University of the Philippines
OPEN UNIVERSITY
Journal of Management and Development Studies

Journal of Management and Development Studies 3: 50-61, 2014
Online ISSN 2350-8434

SOIL TEST KIT: AN EXTENSION TOOL OF CENTRAL BICOL STATE UNIVERSITY OF AGRICULTURE (CBSUA), PILI, CAMARINES SUR, PHILIPPINES

Narses S. Detera*, Jesus P. Togñi Jr, Kristine G. Salazar and Mary Ann A. Saño
Central Bicol State University of Agriculture(CBSUA), Pili, Camarines Sur, Philippines
Corresponding author*: narsesdetera@yahoo.com

ABSTRACT – The soil fertility status assessment using Soil Test Kit of the Department of Agriculture can be an immediate help to farmers located near CBSUA and the whole province. The fertility status will be determined in terms of the nitrogen (N), phosphorous (P) and potassium (K) levels in the soil. The study aimed to : (1) determine the nitrogen (N), phosphorous (P) and potassium (K) and pH of agricultural lands in Cadlan, San Agustin and Sagurong, Pili, Camarines Sur using Soil Test Kit (STK); (2) formulate fertilizer recommendations and integrated nutrient managements for the agricultural lands in the three areas selected and (3) determine how can STK be an extension tool of CBSUA. Rice, corn and sugarcane were the common crops grown in the three sites. Coconut and some vegetables were grown in San Agustin and Cadlan, respectively. The soil pH of soils in the three sites ranged from moderately acid (pH 5.4) to slightly acid (6.0). The N, P and K status differed in three areas. In Cadlan, low, medium and high N status; in San Agustin, medium N status and in Sagurong, low and medium N status were observed. In Cadlan and Sagurong, results showed low, medium and high P status while in San Agustin, only low and medium P status. In Cadlan and Sagurong, there are K deficient and K sufficient areas. In San Agustin, the K status is sufficient. Based on the qualitative description of soil testing using soil test kit, results can be converted to recommended rate. For example, in rice, the recommended rate for medium N is 30-60 kg per hectare during wet season and 45-75 kg per hectare in dry season. The low, medium and high fertilizer recommendations can be computed based on the Soil Test Kit Manual. Other management practices that can be recommended are: addition of organic matter; and no burning of rice straw, instead it should be turning under the rice straw or convert to compost. STK can be re-introduced by the university as an extension tool for the farmers, to estimate the right amount of fertilizers to be applied in their farms, in the barangays under the CBSUA's Adopt-A-Community Program.

Key words: fertility status, soil test kit, fertilizer recommendations

INTRODUCTION

Central Bicol State University of Agriculture (CBSUA), one of the major agricultural universities in Bicol Region, is mandated to do extension activity. Among its clienteles are the farmers in the nearby barangays of the province of Camarines Sur. However, not all farmers understand the importance of soil fertility status in the fertilization of their crops.

In seminars and informal interviews conducted by CBSUA with farmers in the various barangays of Camarines Sur, they were asked: "What is the basis of the amount of fertilizers they applied on to their crops?" The farmers' answers were based on their own experiences and that of other farmers - using data on their previous produce as well as the growth and stand of the crop. The access of the famers on soil testing could vary, from easy to difficult, while others may opt not to submit their soil samples for analysis.

Hence, the Bachelor of Science in Agriculture students, major in Soil Science of CBSUA, residing in these nearby areas are encouraged to help uplift the standard of living of Bicolano farmers. They can do this by helping the farmers gain necessary information, and technologies to enhance their farm productivity.

Soil testing is one of the important management practices in crop production for the new millennium. Industry and university agronomists, consultants, and farm managers utilize soil testing for the benefit of their farmer clients. Periodic soil testing, combined with a good record-keeping system for each field, which include information on prior soil tests, fertilizer and manure applications, and crop yields, serves as a gauge to measure if soil fertility is increasing, decreasing, or remaining constant (The Mosaic 2015).

The fertility status of the soil provides information on its ability to supply the adequate amount of nutrients to the plants. A soil test, or soil analysis, is a quick and precise method of evaluating soil fertility status. The underlying principle of soil testing is that the amount of nutrient extracted by the chemical reagents at any one time is the amount available throughout the growth period of the crop (Badayos, et al., 2005).

Soils often contain high amount of nutrients, but the majority of nutrients are in solid form. Plants take up nutrients in solution; and therefore many of the solid nutrients may be unavailable for their use. For example, a soil may contain 5,000 pounds of potassium per acre but only 50 pounds may be available for a crop. The trick to soil analysis is to determine the amount of nutrient that is immediately available, as well as the nutrient and its amount that can be available during the crop's growth (Agro Services International Inc., 2012).

The methods in soil analysis are the laboratory soil test and soil test kit (STK). The laboratory soil analysis takes longer time, and requires chemicals, technical manpower and instruments. On the other hand, STK is cheaper and can be finished in less than an hour. STK has been studied extensively and its results are acceptable, with precision comparable to the results in the laboratory testing, when used properly (PCARRD, 1999).

STK is an inexpensive, quick and handy tool for soil testing tool (BSWM). UPLB developed a soil test kit to make available to farmers and other end-users affordable and accessible soil analytical services. STK gives a qualitative or approximate fertility status of the soil; and results are sufficient for a fertilizer recommendation to be made for

specific crops, and thus, eliminating much guesswork of the nutrient need of the soil (UPLB 2013).

The soil analysts at Regional Soils Laboratory of Department of Agriculture (DA) in Naga City mentioned that only few farmers have their soils analyzed at the laboratory.

One of the specific interventions of the on-going Agri-Pinoy Rice Program of DA, from 2011-2016, is its support to soil laboratories and establishment of mobile soil clinics.

A study on "Mobile Soil Test Clinic to Enhance Farm Productivity" was soft launched on 4 June 2014 during the 63rd anniversary of Bureau of Soil and Water Management (BSWM Online, DA). The Tipid Abono Fertilization Program (TAFP) of DA has conducted soil analysis using Soil Test Kit (STK), Rapid Soil Test (RST), and laboratory analysis as part of its monitoring scheme. They wanted to confirm and determine in situ the soil nutrient status and plant nutrient uptake using plant tissue samples (BSWM, 2007).

However, in-depth literature search did not reveal any study to date on the use of soil test kit in different provinces of the country.

Bringing the soil testing laboratory to the farmer's field will mean lesser cost and easy access for the farmers. The basic aim of the soil testing service is to provide farmers a basis for better and efficient use of fertilizers, as well as better soil management practices to increase agriculture production. High crop yield cannot be obtained without applying sufficient amount of fertilizers to overcome existing deficiencies.

Thus, soil fertility status assessment using DA's Soil Test Kit can be an immediate help to these farmers. The fertility status was determined in terms of the nitrogen (N), phosphorous (P) and potassium (K) levels in the soil.

This study was conducted in three different barangays of Pili, namely: Cadlan, San Agustin and Sagurong in 2010, 2009 and 2008, respectively. The specific objectives of the study were to: (1) determine the fertility level of the soil with N, P and K as indices and soil pH of agricultural lands in Cadlan, San Agustin and Sagurong, Pili, Camarines Sur, using Soil Test Kit (STK); (2) formulate fertilizer recommendations and integrated nutrient managements (INM) for the agricultural lands in the three selected areas; and (3) determine how can STK be an extension tool of CBSUA.

METHODOLOGY

A pre-field survey was done. Information on soil classification and land uses were taken from the soil report maps of the barangays. Grid method of soil sampling was used in the study. The area was traversed in the distance of 100 meters. A straight line using a long stretch string marked at 100 meters was used. Each horizontal and vertical intersect represents boring holes where soil samples were taken.

Global positioning systems (GPS) was also used to determine the latitude and longitude of the sample site. Each spot sample has a corresponding GPS reading. Example: Barangay San Agustin point 36, N 13° 33' 50.3''and E 123° 15' 52.4". The number of auger borings for Sagurong, Cadlan and San Agustin were: 53, 49 and 63, respectively. Soil sampling was performed on the three sites up to 30 cm depth. Each barangay was

considered as one site. Sagurong has a total land area of 311 ha and 6 zones. Cadlan has 890 ha and 5 zones, while San Agustin's total land area is 776 ha with 5 zones. The base maps of the three sites are shown in Figures 1a to 1c.

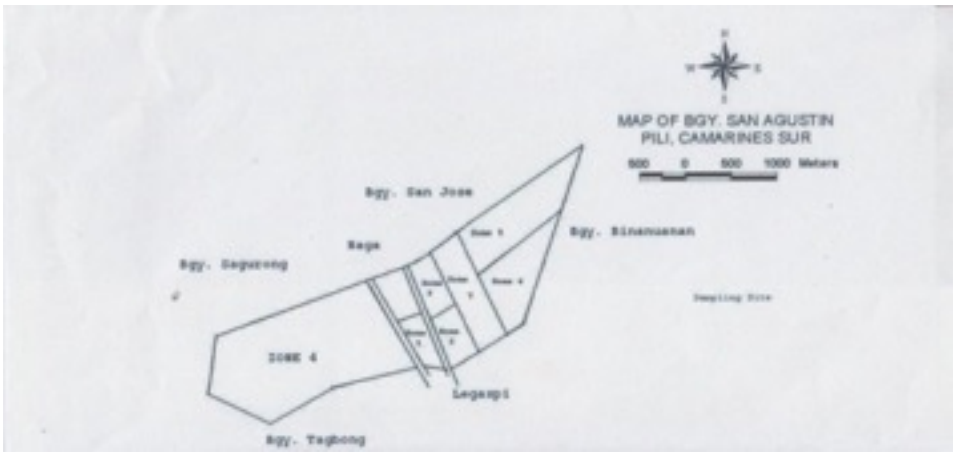

Figure 1a. The Base Map of Barangay San Agustin, Pili, Camarines Sur

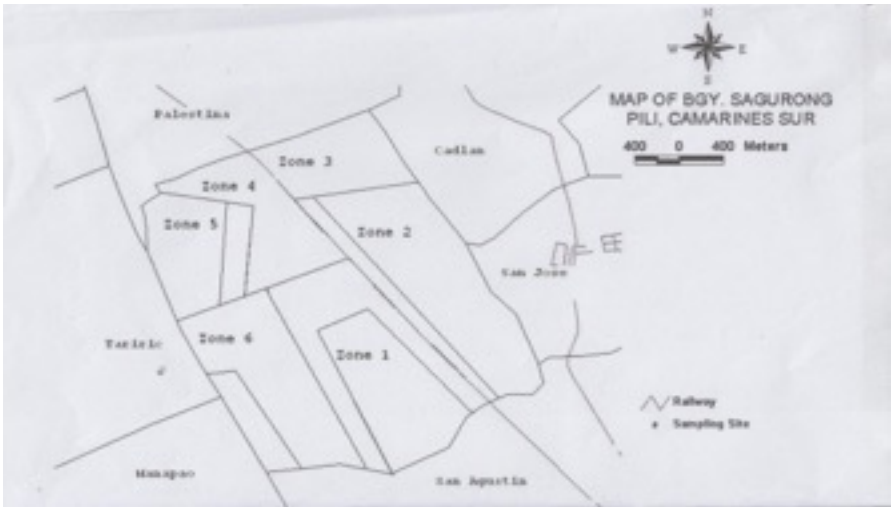

Figure 1b. The Base Map of Barangay Sagurong and Cadlan, Pili, Camarines Sur

Barangays Sagurong, San Agustin and Cadlan were also included as study sites in a related research done by the author. In said study, the farmers were asked whether they have their soils analyzed using soil test kit prior to planting. The results formed part of this study.

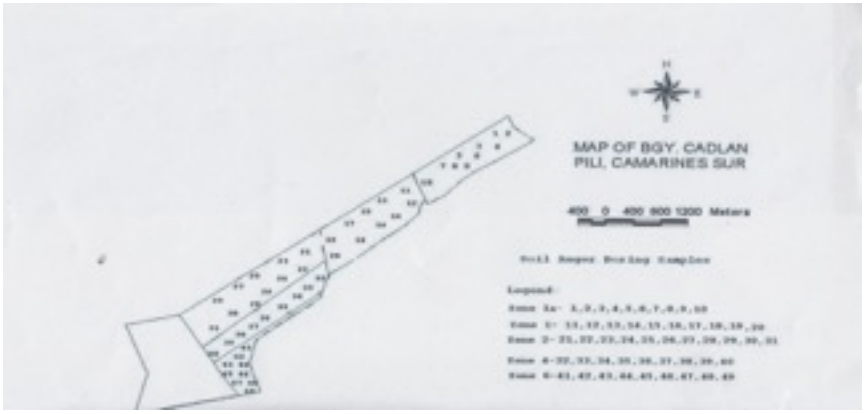

Figure 1c. The Base Map of Barangay Cadlan, Pili, Camarines Sur

RESULTS AND DISCUSSION

Summary of the Soil Test using STK

The summary of the soil test on N, P, K and pH of agricultural lands in San Agustin, Sagurong and Cadlan, Pili, Camarines Sur, Philippines is shown in Table 1.

Soil pH. The soil pH of soils in the three experimental areas ranged from moderately acidic (pH 5.4) to slightly acidic (6.0). In San Agustin and Cadlan, the soil pH ranged from 5.4 to 6.0. The soil pH in Brgy. Sagurong ranged from 5.4 (moderately acidic) to 5.8 (slightly acidic).

Based on the relationship of pH with the availability of nutrients, N, P, K, calcium (Ca), magnesium (Mg) and sulfur (S) started to decrease at pH 5.5. However, iron (Fe), aluminum (Al) and hydrogen (H) increased at low pH.

The pH requirement of rice is 6.0 to 6.5 and for corn and sugarcane, pH 6.0 to 8.0 (Badayos et al, 2005). As noted there were areas in Cadlan and San Agustin with pH 6.0. These soils are suited to rice, corn and sugarcane. However, in Brgy. Sagurong, the highest soil pH is 5.8 which is lower than the requirement fo rice, corn and sugarcane.

Nitrogen (N). Nitrogen is necessary for chlorophyll synthesis and involved in photosynthesis. It is also a component of vitamins, amino acids and energy system within the plants. N is also directly responsible for increasing protein content in plants. (Periodic table of crop nutrients: Nitrogen).

The nitrogen status differed in three areas. In Cadlan, low, medium and high N status; in San Agustin, medium status while in Sagurong, low and medium N status. In Cadlan, soils low in N was planted with corn; in medium N soils, sugarcane, corn and rice were grown. Soils with high N were rice lands. In Sagurong, soils with low N were planted with rice, coconut and sugarcane while with medium N was planted with corn.

Phosphorous (P). The P status differed for the three areas. In Cadlan and Sagurong, there was a low, medium and high P status while in San Agustin, low and medium P status only.

Table 1. The summary of the soil test using STK of agricultural lands in San Agustin, Sagurong and Cadlan, Pili, Camarines Sur, Philippines

Site	Soil Test Result(N-P_2O_5-K_2O)	Soil pH	Soil samples
San Agustin	Medium-Low-Sufficient	5.4	12
	Medium-Low-Sufficient	5.8	19
	Medium-Low-Sufficient	6.0	23
	Medium-Medium-Sufficient	5.4	3
	Medium-Medium-Sufficient	6.0	6
Sagurong	Low-Low-Sufficient	5.4	22
	Low-Low-Sufficient	5.8	13
	Low-Medium-Sufficient	5.4	5
	Low-High –Sufficient	5.4	3
	Low-High-Deficient	5.8	3
	Medium-Low-Sufficient	5.4	4
	Low-High-Deficient	5.8	3
Cadlan	Medium-Low-Sufficient	5.8	10
	Low-Medium-Sufficient	5.4	9
	Medium-Low-Deficient	5.4	3
	Medium-Low-Deficient	6.0	9
	High-Low-Sufficient	5.8	9
	High-Low-Sufficient	5.4	9

Phosphorus is a vital component of adenosine triphosphate (ATP), the "energy unit" of plants. ATP is needed from the beginning of seedling growth up to the formation of grain and maturity. Some specific growth factors associated with P are: stimulated root development, increased stalk and stem strength, improved flower formation and seed production, more uniform and earlier crop maturity, increased nitrogen- fixing capacity of legumes, improvements in crop quality, and increased resistance to plant diseases. Periodic table of crop nutrients: Phosphorous).

Potassium (K). The K status also differed for the three areas. The K status has two descriptions only, sufficient and deficient. In Cadlan and Sagurong, there is K deficient and sufficient areas. In San Agustin, the K status is sufficient.

Potassium plays a regulatory role in the plants; essential in nearly all processes needed to sustain plant growth and reproduction such as photosynthesis, translocation of

photosynthates, plant respiration, protein synthesis and many others (Periodic Table of Crop Nutrients: Potassium).

Crops grown. The common crops planted in the three barangays were: rice, corn and sugarcane. In San Agustin, additional crop was observed, coconut. In Cadlan, some vegetables were planted. The areas planted with different crops for Cadlan and San Agustin is shown in Figures 2a to 2b.

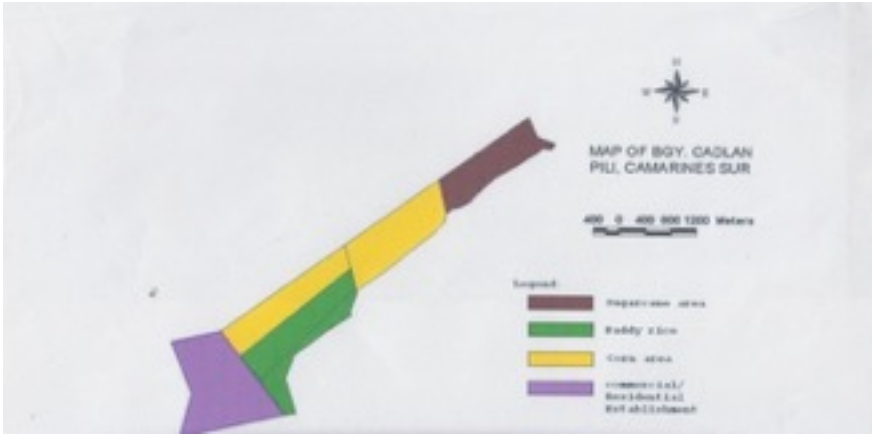

Figure 2a. Crop Map of Cadlan, Pili, Camarines Sur.

Figure 2b. Crop Map of Sagurong, Pili, Camarines Sur

Based on the table of Soil pH preference of some agricultural crops, the pH preference of rice, 6.0-6.5; corn, 6.0-8.0; and sugarcane, 6.0-8.0. The soil pH in Sagurong ranged from 5.4-5.8. Compared with the pH preference for rice, corn and sugarcane, the pH of the area is not suitable for these crops.

Soil Fertility Management Practices. Based on the qualitative description of soil testing using soil test kit, it can be converted to recommended rate. For example, in

rice, the recommended rate for medium N is 30-60 kg per hectare during wet season and 45-75 kg per hectare in dry season. For the same crop: low P at 50-60 kg/ha for dry and wet seasons. For deficient K, 0-30 kg per hectare for both seasons is recommended. The low, medium and high fertilizer recommendations can be computed based on the Soil Test Kit Manual.

The fertiliser recommendations (FR) or recommended rate(RR) for field crops in San Agustin, Pili, Camarines Sur are shown in Table 2. This is done based on the STK results. The STK manual is the reference of the fertilizer recommendation in Table 2.

Table 2. Fertilizer recommendations for field crops in San Agustin, Pili, Camarines Sur

Crop	**Nitrogen (kg/ha)**	**Phosphorus (kg/ha)**	**Potassium (kg/ha)**
Rice			
Wet season	30-60	50-60	0-75
Dry season	45-75	50-60	0-30
Banana	40-50	20-50	0-50
Vegetables			
Pechay	30-90	20-50	20-50
Eggplant	30-60	20-60	20-50

In a study on farmers' awareness and adoption of soil testing in Camarines Sur (2012), San Agustin, Sagurong and Cadlan were included on the area covered. Five out of 8 farmers in San Agustin submitted their soil samples for soil test once to 3 times in 1975, 1976, 2006 and 2009. Soil samples were submitted to Regional Soils Laboratory (RSL), Department of Agriculture. In Sagurong, one out of 3 farmers interviewed have submitted soil samples for testing in 2000. The only farmer interviewee in Cadlan did not submit sample for soil testing.

However, in Brgy. San Agustin, the farmers interviewed did not submit soil samples for testing. The results in Table 2 can be used by the farmers in their fertilization plan for their farms.

The summary of the cultural management practices in Brgy. San Agustin is shown in Table 3.

The farmers can use the amount of fertilizers based on STK as one of their management practices. By doing so, they will be able to save money since the fertilizers applied are the needed nutrients of the crops. Based on the inorganic fertilizer used, 3 to 6 bags complete fertilizer (CF) supplied 21 to 42 kg of N, P_2O_5 and K_2O per hectare, and 2 to 6 bags urea supplied 46 to 138 kg N. Based on the computation, the farmers applied more than the needed N and K_2O and less P_2O_5 per hectáre.

Other management practices that can be recommended are: (1) adding organic matter (OM); and (2) turning under the rice straw or converting it to compost, instead of burning them.

Table 3. The farm management practices in Brgy. San Agustin, Pili, Camarines Sur.

Farm Management Practices	Description of Activity
Fertilization	Use of complete fertilizer (CF), 3-6 bags and urea, 2-6 bags
Organic Matter Maintenance/ Utilization of Organic Materials	Rice straw plowed under Gather rice straw, decompose and spread(to know its effects in soil and plants)
Cropping pattern	Monoculture (Rice-rice-rice) Multiple cropping (eggplant. Pechay)
Organic materials(rice straw)	Burning
Tillage	Use of tractor Bolo for eggplant and pechay site
Variety of Seeds	RC 10
Water source	Natural irrigation
Soil testing using STK	Did not submit soil samples

Soil Test Kit as Extension Tool of CBSUA

CBSUA's Adopt-A-Community Program is one of the modalities in their delivery of extension services to partner communities such as schools, cooperatives and barangays. Its aim is to transfer the technologies and good practices developed by the university to the target clientele, depending on their needs. The soil test kit can be used by the university as an extension tool for the farmers, to estimate the right amount of fertilizers to be applied in their farms, in the barangays that will be adopted by CBSUA.

Towards this end, farmers in Barangay San Agustin were interviewed about STK - in terms of awareness of soil testing and its usage. The results revealed that they encountered some problems with the use of STK. They said that the results of the soil test were either not received by the farmers, or took longer before these were received. Hence, the farmers were not encouraged to use the STK regularly despite knowing its importance in applying the right amount of fertilizers for their crops.

STK can be re-introduced to the farmers in adopted barangays through concerted efforts of the CBSUA agriculture students and faculty of College of Agriculture and Natural Resources. Soil Science 2 students conduct soil testing during the 1st semester of each academic year. Their actual soil test using STK can be done on the farmer's site. Students whose parents have farms can conduct the test in their own farms. For students without own farms, they can adopt farmers in their respective localities.

CONCLUSION

The soil pH in the three barangays ranged from 5.4 to 6.0, which are considered moderate to slightly acidic. In Sagurong, soil pH ranged from 5.4 to 5.8. These pH values were lower than the pH preference of commonly grown crops such as rice, corn and sugarcane.

The N status ranged from low to high in Cadlan; low to medium in Sagurong; and medium in San Agustin. However, the P status in Cadlan and Sagurong ranged from low to high; while San Agustin had low to medium phosphorus. In San Agustin, the soil was K sufficient. Potassium deficient areas were observed in Cadlan and Sagurong.

These results in STK for each location can be converted to recommended rate (RR) using the Soil Test Kit Manual. Farmers use the RR in their decision on fertilizer scheme and schedule. By doing so, they will be able to save money since the fertilizers to be applied are the needed nutrients of the crops.

STK can be re-introduced by the university as an extension tool for the farmers. They will be able to estimate the right amount of fertilizers for application in their farms that are within the barangays under the CBSUA's Adopt-A-Community Program.

RECOMMENDATIONS

Based from the results, easy-to-read and understand brochures and pamphlets can be prepared and distributed to the farmers, with the recommendation to regularly monitor the nutrient content of the soil. For all sites, the survey on soil fertility management practices will be part of another study. Also, yield data will be gathered to correlate with the soil test results.

Survey of the soil fertility management practices of farmers in Cadlan, Sagurong and nearby area in CBSUA can be also be done.

The farmers in the study area will be asked to fill up forms related to their crop and soil data. The information will be considered in the formulation of fertilizer recommendations and the INM for each site.

Moreover, the Soil Fertility Map of the three site and other barangays in Pili, Camarines Sur can be made under the program of Department of Agriculture through RSL. Thus, this is a venue for the extension activity of Central Bicol State University of Agriculture in collaboration with the concerned Local Government Units.

STATEMENT OF AUTHORSHIP

The first author conducted the survey on farmer's awareness, formulated recommendations, undertook the writing and served as the adviser of the undergraduate students. The second, third and fourth author conducted the experiments at different locations.

REFERENCES

Agro Services International Inc. What is Soil Analysis? Retrieved from http://www.agroservicesinternational.com/Soil%20Analysis/What%20is%20Soil%20analysis.html on June 9, 2012.

Badayos, R.B., R. L. Castillo. J.I. Clar De Jesus, W. C. Cosico and P.B. Sanchez. (2005). Revised Soil Science 1 Laboratory Manual. Soils and Agro-Ecosystems Division, Agricultural Systems Cluster, College of Agriculture, UP Los Baños, Laguna.

CropNutrition.com (n.d.). Best Management Practices: Soil Testing. Retrieved from http://www.cropnutrition.com/best-management-practices-soil-testing. Retrieved on May 18, 2015.

Department of Agriculture. (2012). Agri-Pinoy Rice Program. Retrieved from http://www.da.gov.ph/index.php?option=com_content&view=article&id=11:agri-pinoy-rice-program&catid=10:programs&Itemid=12 Retrieved on May 18, 2015.

Detera, Narses S. (2012). Farmers' Awareness and Adoption of Soil Testing in Camarines Sur. Unpublished Terminal Report. Central Bicol State University of Agriculture,Pili, Camarines Sur.

Jalalon, Maribel R. (2014). Soft launching of BSWM initiatives on the upgrading of Soils Laboratory on June 4, 2014 during the 63rd Anniversar. Retrieved from http://www.bswm.da.gov.ph/article/0029/soft-launching-of-bswm-initiatives-on-the-upgrading-of-soils-laboratory-on-june-4-2014-during-the-63rd-anniversary on May 18, 2015.

Periodic Table of Crop Nutrients: Nitrogen. Retrieved from http://www.cropnutrition.com/nutrient-knowledge on May 19, 2015.

Periodic Table of Crop Nutrients: Phosphorous. Retrieved from http://www. cropnutrition.com/nutrient-knowledge on May 19, 2015.

Periodic Table of Crop Nutrients: Potassium.Retrieved from http://www. cropnutrition.com/nutrient-knowledge on May 19, 2015.

Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD). (1999). The Philippine Recommends for Soil Fertility Management, Los Baños, Laguna. Philippine Recommends Series No. 36-C.

Salazar, Kristine G. (2009). Fertility Status of Agricultural Lands in Barangay San Agustin,Pili, CamarinesSur. Unpublished Thesis. CBSUA, PIli, Camarines Sur.

Saño, Mary Ann C. (2010). Fertility Status of Soils in Barangay Sagurong, Pili, Camarines Sur. Unpublished Thesis. CBSUA, Pili, Camarines Sur.

Togñi, Jesus Jr. (2009). Fertility Status of Agricultural Lands in Barangay Cadlan, Pili, Camarines Sur. Unpublished Thesis. CBSUA, PIli, Camarines Sur.

University of Minnesota Extension. (n.d.).Nutrient cycling and maintaining soil fertility in fruit and vegetable production. Retrieved from http:/www.extension.umn.edu/garden/fruit-vegetable/nutrient-cycling-and-fertility/#soil-testing on May 18, 2015.

University of the Philippines Los Baños. (2013). Compendium of UPLB Technologies. Office of the Vice Chancellor for Research and Extension. College, Laguna. http://uplb.edu.ph/phocadownload/publications/CompendiumofUPLBTechnologies.pdf