Research article

Study on Use of Plant Based Material as a Fertilizer

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Abstract Soil is the mixture of mineral, organic material, living organisms, air and water that together support the growth of plant life. Fruit peels contain potassium, vitamins, minerals and some essential elements which enhance the growth of plant. Generally, fruit peels are thrown in garbage and it goes to solid waste dumping site. That causes odour problem due to degradation of peel content in dumping site. The present study deals with the utilization of different fruit peels such as orange peels and banana peels as fertilizer added to soil. The soil sample was collected from Shar-Taw-Lay village, Amarapura Township, Mandalay, Myanmar. Three soil samples were investigated by addition of organic waste fruit peel powder of orange and banana. Soil sample, S_1 (2000 g soil) as control, soil sample, S_2 (2000 g soil + 500 g orange peel powder) and soil sample, S_3 2000 g soil + 500 g banana peel powder) and soil sample, S_3 (2000 g soil + 500 g banana peel powder) were fertilized soil. The physicochemical properties of three soil samples such as pH, electrical conductivity, organic matter and texture were determined. The elemental composition of three soil samples was measured by applying EDXRF. The content of N, P, K nutrients of three soil samples was determined by chemical instrumental method. Different fruit peel powders add soils to compare the plant growth were investigated. The chemical fertilizers can be replaced by the fruit peel powder to protect the soil from the infertility. This fruit peel materials have not cost bearing and thus aids in converting this waste into a usable resource.

Keywords fertilizer, fruit peel powder, nutrient, soil

INTRODUCTION

Soil is important because it provides the nutrients that plant need to grow. Without soil, there would be no plants, without plants, there would be no foods, without food, animals could not survive. Soil is relating with fertilizer. Soil is needed the fertilizer that is one of the sources for plant growth. There are two types of fertilizer used in agriculture, organic fertilizer and inorganic fertilizers. Organic fertilizers are fertilizers derived from animal or vegetable matter (eg. compost, manure). Inorganic fertilizers are produced or artificially in a chemical refinery. Fertilizers typically provide in varying proportions. Good fertility is fundamental to success full plant growth, and the application of fertilizers and manures is an essential graining act activity. The maintenance of adequate levels of nutrients in soil is essential for healthy plant growth; cheapest and harmless materials can be used for the plant growth. Fruits contain a high amount of antioxidants that are beneficial to our health in many ways. The fruit peels have nutrients like potash, iron, zinc, calcium, citrate content etc. In addition, among the many fruit sample, orange and banana are traditional food, main consumed for Myanmar people and well cultivated for everywhere in Myanmar. Therefore, fruit sample orange and banana were chosen in this research.

OBJECTIVE

The present work was to investigate how the changes in physical and chemical properties by adding banana peel powder and orange peel powder to the soil from Shar-Taw Lay village, Amarapura Township, Mandalay, Myanmar. Discard substance of orange peel powder and banana peel power into usable product as fertilizer that cheapest and harmless material can be used for the plant growth.

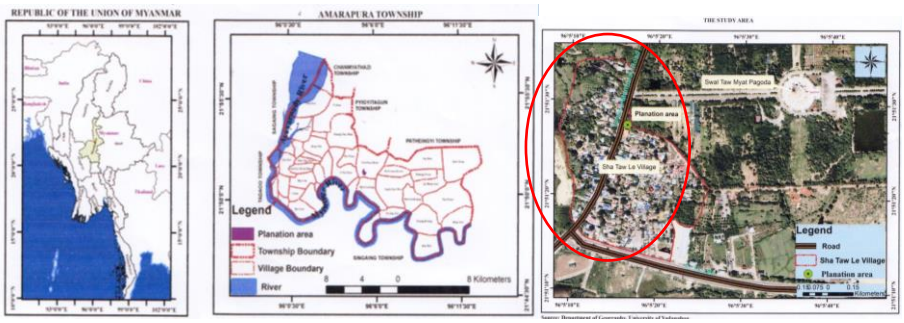


Fig. 1 Map of study area

METHODOLOGY

The soil samples were collected from Shar-Taw Lay village, Amarapura Township, Mandalay, Myanmar. These soil was chosen for this study because these soil was supplied by natural fertilizer such as cowdung, dry peat leaves before harvested. These selected soil sown so many crops and paddy. The soil samples were dug the depth 20 cm from the earth surface in the study area and were put in thick plastic bags. The soil normally contain clay, pebbles, root, rock pieces, these soil is sieved by using 2 mm sieve to remove the pebbles, root, rock pieces. The soil samples were air-dried and were crushed into fine powder by using grinder. This dried soil was packed in sterile polythene bags and sent to soil quality center, Department of Agricultural Research, Yezin, Nay-Pyi Taw, Myanmar.

Collection and processing of fruit peel:

Generally fruit peels are collected from fruit juice vendors or thrown in garbage by peel household. Discard fruit peels (orange peel and banana) are cut into small pieces and dried in air. After drying of these peels into powder by using blander.

Orange peel | Orange peel powder | Banana peel | Banana peel powder

Fig. 2 Different fruit peel and fruit peel powder

Preparation of fruit peel powder in soil:

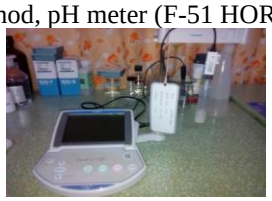
Orange peel powder (500 g) and soil (2000 g) mixed with 300 mL of distilled water as soil sample, S_2 were added to the pot. The amount of water to add was calculated by field capacity method. The fertilized materials were weighed every 2 weeks and the loss of weight was re-filled with water. Banana peel powders were prepared for the above as soil sample S_3 and without peel powder as soil sample S_1. After composting 45 days, these two soil samples sent to soil quality center, Department of Agricultural Research, Yezin, Nay-Pyi-Taw, Myanmar.

Control soil sample S_1 (2500 g)

Soil sample- S_2 Soil 2000 g + 500 g orange peel powder

Soil sample-S_3 Soil 2000 g + 500 g banana peel powder

(1) pH, 1 : 2.5 soil: Water suspension method, pH meter (F-51 HORIBA)



(2) Electrical conductivity (EC), Saturation extract method, conductivity meter (DS-51HORIBA)

(3) Organic matter, Tyurin's method, Analytical balance

(4) Soil texture, pipette method, Analytical balance

(5) Moisture, Gravimetric method, Temperature controlled oven

(6) Total N, Kjaldehl distillation method, Gerhardt Vapodest20s

(7) Total P, Molybivanado phosphoric acid method, UV-visible Spectrophotometer Jenway 6305

(8) Total K, Wet digestion with HNO_3 : $HClO_4$ (4 :1), Atomic Absorption Spectrophotometer, NOV AA-400

(9) Elemental percent composition, powder-pellet, EDXRF

Fig. 3 Control soil and fruit peel powder in soil analytical item, analytical method, apparatus used

In this study, the pH, electrical conductivity (EC), organic matter, texture, moisture, total N, P, K and Elemental percent composition of control soil sample S_1, orange peel powder soil sample S_2, banana peel powder soil sample S_3 were measured at Department of Agricultural Research, Yezin, Nay-pyi-daw, Myanmar.

The pH of three soil samples were measured by water suspension method using pH meter. Electrical conductivity (EC) was also measured by saturation extract method using conductivity meter. Organic matter of soil samples S_1, S_2 and S_3 were determined Tyurin's method using Analytical balance and also measured soil texture by pipette method. Moisture for three soil samples were known by Gravimetric method using temperature controlled oven. Three soil samples S_1, S_2 and S_3 were measured by Kjaldehl distillation method for Total N, Molybivanado phosphoric acid method for Total P and wet digestion with HNO_3 : $HClO_4$ (4 : 1) for Total K by respective apparatus and also determined elemental percent composition by EDXRF.

Pot experiment of chili plants and pea plants:

Effects of prepared fertilized soil sample with chili and pea plants were investigated by pot experiment.

Pot experiment of chili plants:

Duration from time of emergence of chili plant to the end of time period was 45 days work. According to result, increase the time period with increasing of plant growth of fertilized soil sample S_2 and S_3.

RESULTS AND DISCUSSION

Table 1 Result of growth length of chili plant on control soil and prepared fertilized soil

Time frame day	Plant height (cm)		
	Soil sample S_1	Fertilized soil sample S_2	Fertilized soil sample S_3
12	8.6	11.7	12.5
24	13.5	20.6	21.4
36	22.7	37.5	38.5
45	33.6	54.5	55.6

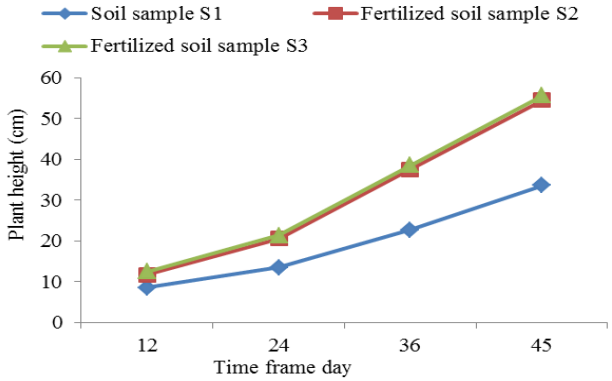


Fig. 4 The plot of growth length of chili plant cultivated on prepared fertilized soil sample versus time frame day

Table 2 Physicochemical properties of soil sample S_1, S_2 and S_3

No	Soil sample	pH	Organic matter (%)	EC (dS/m)	Texture	Moisture
1	Control soil sample, S_1	8.1	2.0 %	0.18	sandy loam	1.4 %
2	Soil + Orange peel powder soil sample, S_2	7.2	11.6 %	0.39	sandy loam	2.4 %
3	Soil + Banana peel powder soil sample, S_3	7.8	13.2 %	0.38	sandy loam	2.8 %

From the above Table, the pH of control soil sample was slightly higher than soil sample S_2 and S_3. Soil organic matter decline in many agroecosystems occur because losses of carbon through oxidation and erosion by intensive cropping are not compensated by carbon inputs through the return of plant biomass. Organic matter reduction is in turn, association with the soil structure degradation. Organic matter of soil sample S_2 and S_3 were higher than control soil sample S_1. Neither strong acidic nor strong basic of three soil samples were found. Organic matter plays a major role in moisture retention, helping crops withstand drought contributes to the chemical and biological properties of the soil and also a source of and exchange for nutrients. The soil sample consists of 61% of sand, 26% of silt and 13% of clay. The texture class of soil sample was sandy loam. Electrical conductivity (EC) is a measure of the salt concentration in the soil solution. Increasing electrical conductivity of control soil sample, S_1 than soil sample S_2 and S_3. The moisture of control soil sample S_1 (1.4%), soil sample S_2 (2.4%), soil sample S_3 (2.8%) were observed.

Table 3 pH of orange peel powder and banana peel powder

No	Fruit peel powder	pH	N	P	K
1	Orange peel powder	5.6	7.2	2.3	1.2
2	Banana peel powder	7.7	4.6	3.7	2.8

By the experiment, it can quantify how much amount of different peel powder required for the particular soil. The orange peel powder was used to decrease the pH of the soil and the banana peel powder was used to increases the pH of the soil.

Citrate peel powder like, orange peel powder, reduces salinity of soil and alkaline peel powder like, banana peel powder reducing acidity content present in soil. According to result, orange peel powder has higher nitrogen content (7.2 mg/g), whereas banana peel powder has higher quantity of phosphorous (3.7 mg/g) and potassium (2.8 mg/g).

Table 4 Major nutritive value of soil sample S_1, S_2 and S_3

No	Soil sample	Total N	Total P	Total K
1	Control soil sample, S_1	0.09%	0.11%	0.31%
2	Soil + Orange peel powder soil sample, S_2	0.18%	0.40%	1.01%
3	Soil + Banana peel powder soil sample, S_3	0.20%	0.35%	1.03%

The major naturitive value of prepared fertilized soil sample S_1, S_2, S_3 were determined. The primary nutrient (N, P, K) are mainly necessary for plants. The total nitrogen value of three soil samples ranged from 0.09%, 0.18% to 0.21%. It was found that nitrogen content of three soil samples were increased and that causes soil fertility.

The total phosphorus values ranged 0.11%, 0.40%, 0.35%. Phosphorus concentration may increases as composting. Thotal potassium content ranged 0.3.1%, 1.01%, 1.03%. According to this

results, potassium content of prepared fertilized soil sample S_2 and S_3 are higher. Therefore it is suitable for crops and vegetable growing. By comparing these results, we can conclude that increased N, P, K value with increasing fertility of soil, soil microorganism, plant growth and maximum nutrient content.

The element composition of prepared fertilized soil sample were determined by EDXRF at Department of Agricultural Research, Yezin, Nay Pyi Taw, Myanmar. According to table, all elemental composition of soil sample S_2 and soil sample S_3 are higher than control soil sample S_1. In this elemental composition, S_2 and S_3 fertilized soil sample contained highest amount of Si, Al, Fe and high amount of Ca, K. And then, meidum for Ti, Mn and low mineral levels are observed in Zn, Pb, Cr. The high elemental content of S_2, and S_3 fertilized soil sample show increasing pest and pathoger resistance, drought and heavy metal tolerance, and stability and yield of agricultural corps.

Table 5 Determination of elemental composition of soil sample S_1, S_2 and S_3

Soil sample	Si	Al	Fe	Ca	K	Ti	Mn	Zn	Pb	Cr
Control soil sample S_1	30.726%	5.528%	2.059%	2.359%	1.243%	0.456%	0.084%	0.028%	0.018%	0.006%
Orange soil sample, S_2	47.100%	15.200%	18.300%	6.470%	8.630%	1.450%	0.217%	0.153%	0.186%	0.0889%
Banana soil sample, S_3	46.500%	15.000%	17.000%	7.190%	8.730%	1.580%	0. 276%	0.148%	0.180	0.0663%

Application of fruit peel powder in soil:

Soil samples S_1, S_2, S_3 were filled with each pot. Pea seeds and chili seeds were sown in various pots and water was poured every day. Control and two different peel powder was used to compare the plant growth.

After 45 days, check the growth of pea plant and chili plant compare with the plant in control soil. Length of the plant was very less in control soil than the orange peel powder applied soil. Size of the leaves was also increased in the plants which were grown on banana peel powder with soil. Length of peas and chili plant were also bigger than control.

Fig. 5 Different in growth of chili plant a) control soil and b) soil + banana peel

Fig. 6 Different in growth of pea plant a) control soil and b) soil + banana peel

CONCLUSION

In this study, the plant base materials such as orange peel and banana peel were used as natural fertilizer. The physicochemical changes during the combination of orange peel powder or banana peel powder to soil were determined at enhancing properties of soil. The orange peel powder was used to

decrease the pH of the soil and the banana peel powder was used to increase the pH of the soil. The pH of control soil samples is slightly higher than soil sample S_2 and S_3. It was found that, organic matter, electrical conductivity (EC), of orange peel powder soil sample S_2 and banana peel powder soil sample S_3 were higher than control soil sample S_1. Furthermore, total N, P, K value of soil sample S_2 and S_3 were also found higher than control soil sample S_1 as well as elemental composition. So, the peel powder can be feasibly used as a soil fertilizer, improving soil morphology, as micronutrient supplement (Zn, Fe, Ca) and also for horticultural purposes. The plant growths of different fruit peel powder add soil were more than control soil. The organic waste such as orange and banana fruit peel powder were used as natural fertilizer. By using this orange peel powder and banana peel powder as fertilizer, it can be reduced to fruit peel waste. Soil application of compost from organic residues, such as animal manures, sewage sludge, household wastes, represents a management strategy that could counteract depletion of organic matter in soils. Besides, organic residues recycling and further use in soils represents an attempt to alleviate the serious environmental problems caused by residue accumulation. The use of compost in soils requires that it achieves and adequate degree of maturity, which implies a stable organic matter content and the absence of phytotoxic compounds and plant or animal pathogens. Mineral fertilization provides readily available nutrients for plant growth; however, it does not contribute to improve soil physical condition. For the enhancement of the growth of plant and vegetables in home gardens, banana peel power and orange peel powder were applied as soil conditioner and its response was measured by using some parameters.

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