Molluscan Soil Neutralizer

MARY ANN G. LAZO
SOLITA EVANGELINE S. BANEZ

ABSTRACT

The primary aim of this research work was to find out indigenous substances such as mollusk shells that could be utilized to neutralize the acidic soil brought about by acid rain.

Specifically, it attempted to conduct qualitative chemical analysis on the presence of lime in the shells of mollusks such clams (ulya , Tag.), green mussels (tahong, Tag.) and oyster (talaba, Tag.) and to find out the effect of these shells on the vertical growth of eggplant.

The pH value of the soil used was 5.8 which showed that the soil used was acidic. Three experiments were conducted where the soil was treated with pulverized shells of tahong, talaba and tulya. In the control treatment, no molluscan treatment was done on the soil; only water was applied. Three replications of the four experiments were done.

Through the qualitative analysis conducted, it was found out that lime was present in the mollusk shells. Based on the data gathered, this lime could be used to neutralize the acidity of the soil as reflected by the difference in the vertical growths of eggplants grown in soil treated with talaba, tahong, and tulya shells as compared to those planted in the control. Soil treated with talaba produced the tallest eggplants, followed by the soil treated with tahong and tulya. Eggplants grown in the control treatment were the shortest.

Introduction

Background of the Study

Air is polluted in various ways. Car engines burn fuel and the fumes from the exhausts go into the air; power stations burn coal, oil, and gas; smoke from tall chimneys and houses using gas or coal fires that up into the sky. All these and many more contribute to the problem of acid rain. But not all pollution is man-made. Volcanoes also make gases which can add to the problem of acid rain.

Acid rain occurs within and downwind of areas of major industrial emissions of sulfur dioxide (SO,) and the oxides of Nitrogen (No,). After SO, and No, are emitted into the atmosphere, they are transformed into sulfate or nitrate particles, which when combined with water vapor, turn into mild sulfuric or nitric acids. These acids then return to earth as rain.

It is apparent that very substantial harm is being done to our environment, it is clear that remedial action is needed. There can be no quick solutions. The clean-up may take decades.

Fanning, which is one of the country's sources of income, may also be affected by pollution. The farmers depend mainly on rain water for the irrigation of their farms.

Rain, the substance needed by all plants in order to survive has become, in a special fonn, a potential killer. Acid rain, if unchecked, poses a potentially devastating threat to the farms. It washes out important minerals from the leaves of plants. It can also destroy the fertility of the soil by making it acidic. Too much acid in the soil results to very poor crop production, if not treated or neutralized with a base.

Excessive use or misuse of fertilizers, which may not suit the specific soil deficiency in a given area, and application of a strong insecticide due to misinformation or ignorance on the parts of the farmers are some of the other factors that may account for poor crop production.

The effect of acid rain on the soil and misinformation on the use of fertilizers and insecticides motivated the researchers to find out a solution to treat high acid content or low pH value of farms in order to improve crop production. Hence, this study on the molluscan soil fertilizer.

Significance of the Study

The researchers believed that shells of mollusks may be used to neutralize the soil with pH value. The utilization of shells of green mussels (tahong, Tag.), clam (tulya, Tag.) and oyster (talaba, Tag.) also helps solve the problem on pollution in the locality and the present farmers' problem on costly fertilizers. The researchers believed that the result of this study will provide a vital information to the farmers in the community about condition of their farm and how to treat it by recycling indigenous materials.

Objectives of the Study

This study aimed to utilize mollusk shells such as oyster (talaba, Tag.), clams (tulya, Tag.) and green mussels (tahong, Tag.) as first aid treatment to acidic farm due to the effect of acid rain.

Specifically, it sought to:

1. Determine the presence of lime in the shell of mollusk animals such as tulya, tahong, and talaba through qualitative chemical analysis.

2. Find out the effect of shells of tulya, tahong, and talaba as fertilizer in the vertical growth of eggplants.

Scope and Delimitation

This study was delimited to the treatment of agricultural soil by utilizing discarded mollusk shells such as clams, green mussels, and oysters as "first aid" treatment to the soil. The effect of these mollusk shells on the vertical growth of the eggplant was also studied.

The experimental method of research was done under laboratory conditions. The researchers conducted chemical analysis on the presence of lime in the shells. Lime is one of the important nutrients in neutralizing acidic soil.

Review of Related Literature

Acid rain. All pure rainfall is slightly acidic. This normal level of acidity results when carbon dioxide in the atmosphere combines with rain to form carbonic acid, a weak acid also fonned by the carbon dioxide in soda pop. Because of increasing industrial discharges into the atmosphere, an excessive level of acidity is created in rain falling on most of the eastern United States. The sulfur dioxide produced by burning coal and the nitrogen oxides from automobile exhaust are increasing at a rapid rate. When they combine with the moisture in the air, sulfuric acid and nitric acid are fonned. These acids are returned to earth during nonnal rainfall periods as acid rain. Increased acid concentration in a lake can result in the eventual extinction of all life within it (Rakow, 1982).

Moreover, acid rain has detrimental effects on plant life. Cells in leaves of some plants die when rainwater approaches on pH of 3. Values of pH of 2.0 to 3.1 have been measured during individual rain storms. This rain falls directly on plants with no possibility of partial neutralization by the soil or dilution by ground water (Keenan, 1979).

Chemical reactions. Reactions of the different gases involved in the fonnation of acid rain are as follows:

a. Carbon Dioxide + Water	□	Carbonic Acid
CO, + H,O	□	H,CO,
b. Nitric Oxide + Oxygen	□	Nitrogen Dioxide
2NO + O,	□	2NO,
c. Nitrogen Dioxide + water	□	Nitrous Acid + Nitrogen Oxide
3NO, + H,O	□	2HNO, + NO
d. Sulfur dioxide + water	□	Sulfurous Acid
SO, + H,O	□	H,SO,
e. Sulfurous Acid+ Water	□	Hydrogen Ion + Hydrogen Sulfite
H,SO, + H,O	□	H,O+ + HSO,
f. Hydrogen Sulfite + Water	□	Sulfuric Acid
HSO, + H,O	□	H,SO,+H

Treating soils. Very few soils are loam. It is necessary to treat most soils in a special way to change them into loam. Here are some ways of treating different kinds of soil: (Science Club Magazine, 1982)

KIND OF SOIL	PROBLEM	TREATMENT
Peat	Too acidic.	Drainage. Add lime.
Chalk Sandy	Sticky, soft in wet weather Short in plant food.	Add humus-making substances and fertilizer.
Clay	Tends to waterlog cakes and cracks in dry weather.	Drainage, digging, add lime and humus-making substances.

Effects of acid rain on crops. While the sensitivity of many crops appears to be much greater than that of many tree species, no solid evidence exists that the leaves of crops have been damaged by acid droplets in the field (Nato, 1980). However, a number of detailed studies have begun to suggest that even in a well-buffered agricultural system acid rain may be detrimental.

In a study by Lee and Neely (1980) of 27 crop plants grown in pots and exposed to simulated acid rain over a pH from 2.5 to 5.7, visible, unsightly foliage lesions appeared in 21 crops at a pH of 3.0 (which occurs with a rainfall frequency of 0.5 to 1.0% in affected regions of North America). Studies of major Ontario crops by Hutchinson (1981) showed that lettuce, beets, onions, soybeans, pinto beans, and tobacco were all severely affected in rains of pH 2.5 and 3.0. Such crops as tobacco, lettuce, and spinach depend upon healthy foliage for their sale. Studies at Brookhaven National Laboratory in the United States (Evans et al., 1983) demonstrated that plants exposed to simulated acidic rainfalls of pH 4.2, 3.8 and 3.5 had decreased seed yields by 2.6%, 6.5% and 11.4%, respectively, compared to plants exposed to ambient rainfall only. Such seed losses in a major crop, such as soybeans, would amount to losses of many millions of dollars per year in the United States (Henry, 1996).

The molluscans. Clams, green mussels, and osyters are marine animals that belong to Phylum Mollusca. The Phylum Mollusca derives its name from the Latin word mollis which means "soft" and the characteristics of softness typifies the various representatives of the group. They are all soft-bodied animals, usually enclosed in a shell, which they construct for protection. The Mollusca are non-segmented animals without distinct appendages, although most of them possess a muscular structure, the foot, especialized for locomotion. Their symmetry is mainly of bilateral type and their soft parts are enclosed in a mantle known technically as a pallium, which is formed chiefly from the dorsal fold of the outer body wall. The pallium generally manufactures a secretion that forms a hard shell consisting mainly of carbonate of lime and this affords ample protection for the inner soft parts of the animal (Fasten, 1983).

Research Design

Input Variable	Processes	Output Variables
Shells of Green Mussel (Tahong) Oyster (Talaba) Clams (Tulya)	**1.** Qualitative Chemical Analysis for the presence of Lime **2.** Tested to the growth of eggplants	1. Presence of lime 2. Increase height of eggplants (Those tested with shells) 3. Molluscan shells as neutralizers and fertilizers

Fig. 1. The research design.

The shells of tahong, talaba, and tulya were used as samples of the study. Through the qualitative chemical analysis, it hoped to find out whether or not lime is present in mollusk shells. Lime could be used to neutralize the acidity of the soil and this could be reflected by the expected difference in the vertical growth of eggplants to be treated by the molluscan shells and that of the control (eggplants which would not be given any treatment).

Hypotheses

This study was premised on the following null hypotheses:

1. There is no lime in mollusk shells such as tulya, tahong and talaba.
2. There is no significant difference between the vertical growth of eggplants treated with pulverized shells of tulya, tahong and talaba and that of the control.

Methodology

This study followed the experimental design which included the following phases:

Phase I. This includes the analysis of the pH value of the soil by the Soil Laboratory in Vigan, Ilocos Sur, gathering, cleaning and pulverizing the shells of tulya, tahong and talaba, and planting eggplants to be tested.

Phase II. This includes the experiment proper. The qualitative analysis for the presence of lime was conducted. The vertical growth of eggplants treated with pulverized shells was observed, recorded, and compared with that of the control.

Phase III. This includes the tabulation of results and the analysis and interpretation of the data gathered in this study.

Materials and equipment. The materials used in this study were the following:

I. Raw materials – shells of tulya, talaba, and tahong; eggplants; soil; and water
2. Laboratory equipment and materials - graduated cylinder, beakers, litmus paper, tape measure, test tubes, test tube racks, pippette, platform balance, 12 milk cans, mortar and pestle, and sifter
3. Chemicals - sulfuric acid, carbonic acid, nitric acid

Procedures/method. The following methods and procedures were observed:

1. Soil was analyzed at the soil laboratory.
2. The shells of tulya, tahong, and talaba were pulverized.
3. The presence of the lime in the pulverized shells was determined.
4. The reaction of the heated pulverized shells with water was observed. It was further tested with litmus paper (red and blue) to determine whether the substance formed is acidic or basic. The test of the presence of CO_2 was conducted and observed.
5. A mixture of pulverized shell of tulya was made to react with the following acids separately: (a) sulfuric acid, (b) nitric acid, (c) carbonic acid.
6. Procedure 5 was done using tahong shell.
7. Procedure 5 was done using talaba shell.
8. Eggplants were used as the experimental plants.
   8.1 These were planted in the same kind of soil (same source).
   8.2 Pulverized shells were spread out on top of the soil after planting (1 tbsp per plant).
   8.3 The plants were watered with the same amount and source of water.

Presentation, Analysis, and Interpretation of Data

Soil Analysis

The soil was analyzed to have a pH value of 5.8 as determined by the soil laboratory analysis. This shows that the soil used was acidic because the pH value is lower than 7. Substance with a pH value of7 are neutral; lower than 7, acidic; and higher than 7, basic. Acidic soil needs neutralization by a basic substance before or immediately after planting.

Reaction of Heated Pulverized Shell With Water

Table 1 shows that the mass of the substance after heating is slightly less than the mass before heating. The slight difference is accounted by the carbon dioxide released when calcium carbonate is heated. The Law of Conservation of Mass was observed. The heated pulverized shell was made to react with water and tested with litmus paper. It was found out that the red litmus paper turned blue. This shows that the substance is basic.

The chemical reaction is shown in the following equation:

caco, □ Cao +CO,

CaO + H,O □ Ca(OH), (base)

The presence of carbon dioxide was tested. The gas collected was allowed to bubble out in a test tube containing water and litmus paper. It was found out that the blue litmus paper turned red. This shows that the substance produced by the gas and water is acidic.

Table 1. Reaction of the heated pulverized shell with water.

TRIAL NO,	MASS OF TULYA (g)		MASSOF TAHONG (g)		MASS OF TALABA (g)		VOL.OF H,O ADDED (ml)	REACTION OFLITMUS PAPER
	A	B	A	B	A	B		
I	1	0.95	1	0.95	1	0.9	S	Red litmus paper turned blue
II	1	0.95	1	0.95	1	0.95	5	Red litmus paper turned blue
III	1	0.95	1	0.95	1	0.95	5	Red litmus paper turned blue

Legend:

A– mass before heating
B– mass after heating

The reaction is:

$$CO_2 + H_2O \quad □ \quad H_2CO_3 \text{ (acid)}$$

Effects of the Pulverized Mollusk Shells on the Vertical Growth of Eggplant

Tables 2-5 show the vertical growth of the eggplants at different treatments.

Table 2 shows the vertical growth of the control eggplants, which were given water only. Trial I had the biggest increase in height (2.65 cm), while Trial ill had the lowest (2.46 cm.)

On the other hand, eggplants treated with pulverized tulya shells showed varied vertical growth (Table 3). The data show that Trial II had the greatest increase in height (4.17 cm), followed by Trial III (2.85 cm) and Trial I (2.5 cm).

Table 4 shows that among the three treatments with pulverized tahong shells, Trial III produced the tallest eggplants with a height increase of 5.14 cm, followed by Trial I (4.12 cm), and Trial II, the least (3.02 cm).

Table 2. Vertical growth of control eggplants.

DATE MEASURED	HEIGHT OF EGGPLANT (cm)		
	TRIAL I	TRIAL II	TRIAL III
September 8	6.3	6.3	6.3
13	6.6	6.6	6.6
17	6.9	6.9	6.9
19	7.3	7.1	7.2
21	7.6	7.6	7.6
24	8.1	7.9	7.9
October 6	11.5	11.5	11.0
9	11.7	11.6	11.3
11	11.7	11.7	11.4
14	11.8	11.8	11.4
Average Height	8.95	8.9	8.76
Increase in Height	2.65	2.6	2.46

Table 3. Vertical growth of eggplants treated with pulverized tulya shells.

DATE MEASURED	HEIGHT OF EGGPLANT (cm)		
	TRIAL I	TRIAL II	TRIAL III
September 8	8.8	7.5	9.0
13	9.1	7.9	9.7
17	9.5	8.7	10.5
19	9.8	9.3	10.7
21	10.2	9.6	11.0
24	10.6	10.6	11.5
October 6	13.0	15.0	13.5
9	13.8	15.7	14.0
11	14.0	16.0	14.1
14	14.2	16.4	14.5
Average Height	11.3	11.67	11.85
Increase in Height	2.5	4.17	2.85

Table 4. Vertical growth of eggplants treated with pulverized tahong shells.

DATE MEASURED		HEIGHT OF EGGPLANT (cm)		
		TRIAL I	TRIAL II	TRIAL III
September	8	10.1	7.7	7.5
	13	10.9	8.5	8.3
	17	11.7	8.8	9.1
	19	12.3	9.2	10.0
	21	12.9	9.6	11.5
	24	13.8	10.5	12.3
October	6	16.5	12.5	16.0
	9	17.3	12.9	16.0
	11	18.0	13.5	17.1
	14	18.7	14.0	17.9
Average Height		14.22	10.72	12.64
Increase in Height		4.12	3.02	5.14

Table 5 presents the vertical growth of eggplants planted in soil treated with pulverized talaba shell. The data show that Trial III produced the tallest eggplants with an increase in height of 6.74 cm, followed by Trial II (5.82 cm) and Trial I (4.61 cm).

Table 5. Vertical growth of eggplants treated with pulverized oyster shell.

DATE MEASURED		**HEIGHT OF EGGPLANT (cm)**		
		TRIAL I	**TRIAL II**	**TRIAL III**
September	8	10.0	10.1	10.5
	13	10.9	11.0	11.3
	17	11.5	11.6	12.9
	19	12.1	12.3	13.8
	21	13.9	13.5	15.0
	24	14.9	16.0	16.9
October	6	17.0	20.0	22.0
	9	18.0	20.9	22.8
	11	18.7	21.6	23.4
	14	19.1	22.2	23.8
Average Height		14.61	15.92	17.24
Increase in Height		4.61	5.82	6.74

Comparing the vertical growth of eggplants in the different soil treatments, soil treated with talaba shells produced the tallest eggplants with an average height increase of 5.72 cm, followed by those treated with (4.09 cm), and those treated with tulya shells (3.17 cm). Eggplants given no molluscan treatment were the smallest plants with an average height increase of 2.57 cm. This implies that pulverized shells can neutralize the acidity of the soil and can be used as fertilizer of plants.

Table 6. Summary of the height increase of the different treatments of eggplants (cm).

TRIAL NUMBER	HEIGHT OF EGGPLANT (cm)			
	NO TREATMENT	WITH TREATMENT		
		TULYA	TAHONG	TALABA
I	2.65	2.5	4.12	4.61
II	2.60	4.17	3.02	5.82
III	[illegible]	[illegible]	[illegible]	[illegible]
Average	2.57	3.17	4.09	5.72

The difference in vertical growth among eggplants planted in different soil treatments could be due to the following:

1. Talaba shells are the easiest to pulverize, hence, fastest to be dissolved in water. Tahong and tulya follow, respectively.
2. Talaba shells reacted first, thus neutralization process was faster, hence faster growth of plants,

Chemical reactions for the neutralization are as follows:

1. Calcium hydroxide + carbonic acid → Calcium carbonate + water

$$Ca(OH)_2 + H_2CO_3 \rightarrow CaCO_3 + 2H_2O$$

2. Calcium hydroxide + nitric acid → Calcium nitrate + water

$$Ca(OH)_2 + 2HNO_3 \rightarrow Ca(NO_3)_2 + 2H_2O$$

3. Calcium hydroxide + sulfuric acid → Calcium sulfate + water

$$Ca(OH)_2 + H_2SO_4 \quad CaSO_4 + 2H_2O$$

Conclusion

It can be concluded that the shells of talaba, tahong, and tulya contain lime that neutralizes that acidity of farm soil due to acid rain. Moreover, pulverized shells of the said marine animals can hasten the growth of eggplants.

Recommendations

1. Farmers should subject their soil to chemical analysis before planting.
2. The use of the shells of talaba, tahong, and tulya is recommended for treating acidic soil.
3. Wide dissemination of this research to farmers is needed to help them increase crop production and improve their standard of living.
4. A follow-up study should be conducted using other kinds of marine shells.
5. The usefulness of these mollusk shells in this research should be tested on other kinds of plants.
6. A machine that will crush and pulverize the shell should be devised to minimize human effort.

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