated soil, the active fraction is influenced mainly by previous management. However, in order to gain the highest economic yield, agricultural practices have been excessive in many areas of Thailand. The product outcome because of economic concern is becoming increasingly more desirable, with pesticides, chemical fertilizers application and intensive tillage.

The objectives of this study were to investigate the effect of soil management practices on organic matter content, as important indicator of soil fertility. Crop management was investigated in order to analyze relationship between soil fertility and those practices.

Materials and methods

Crop management practices by interview to gardeners and soil sample sampling was done through soil survey, only within the well-defined agricultural areas. Fifty eight soil samples (0-30 cm.) were collected from three provinces in the western region of Thailand (Figure 1). These are included twenty-one samples from Nakorn Pathom, twenty samples from Samut Sakorn and seventeen samples from Samut Songkram. With in these three provinces, crop system can be divided into two groups. The intensive management can be found at Nakorn Pathom and Samut Sakorn. In contrast, basic agricultural system can be normally found at Samut Songkram.

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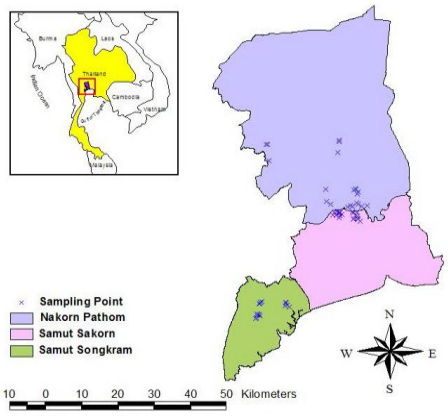

Figure 1. Project study areas and sampling points

Questionnaire method was conducted during the survey and gardeners were interviewed in order to investigate soil performance, including tillage (no-till, conventional tillage), fertilizer (no-used, compost, manure and chemical fertilizer used) and pesticide application.

SOM in form of active fraction was analyzed by Walkley-Black wet combustion method (Black, 1965). Relationships of SOM and soil management practices were compared by one-way ANOVA and the independent t-test.

Results and Discussion

Nakorn Pathom, Samut Sakorn and Samut Songkram are important agricultural areas of Thailand. Economic plants, especially tropical fruits are dominant vegetation. In order to produce the highest benefit, the gardeners in Nakorn Pathom and Samut Sakorn have also rapidly developed their lands by intensive used of fertilizer, pesticides and tillage practices. In contrast, many areas of Samut Songkram have still been cultivated under manure fertilizer and basic agricultural practices which allow a greater accumulation of organic matter. Chemical substances both fertilizers and pesticides have scarcely used. One of the main reasons is that land value of Nakorn Pathom and Samut Sakorn is high, comparing with Samut Songkram. The mixed land use between industrial and agricultural areas, without legal enforcement, can be normally found.

The basic of soil properties in these areas is not different. Clay is the main texture and pH is in between 6-8. Soil colour is yellow-red which the munsell value is mainly showed by 10YR, with eighty-six percentage of samples. Soil drainage is very poor.

According to the interview, fertilizer utilization is different (Figure 2). Consideration on each area (Tables 1 and 2), chemical fertilizer has been heavily applied in Nakorn Pathom and Samut Sakorn's crops to increase economic yields. Nearly one-fifth of both areas illustrated only chemical fertilizers. The mixture between chemical and manure fertilizers was mainly performed which response for twenty from forty-one cases. Chemical fertilizers have been highly demanded for almost samples because of the high competition to increase their yields within short period. In contrast with Samut Songkram, no-used fertilizer was presented for nearly one-third. Manure and compost fertilizers were traditionally applied. Seven cases of chemical used were found and, normally, were applied together with manure and compost fertilizers. Try to be organic farm is aimed so Samut Songkram's gardeners have established their own small groups to produce compost fertilizers. Gardener's attitude with respect to fertilizer application is one of the causes which affect crop practices. The case happening in Samut Songkram can emerge the challenge to promote organic farm to the other regions to sustain soil resource.

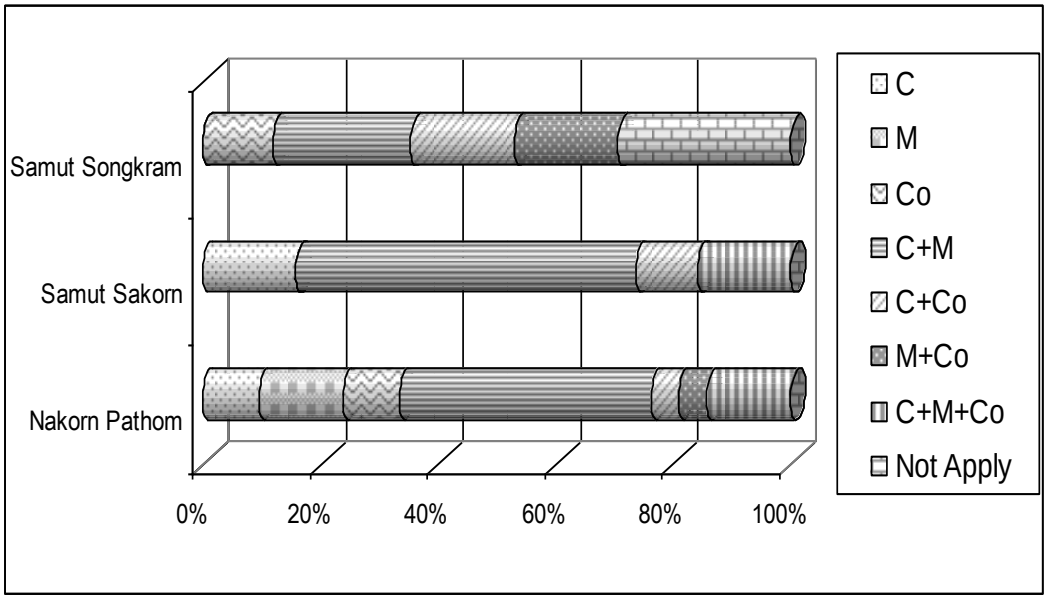

Figure 2. Percentage of fertilizer application

Table 1. Fertilizer application

Areas	Frequency of responses (number)								Total
	C	M	Co	C+M	C+Co	M+Co	C+M+Co	Nil	
Nakorn Pathom	2	3	2	9	1	1	3	0	21
Samut Sakorn	5	0	0	11	2	0	3	0	20
Samut Songkram	0	0	2	4	3	3	0	5	17

Note C = chemical fertilizer; M= manure fertilizer; Co=compost fertilizer

Table 2. Statistical values of SOM under fertilizer application

Nature of fertilizer application	Sizes	Mean SOM	SD.
C	5	6.99	1.01
M	3	5.13	3.16
Co	4	5.76	1.24
C+M	24	5.16	1.52
C+Co	6	5.99	1.98
M+Co	4	7.95	3.28
C+M+Co	6	7.15	2.84
Not Apply	5	5.89	1.56

Note No data for one sample

The results of pesticide and tillage practices were shown in the same ways as fertilizer. Pesticides were applied with the average of two months per time. From Table 3, pesticides were used for almost crops of Nakorn Pathom and Samut Sakorn whereas eleven from seventeen of Samut Songkram's crops was presented. Usually, pesticides were required for orange and rose apple trees and both are the main types of plant which produce high economic values for Nakorn Pathom and Samut Sakorn. In contrast with Samut Songkram, coconut is the main product and its nature has not usually been disturbed by any pests.

Table 3. Pesticide application

Areas	Frequency of responses (number)	
	Pesticides	No pesticides
Nakorn Pathom	19	2
Samut Sakorn	19	1
Samut Songkram	11	6

Hence, pesticide requirement according to plant types and fruit marketing competition have an effect on the amount of pesticide used. Again, pesticide used has not responded to SOM with any significant difference (P>0.05) in their average amount (Table 4).

Table 4. Statistical values of SOM under pesticides application

Nature of Pesticide used	Sizes	Mean SOM	SD.
Pesticides	49	5.97	2.14
No Pesticides	9	5.52	1.30

Tillage practices, for Nakorn Pathom and Samut Sakorn's crops illustrated fifteen and eighteen respectively, have been done both common ways, with every one month in average, and intensive tillage, with at least two years per time (Table 5). Surprisingly, SOM in crops with no tillage showed slight more SOM, with no significant difference, than crops with conventional tillage (Table 6). The result found that only one site in Samut Sonkram illustrated tillage practices.
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Table 5. Tillage practices

Areas	Frequency of responses (number)	
	Conventional tillage	No tillage
Nakorn Pathom	15	6
Samut Sakorn	18	2
Samut Songkram	1	16

Table 6. Statistical values of SOM under tillage practices

Tillage practices	Sizes	Mean SOM	SD.
Conventional Tillage	34	5.61	1.94
No Tillage	24	6.19	2.00

Soil fertility in this research was considered by SOM content. From statistical results, the average percentage of SOM at Nakorn Pathom, Samut Sakorn and Samut Songkram were 5.27, 5.73 and 6.86, respectively. Statistical result by one-way ANOVA illustrated significant difference (P<0.05) of SOM in these areas. Statistical relationship of the amount of SOM can be separated into two groups (Table 7). Those are the groups of Nakorn Pathom and Samut Sakorn and the second is the groups of Samut Sakorn and Samut Songkram.

Table 7. Statistical relationships of SOM

Areas	Sizes	Mean SOM	SD.
Nakorn Pathom	21	5.27^{a}	2.21
Samut Sakorn	20	5.73^{ab}	1.72
Samut Songkram	17	6.86^{b}	1.89
Total	58	5.90	2.03

Consideration on SOM and their management practices including fertilizer application, pesticide application and soil preparation, no statistical relationship was shown. Poor physical properties resulting from chemical fertilizers and intensive tillage have led to further depletion of SOM. The result shows that soil management which considerably practices for Thai gardeners' tradition is not necessary to reverse soil fertility. The budget of fertilizer and pesticides are predominant

comparing with the other agricultural practices. From SOM analysis, it is clear that SOM of Samut Songkram's crops, which have not been intensive developed, shows the highest, comparing with the other two.

For pesticide application, Farenhorst (2006) indicated that SOM is the single most important soil constituents influencing pesticide sorption in soils. From this study results, SOM of Nakorn Pathom and Samut Sakorn, which presented ninety-three percent of pesticide application, was less than Samut Songkram, which applied pesticide sixty-five percent. Hence, pesticide costs may be unnecessary for Nakorn Pathom and Samut Sakorn resulting from their amount of SOM.

The questions regarding the amount of fertilizer required and pesticide application to obtain economic optimum yield are raised with result of this study. In point of fact, organic and clay particles can hold to nutrients in soil. Soil textures in this study area are mainly clay which cannot change its amount, organic levels can easily decrease or increase by soil performance. Many gardeners neglect this valuable resource by tilling excessively which can cause the loss of organic matter by greater removal of plant nutrients and less opportunity for nutrient cycling. Consequently, these directly affect the declining of nutrient holding capacity.

Conclusion

There was a clear need of greater sustainable management. Basic agriculture system can allow the limited removal of soil nutrients since they can return the nutrients back to the land. Long term management is considerably required. Soil in which manure and compost fertilizers used illustrated the highest amount of SOM (Figure 3). Chemical fertilizer application and rapid soil practices have long term effect on soil properties, particularly SOM which resulted in this study.

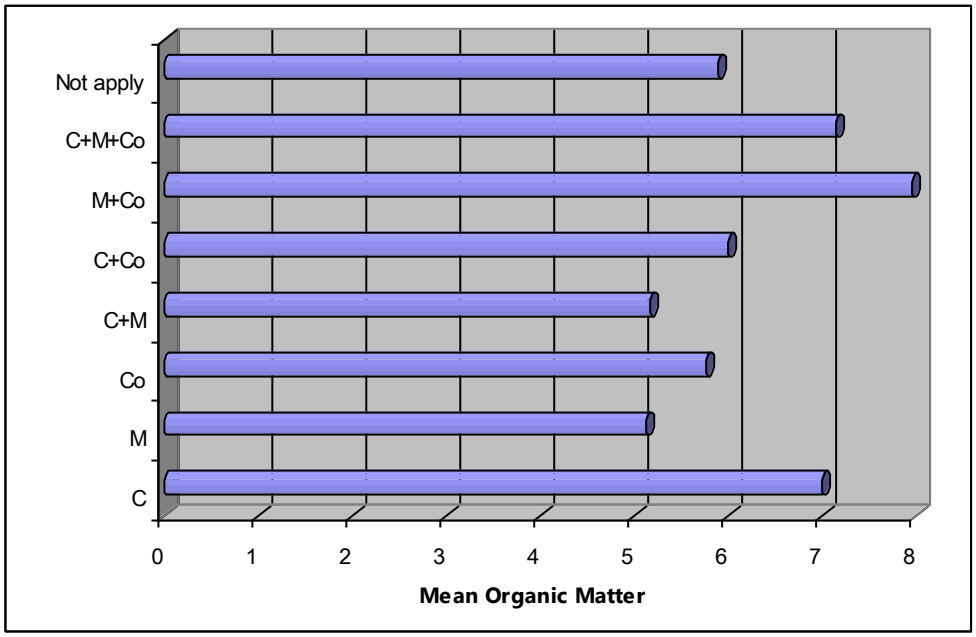

Figure 3. Mean of SOM with different fertilizer application

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