PHILIPPINE SCIENCE HIGH SCHOOL WESTERN VISAYAS

Doña Lawaan H. Lopez Campus
Iloilo City

INSECTICIDAL EFFECT OF TOBACCO LEAVES ON BROWN
PLANTHOPPER BUGS (*Nilaparvata lugens* Stal.)
IN RICE (*Oryza sativa*)

A Research Paper Presented to the
Faculty of the Philippines Science High School Western Visayas
Iloilo City

in Partial Fulfillment
of the Requirements in
Science Research II

by

Marianne P. Aguila
Happy Rizalina M. Guevara
Marie Emerose A. Manuel

February 2000

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APPROVAL SHEET

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Abstract

This study determined whether or not tobacco leaves had an insecticidal effect on brown planthopper bugs (*Nilaparvata lugens* Stal.). It was hypothesized that there was no significant difference in the effectiveness of the insecticide from tobacco leaves when the extract-water concentration was 1:3, 1:2, 1:1; and effectiveness of the insecticide from tobacco leaves compared with the commercial insecticide, methyl parathion. Statistical tools employed were the t-test, One-Way Analysis of Variance, and the Scheffe test.

Results showed that tobacco leaves had an insecticidal effect on brown planthopper bugs and that there was no significant difference in the effectiveness of the extract-water solution when the concentration was 1:3, 1:2, and 1:1. Also, although tobacco leaves had an insecticidal effect, they were still considered inferior to the commercially made one for there was a significant difference in the effectiveness of the insecticide from tobacco leaves compared with methyl parathion.

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Chapter 1

Introduction to the Study

Background of the Study

The struggle between man and insects began long before the dawn of civilization, has continued without cessation to the present time, and will continue, no doubt, as long as the human race endures. It is because both men and certain insect species constantly want the same things at the same time. Its intensity owes it to the vital importance of the things they struggle for, and its long continuance is because the contestants are so equally matched.

Rice (*Oryza sativa*) has been the most commonly used food grain for a majority of the people of the world (Grolier International Encyclopedia, 1991). It is considered the staple food for most of us. For this matter, when insects attack the rice fields, it leaves us with less food for everyone else.

One of the most common rice pests is the brown planthopper. It is considered one of the most important insect pests of rice which occasionally break out to cause considerable losses. Brown planthoppers must be controlled with insecticides as soon as possible when the population shows any sign of increase in early September. Otherwise, enormous injury will occur. Because of this, more ways are being developed to find an insecticide, which is both cheap and effective.

The alkaloid nicotine is an important insecticide. It is used universally to protect plants and animals against pests and parasites. It is especially valuable as a contact insecticide for the control of aphids, scales, and leafhoppers. In some of its fixed forms it is a stomach poison for chewing insects (Beinhart, 1951).

Tobacco and its chief alkaloid, nicotine, have been used since 1690 as insecticides (Feinstein, 1951). Tobacco is commonly known as the plant from which cigarettes, cigars, pipes, and snuff come from. It is produced all over the world and although some people call it a filthy weed, it has, in fact, a tremendous economic significance (Beinhart, 1951).

Rice is an ideal test plant because of its importance and brown planthoppers are one of its common pests. Since we know the fact that nicotine is an insecticide that can be extracted from tobacco, then the researchers decided to conduct this study.

The relationship between the independent and dependent variables in the study is presented in Figure 1.

Statement of the Problem and the Hypotheses

The tobacco leaves were tested for insecticidal effect on brown planthopper bugs. The study specifically sought to answer the following:

1. Do tobacco leaves have an insecticidal effect on brown planthopper (*Nilaparvata lugens* Stal.)?

2. Was there a significant difference in the effectiveness of the insecticide from tobacco leaves when the extract-water concentration was (1) 1:3, (2) 1:2, and (3) 1:1?

INDEPENDENT VARIABLE DEPENDENT VARIABLE

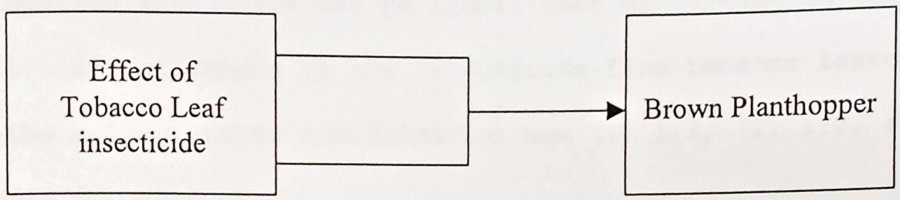

Figure 1. Effect of tobacco leaf insecticide on brown planthopper.

3. Was there a significant difference in the effectiveness of the insecticide from tobacco leaves compared with the commercial insecticide, methyl parathion?

In line with the afore-mentioned problems, it was hypothesized that there was no significant difference in the

1. effectiveness of the insecticide from tobacco leaves when the extract-water concentration was (1) 1:3, (2) 1:2, and (3) 1:1.

2. effectiveness of the insecticide from tobacco leaves compared with the commercial insecticide, methyl parathion.

Significance of the Study

Almost all countries all over the world make use of rice as their basic sustenance. A lot of farmers all over the world are also having farming as their only source of livelihood. Since tobacco is also produced all throughout the world, it's just being sensible to make use of their nicotine content in a productive purpose rather than using them to manufacture cigarettes which could not only harm us but kill us.

The past few months have been very difficult for the country because of the food shortage brought about by the El Niño phenomenon. Plus the crops destroyed by pests and insects, such as green leafhopper bugs and brown planthopper bugs, these problems cause the government to be concerned. Since the study established the effectiveness of tobacco leaves as an insecticide, we have an additional solution to the problem.

This study could benefit first of all, the farmers, families, and most importantly, the country. This is because through this study, the researchers were able to discover an insecticide that can be used as substitute for commercial insecticides in destroying brown planthopper bugs.

Definition of Terms

For clarity and single-mindedness, the following are given their conceptual and operational meanings:

Insecticide- is a chemical compound used to protect crops and other plants against invasion by insect pests such as flied, moths and caterpillars (21st Century Universal Encyclopedia, 1994).

In this study, it would mean the tobacco leaf extract-water solution.

Commercial [insecticide]- an insecticide that is out in the market (New Scholastic Dictionary of American English, 1981).

In this study, the term would mean the commercially-prepared insecticide, methyl parathion.

Tobacco- is a tall herbaceous plant, the leaves of which are harvested, cured, and rolled into cigars, shredded for use in cigarettes and pipes, and processed for chewing or snuff (Grolier Encyclopedia of Knowledge, 1991).

In this study, the term meant the source of extract for the insecticide.

Brown planthopper- is one of the most destructive insect pests of rice which occasionally breaks out to cause considerable losses (Insect Pests of Rice, 1994).

In this study, the term meant the test organism.

Rice- is a member of the grass family, Graminae, which can be grown successfully under climatic conditions ranging from tropical to temperate (Grolier Encyclopedia of Knowledge, 1991).

In this study the term meant the direct habitat of the test organism.

Concentration- the amount dissolved in each part of a liquid (New Scholastic Dictionary of American English, 1981).

In this study, the term meant the water-tobacco extract ratio, that is, 1:1, 1:2, and 1:3 respectively.

Insecticidal effect- the effect of a substance on insects (New Scholastic Dictionary of American English, 1981).

In this study, it meant the mortality rate of the brown planthopper bugs.

Mortality [rate]- number of deaths in a given period in a given area (New Scholastic Dictionary of American English, 1981).

In this study, it meant the number of dead brown planthoppers.

Scope and Delimitation

This study aimed to test tobacco leaves for their insecticidal effect on brown planthoppers, which were the test organisms in this study. There were three replicates for each insecticide preparation. The statistical tools used were the t-test, One-Way ANOVA, and the Scheffe test.

This study was conducted last January 11, 2000 at the Philippine Science High School Western Visayas Science Research Laboratory.

Chapter 2

Review of Related Literature

Insect Control

Life forms that act as parasites or disease carriers and in some manner cause damage to human food supplies are considered pests. It is becoming more and more evident that food production is greatly affected by insect pests than any other pests.

With this increasing trouble, new methods of control are being introduced. Scientists, called entomologists, conducted pest control operations to regulate pests that attack the crops, domiciles, and the human body. Pest control programs usually are ideal for rapid evolution of resistance, often within a few generations.

Environmentalists, scientists, and workers in the pesticide industry have also contented that some pesticide compounds are hazardous to human health. Workers in factories that produce some of these compounds have, in the process of bringing legal suit against some manufacturers, received financial compensation for illness allegedly caused by exposure to these chemicals (Grolier Encyclopedia of Knowledge, 1991).

Pesticides have many well-known harmful effects. Because of this, researches were conducted to find safer alternatives to dangerous pesticides.

The Philippines has been endowed with many plants that could be used in our war against insects. These extracts could either kill or repel the insects or deter the feeding as growth of the insects.

In the use of pesticides, as with all chemicals, users should read the label before application and follow the instructions precisely. All chemicals can be hazardous to humans and to the environment unless they are employed with knowledge, caution and appropriate restraint (Grolier Encyclopedia of Knowledge, 1991).

It is the job of the pest control specialist to somehow balance getting rid of harmful insects while preserving beneficial ones pest control specialists use a variety of methods to destroy insect pests. These methods range from spraying chemical insecticides to releasing natural predators.

By 1930, rapid advances in chemistry led to the development and application of pesticides based on various metallic compounds (Grolier Encyclopedia of Knowledge, 1991). For instance, in 1939, Paul Mueller, an entomologist, discovered DDT's (dichlorophenyl trichloroethane) insecticidal properties. Six years later, there was a documented resistance in insect population. Rachel Carson's book, Silent Spring (1962), influenced both the U.S. congress and several state legislatures. As a result, the use of some pesticides was restricted.

Tobacco and Nicotine

Tobacco is a tall herbaceous plant, the leaves of which are harvested, cured, and rolled into cigars, shredded for use in cigarettes and pipes, and processed for chewing or snuff. Tobacco is an important crop in most tropical countries and in many temperate ones. The main source of commercial tobacco is *Nicotiana tabacum*, although *Nicotiana rustica* is also grown and is used in Oriental tobaccos. Growers have developed a wide range of varieties, from the small-leafed aromatic tobaccos to the large, broad-leaved cigar tobaccos (Grolier Encyclopedia of Knowledge, 1991).

Tobacco is produced worldwide. Fifty-four countries grow about seven billion pounds of it annually on 7 3/4 million acres. It is smoked in cigarettes, cigars and pipes. It is chewed in its natural leaf state or, grinded to a powder to which various metals have been added, as snuff. Or it may be treated with a mixture of sugars, honey, licorice, and other flavors, and oil and formed into plugs, ropes, or pellets for chewing or smoking. A few people snuff it into the nostrils to clear the head. Some call it filthy weed, but the fact is that tobacco has tremendous economic significance.

The species of *Nicotiana tabacum* supplies most of the world's tobacco, and it is the only specie grown in the United States for tobacco purposes. The specie *Nicotiana rustica*, which was being used by the North American Indians when the first white explorers reach the continent, is now grown extensively in India, Pakistan, and the Soviet Union, and to a lesser extent in Arabia, Persia, Syria, Abyssinia, Poland, and Hungary. The total production of *Nicotiana rustica* is estimated to be 750 million pounds from 700,000 acres. It is used for smoking, chewing, snuff, and nicotine extraction.

Nicotine is an alkaloid obtained from the dried leaves of the tobacco plant *Nicotiana tabacum*, first synthesized in 1904. It may be prepared by extracting oil from the leaves by boiling water, mixing it with milk lime, and distilling; the distillate is treated with oxalic acid, concentrated, treated with potash and the nicotine extracted with ether. Although it is a colorless oil, it rapidly turns brown on exposure to air.

Nicotine is exceedingly poisonous, a few drops in the stomach being sufficient to cause death due to respiratory paralysis. Nicotine is readily absorbed through the skin and nicotine poisoning is generally due to careless handling when used as an insecticide (21st Century Universal Encyclopedia, 1994).

Pure nicotine is a tobacco extract highly toxic to warm-blooded animals. The insecticide usually is marketed as a 40% liquid concentrate of nicotine sulfate, which is diluted in water and applied as a spray. Dusts can irritate the skin and are not normally available for garden use. Nicotine is used primarily for piercing-sucking insects such as aphids, whiteflies, leafhoppers, and thrips. Nicotine is more effective when applied during warm weather. It degrades quickly, so can be used on many food plants nearing harvest. It is registered for use on a wide range of vegetable and fruit crops (http://www.nmsu.eau/pubs/_h/h-150.html).

The best known example of a botanical insecticide is nicotine, which is extracted from tobacco plants. Despite the tobacco plant producing toxic amounts of nicotine, some insect pests, such as the tobacco hornworm, have evolved mechanisms to deal with the toxic product and exploit the tobacco plant as a food source. Nicotine is no longer used in the United States, but still used elsewhere. It is marketed as either the sulfate or the alkaloid.

The recent synthetic organic insecticide, imidacloprid (shown above alongside nicotine) acts at the nicotinic receptor in a manner analogous to nicotine. Imidacloprid was found to have systemic action on crop plants against sucking insects such as white fly, Bemisia tabaci. The mammalian toxicity is given in Thomson as 450 mg/kg.

Tobacco and its extracts were used for the control of insects long before it was known that nicotine was the toxic agent. The first reference to the use of tobacco extracts for spraying plants was in 1690.

English and continental gardeners early recognized the value of tobacco from the American colonies. According to present standards it must have been strong tobacco. In a letter dated January 20, 1734, Peter Collison of London suggested to his American correspondent, John Bartram, the Philadelphia botanist, the use of tobacco leaves to protect letters and packages containing seeds and plants being shipped to him. In 1746 he advised Bartram to use water extracts of tobacco for the control of the plum circulio on nectarine trees.

Tobacco dusts and extracts were recommended for the control of plant lice in France in 1763. In 1773 Richard Weston developed a hand bellows for fumigating insects with tobacco smoke. The first American reference was in 1814 by Peter W. Yates of Albany, who used tobacco water against sucking insects. William Cobbett, in England, in 1829 recommended tobacco extracts for the control of the wooly aphid. Thomas Fessenden in 1832 included tobacco in a list of insect repellants and insecticides.

By 1884, tobacco was described as one of the three most valuable insecticides in general use. Tobacco was then used as the dust or water extract, or the leaves and stem were burned as smudge for fumigating greenhouses. Specially prepared papers impregnated with tobacco extracts were extensively in use. Special burners were developed for burning the tobacco or nicotine preparations and to blow the heavy smoke into the greenhouses or about the infested plants. Tobacco washes, prepared by gardeners and horticulturists from specially prepared tobacco leaf and stem materials, were in common use. They preceded the tobacco extracts soon to be manufactured commercially.

The first manufactured products were simple water extracts that contained 1 to 10% nicotine. In 1895 a product containing 40% free nicotine was offered to the trade, followed in 1898 with one containing 80% free alkaloid.

In 1910, a product containing 40% nicotine as the sulfate appeared. It marked the beginning of the modern nicotine business, as it made possible transportation in gallon cans instead of casks or large hogsheads, previously required to carry the weaker extracts or the raw leaf and stems to supply the same amounts of active alkaloid. The 40% nicotine sulfide offered fewer hazards in handling in sheep dips and for the other applications than the pure alkaloid, and it proved more effective because it also contained other distillation products of tobacco with adhesive property.

Today nicotine still has its widest use in agriculture as a contact insecticide for the control of important groups of sucking insects, such as aphids and scales. For these insects, it is used as a dilute spray, or as a dust, or it is vaporized in smoke or other aerosol form. In those forms, the alkaloid is readily available, and its lethal action is immediate upon contact with an insect. A similar action but of more extended duration, follows the use of nicotine sulfate alone, as in the control of poultry lice and mites. Here the alkaloid is released more slowly over a period of 24 to 48 hours. In a third form--the so-called fixed nicotine combination--the alkaloid is very slowly given off over entirely long period, often up to 30 days. The fixed forms include nicotine bentonite, bentonite fused with sulfur combined with nicotine, and nicotine tannate. Materials of this type act as a stomach poison to leaf-chewing insects.

The development of fixed nicotine, like nicotine tannate and nicotine, even in the fixed forms, and leaves no residues that might be dangerous to consumers of food products sprayed with it.

The pure alkaloid, offered in concentration of 50, 80, 95, and 98 percent, is adapted for direct fumigation in fields and orchards. This form has been replaced in part by smoke aerosols, where the nicotine is impregnated on paper, on tobacco dust, or on a similar slow-burning material so as to make a smudge quicker. Special burners have been developed for making the smudges. A combination of nicotine and DDT in a tobacco base makes an effective smudge for freeing an area of mosquitoes.

Another type of smudge, or vaporized nicotine fumigants, are offered in a mixture containing 80 percent nicotine alkaloid and 18 percent oil. The mixture, when dispensed by a hating device, has proved effective in treating large acreages. Nicotine has also been successfully used in the bomb-type aerosols, in which materials of low boiling point furnish the impelling power.

Nicotine-bearing dusts are available in a wide rang of alkaloid contents. Some are prepared from the natural leaf tobacco and contain 0.45 o 1.0 percent nicotine.

Rice (*Oryza sativa*)

Rice is a member of the grass family, Gramineae, which can be grown successfully under climatic conditions ranging from tropical to temperate.

Rice is harvested from about 150 million hectares throughout the world. Rice is primarily a tropical or subtropical plant, and is grown as a flooded wetland crop. It is also grown in dryland fields with rain as a sole source of moisture. It is established by direct seeding or by transplanting. It is cultivated on mountain races and in low-lying river valleys where floating rice may be grown in several meters of standing water.

Rice often grows where no other crop will. In the developing countries of the tropics and the subtropics, it has traditionally been a subsistence crop. Despite the recent adoption of new rice technology by many subsistence farmers, the average yields of rice in most developing nations remain low; ranging between 1.6 and 3 tons per hectare compared with 5 tons per hectare in the more developed rice-growing nations.

The importance of rice for the people of the developing world can hardly be exaggerated. Rice is the major source of protein and calories for 1,500 million low-income people in Asia for hundreds of millions of low-income people in the developing countries of Africa and Latin America. Analysis by the International Food Policy Research Institute shows that rice occupies one-third of the area planted to cereals in the developing countries, which is about 50% more area than wheat, the second most important crop. There are 36 countries with more than 100,000 hectares of rice, and half of these countries fall in the lowest income group, with annual income less than $300/capital. More than 95% of the worlds' rice area is in the developing countries, mostly in Asia.

During the past quarter century, rice breeding programs have been initiated in several countries. Resistance to diseases and insects where the major objectives of the earlier researches (Grolier International Encyclopedia, 1991).

Here in the Philippines, Midsayap, Cotabato-based researchers of Phil-Rice, reported that rice black bugs, destructive pests of rice plants hitherto known only to be found in Palawan, has ravaged rice crops in Western Mindanao.

This is an example of a problem that attacks rice production in some areas of the Philippines. There is a growing need for substantial efforts to stabilize the high yield levels already attained for irrigated rice.

Rice research programs are being provided with new biotechnology techniques for addressing research problems associated with rice production. The International Program on Rice Biotechnology (IPRB), as a case in point, was designed to support more research activities in the development and adaptation of biotechnology techniques to rice research programs. It was also intended to broaden the geographic range of application of rice biotechnology beyond that afforded by the incentive systems for private sectors R and D programs or by the public sector incentives to provide technology to farmers in countries with strong National Agricultural Research Systems (NARS) (Policy Forum, 1998).

Brown Planthopper Bug

Insects constitute more than half the known species of animals. About one million species have been named and classified and several thousands more are discovered each year. Their presence, small size, amazing range of adaptation and their fertility all make them man's most serious rivals for the possession of the earth. The proper study of insects is a lifetime task.

It is hardly possible to over-emphasize the importance of insects. Some being direct benefit to man as pollinators of flowers, as predators on pests, and as objects of beauty; others are directly harmful as pests of crops, as carriers of diseases, as consumers of food, as destroyers of clothes, furniture, books and buildings. As these and many other points they impinge upon our daily lives. In spite of tremendous efforts and enormous expense, malaria mosquitoes flourish and plagues of locusts still occur. The story of the insects is one of the fantastic evolutionary successes.

Nearly all insects are land animals, although a few live in fresh water and a few in salt water. Insects range in size from tiny beetles 0.25 millimeters long to some large tropical moths with a wingspan of 30 centimeters. Most insects, however, are less than 2.5 millimeters long.

Insects are the only invertebrates capable of flying. The ability to fly allows them to escape from enemies and spread into new environments. Among the insects, there is a tremendous variation in how they are adapted for feeding and reproduction. These adaptations allow insects to exist in all types of environments and to obtain nourishment from many sources.

Insects are so widespread and so numerous that they affect almost every part of daily life in some way. Each year, insects cause billions of dollars of damage to crops. Insects spread many plant diseases such as Dutch elm disease and corn smut. They also transmit animal diseases.

Insects also serve as valuable functions. Some insects are necessary for the pollination of important crops. Scientists are still searching for ways of controlling harmful insects without harming other insects or animals. Chemical insecticides kill harmful and helpful insects and endanger other animals. Furthermore, in time, insect's populations become resistant to chemicals.

Many scientists believe that biological methods of insect control are safer than chemical insecticides. Biological controls include sterilizing males and releasing them; developing resistant plans; introducing specific predators and parasites that destroy only harmful insects, and using insect sex attractants, called pheromones, to lure insects into traps.

There is an opinion that the origin of the planthopper, which immigrates suddenly into paddy, fields around June and July out of the country as the white-backed planthopper. In order to confirm this hypothesis, it is necessary to get information about occurrence of these two species of planthoppers in the area of Southeast Asia.

Nilaparvata lugens Stal. is probably the most serious insect pest of rice in Asia. Its feeding causes a symptom called hopperburn. It also transmits grassy stunt and ragged stunt virus diseases (Illustrated Guide to Integrated Pest Management in Rice in Tropical Asia IRRI, 1985). In *Nilaparvata lugens* , more brachypterous forms develop at low temperature. In males, short daylength and high temperature increase in the percentage of brachypterous forms, but daylength has no effect on the development of winged female forms. Adult *Nilaparvata lugens* remain active from 10 to 32 degrees. The macropterous females are somewhat more tolerant of temperature than are the males. *Nilaparvata lugens* adults usually live for 10-20 days in summer and 30-50 days during autumn. Females kept at 20 degrees Celsius have an oviposition period of 21 days, which is reduced to 3 days if they are kept at 30 degrees Celsius (Insect Pests of Rice, 1994).

The rice brown planthopper has a high capacity to reproduce. Frequently, farmers' misuse of insecticide causes outbreaks of hopperburn and/or virus diseases over large areas. The development of biotypes often reduces the life span of resistant rice varieties. The effectiveness of the control by insecticides is lessened because the hoppers are found at the base of plants and the crop canopy acts as an umbrella to protect the insects from the spray droplets (Illustrated Guide to Integrated Pest Management in Rice in Tropical Asia IRRI, 1985).

Nilaparvata lugens increases in September and October. During the later part of the cropping season, *Nilaparvata lugens* is known to occur in overlapping generations (Insect Pests of Rice, 1994). The brown planthopper is mainly a pest of irrigated wetland rice, but it can also become abundant in rainfed wetland environments. It is rare in upland rice (Illustrated Guide to Integrated Pest Management in Rice in Tropical Asia IRRI, 1985).

IRRI further observed that brown planthoppers and green leafhoppers compete for survival. It was found out that leafhoppers density increased more as brown planthoppers and predators were removed than when predators alone. The same holds true for the brown planthoppers; but when both were removed the brown planthoppers population is increased to maximum. Predators lower past densities by reducing competition between leafhoppers and brown planthoppers.

In the latter part of 1976 alone, brown planthoppers infestation in the Philippines totaled 50,000 hectares resulting to yield losses at approximately 20% of the total affectedz hectarage or an equivalent of US $6 million.

This disease continued to be a threat even though some plant breeders have successfully developed cultivars, which proved resistant against brown planthoppers. For instance IR50, IR36 and IR42 are resistant to brown planthoppers, but are susceptible to other insects.

Chapter 3

Research Design and Methodology

This study aimed to determine the insecticidal effect of tobacco leaves against brown planthopper (*Nilaparvata lugens* Stal.). It also determined the difference in the effectiveness of the insecticide from tobacco leaves when the extract-water concentrations were 1:3, 1:2, and 1:1, and the difference in the effectiveness of the insecticide from tobacco leaves compared with the commercial insecticide, methyl parathion.

It was hypothesized that there is no significant difference in the effectiveness of the insecticide from tobacco leaves when the extract-water concentrations were 1:3, 1:2, and 1:1, and no significant difference in the effectiveness of the insecticide from tobacco leaves compared with the commercial insecticide, methyl parathion.

Materials

In testing the insecticide properties of tobacco leaves, the researchers needed spray bottles, net cages, marking pens, disposable masks, disposal gloves, brown planthopper bugs, rice plants, tobacco leaves, water and methyl parathion.

Methods

Planting and Rearing

The researchers first planted rice seedlings and grew them. They needed 15 rice plants for the experiment, three for control. They needed another eight for the rearing of test insects. These served as the food for the test insects. All the rice plants were placed in pots.

In rearing the test insects, the brown planthopper bugs were first collected using nets. These insects were placed in net cages containing rice plants. The cages were made of net and wood.

Preparation of Insecticide

The tobacco leaves were then osteurized and combined with water. There were three concentrations of the extract-water solution. Concentration 1 was composed of one liter of the extract and three liters of water (1:3). Concentration 2 was composed of one liter of the extract and two liters of water (1:2). Concentration 3 was composed of one liter of the extract and one liter of water (1:1).

Treatment Application

Three plants were sprayed with concentration 1. Each plant was sprayed 10 ml of the concentration. The same method was applied to concentrations 2 and 3 and to the methyl parathion. Each control plant was sprayed with 10 ml of water.

Data Collection

When the plants had dried, the researchers placed them in net cages and 10 brown planthopper bugs were placed in each plant. The number of dead bugs was then counted and recorded.

Per concentration, the mean was computed and their differences were subjected to testing using the One-Way ANOVA for any significance. The SPSS was then used to get the ANOVA F-result. Then, the average mean of the extract-water solution was compared with the mean of the commercial insecticide, using the t-test to test for any significance.

Statistical Data Analysis

Certain statistical tools were used in this study. The mean was used as a descriptive statistical tool. The t-test, One-Way Analysis of Variance (ANOVA), and the Scheffe test were used as inferential statistical tools.

Descriptive Statistical Tools

Mean. The mean was used to determine the average of the obtained values for the brown planthoppers' mortality.

Inferential Statistical Tools

t-test. The t-test, set at .05 alpha level of significance, determined the difference in the insecticidal effects between the extract-water solution and methyl parathion.

One-Way Analysis of Variance (ANOVA). The One-Way ANOVA, set at .05 alpha level of significance, determined the significant difference in the mortality of the brown planthoppers among the different concentrations of the extract-water solution.

Scheffe Test. The Scheffe test, also set at .05 alpha level of significance, was a post-hoc multiple comparison test following the difference in the One-Way ANOVA test.

Chapter 4

Results

This study aimed to determine the:

Insecticidal effect of tobacco leaves against brown planthopper (*Nilaparvata lugens* Stal.). It also determined the difference in the effectiveness of the insecticide from tobacco leaves when the extract-water concentrations were 1:3, 1:2, and 1:1, and the difference in the effectiveness of the insecticide from tobacco leaves compared with the commercial insecticide, methyl parathion.

It was hypothesized that there is no significant difference in the effectiveness of the insecticide from tobacco leaves when the extract-water concentrations were 1:3, 1:2, and 1:1, and no significant difference in the effectiveness of the insecticide from tobacco leaves compared with the commercial insecticide, methyl parathion.

Mortality of Brown Planthoppers in Different Concentrations of the extract-water solution

Several of the brown planthoppers died when treated with the insecticide from tobacco leaves.

The mean mortality in the different concentrations were 3.33, 6.00, and 8.33 for Concentration 1, Concentration 2, and Concentration 3 of the extract-water solution respectively.

Table 1 shows the data.

Differences in the Mortality of Brown Planthoppers in Different Concentrations of the extract-water solution

The One-Way ANOVA showed that there was a significant difference in the mortality of the brown planthoppers when treated with different concentrations of the extract-water solution, as reflected by $F(6) = .001$, $p < .05$.

Table 2 shows the data.

The Scheffe test showed that the significance in the mean mortality of the brown planthopper existed among all the concentrations.

Table 3 shows the data.

Table 1

Means of Mortality of Brown Planthoppers treated with Different Concentrations of the extract-water solution

Category	Replicate 1	Replicate 2	Replicate 3	Mean
Concentration 1	3	4	5	3.33
Concentration 2	5	5	6	6.00
Concentration 3	6	7	6	8.33

Table 2

One-Way ANOVA shows the difference in the number of dead Brown Planthoppers treated with Different Concentrations of the extract-water solution

Category	Source of Variation	Df	f	Significance
Concentration Levels	Between group	2	33.800	.001
	Within group	6		
	Total	8		

Table 3

Scheffe test for One-Way ANOVA in Table 2

Category		Mean Difference	Significance
Concentration Levels			
Concentration 1	Concentration 2	-2.67*	.013
Concentration 1	Concentration 3	-5.00*	.001
Concentration 2	Concentration 3	-2.33*	.024

*Mean difference is significant at the .05 level.

Differences in the Mortality of the Brown Planthoppers in the extract-water solution and methyl parathion

The t-test showed that there was a significant difference in the mortality of the brown planthoppers when treated with the insecticide from tobacco leaves and when treated with the commercial insecticide, methyl parathion.

Table 4 shows the data.

Table 4

t-test shows the difference in the number of dead brown planthoppers treated with the extract-water solution and methyl parathion.

Category	Mean	Mean difference	df	t	Significance (2-tailed)
Insecticide from tobacco leaves	5.89	-4.11	4	-2.848	.047
Methyl parathion	10.00				

Chapter 5

Summary, Findings, Conclusions, Recommendations

Summary

This study aimed to test tobacco leaves for their insecticidal effect on brown planthoppers. Specifically, this study answered the following questions:

1. Do tobacco leaves have an insecticidal effect on brown planthoppers (*Nilaparvata lugens* Stal.)?

2. Is there a significant difference in the effectiveness of the insecticide from tobacco leaves when the extract-water concentration is (1) 1:3, (2) 1:2, and (3) 1:1?

3. Is there a significant difference in the effectiveness of the insecticide from tobacco leaves compared with the commercial insecticide, methyl parathion?

Based on these problems, it was hypothesized that there exists no significant difference in the

1. effectiveness of the insecticide from tobacco leaves when the extract-water concentration is (1) 1:3, (2) 1:2, and (3) 1:1

2. effectiveness of the insecticide from tobacco leaves compared with the commercial insecticide methyl parathion.

Findings

This study was able to establish the following findings based on the data gathered:

1. Tobacco leaves have an insecticidal effect against brown planthoppers.

2. There is no significant difference in the effectiveness of the insecticide from tobacco leaves in different extract-water concentrations.

3. There is a significant difference in the effectiveness of the insecticide from tobacco leaves compared with the commercial insecticide, methyl parathion.

Conclusions

Based on the results of the study, the following can be concluded:

Tobacco leaves had the potential to kill brown planthoppers as shown by the mean mortality of 3.33, 6.00, and 8.33 in an original number of 10 brown planthoppers per replicate. There was no significant difference in the effectiveness of the insecticide from tobacco leaves in different extract-water concentrations. These concentrations, therefore, are as potent as each other.

Although tobacco leaves had an insecticidal effect on brown planthoppers, the insecticide made from its extract was still inferior to the commercially-prepared ones because there was a significant difference in the effectiveness of the insecticide from tobacco leaves compared to the commercial insecticide, methyl parathion.

Recommendations

It is recommended that interested researchers continue and pursue this study in other areas.

Future studies can include time exposure as a factor that can affect the mortality rate of the brown planthopper.

Also, the researchers recommend that future researches be conducted on other plants that may have insecticidal effects on brown planthoppers.

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