BIBLIOGRAPHY

CAWA-IT, EVA B. APRIL 2006. Field Efficacy Evaluation of Fungicides for the Control of Mulberry Red Rust (*Aecidium mori* Barclay) in La Trinidad, Benguet. Benguet State University, La Trinidad, Benguet.

Adviser: Valentino L. Macanes

ABSTRACT

The efficacy of five fungicides was evaluated against mulberry red rust. The fungicides were Microthiol DF, Redeem, Funguran OH, Curazeb and Kocide 101. The fungicides were evaluated based on the manufacturer's recommendation as indicated on the container label. The study was conducted from September 2005 to March 2006 at the Benguet State University Sericulture Project in Puguis, La Trinidad, Benguet.

Results of the study revealed that all the fungicide treatments were effective against red rust of mulberry. The plants sprayed with the treatment produced clean and healthy leaves, a kind of leaves excellent as food for silkworms. Nevertheless, Kocide 101 appeared to be slightly more effective among the test fungicides by having the lowest mean rust infections. Besides, the efficacy was relatively quicker. Redeem and Microthiol DF were similarly effective except that their effect were relatively slower in comparison with Kocide 101.

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INTRODUCTION

Nature of the Study

Mulberry is the sole food of mulberry silkworm (*Bombyx mori* L.). The quality of mulberry leaves influenced the development of the silkworms, and therefore in order to be successful in silkworm rearing and cocoon production, the high quality mulberry leaves must be offered (Omura, 1980). Thus, the production of leaves with high nutritive value is the ultimate objective of mulberry cultivation and management.

There are more than thirty (30) kinds of diseases caused by several pathogens and these are fungi, bacteria, mycoplasmas, viruses, and nematodes. Fungal diseases are the most widespread in all mulberry-growing countries all over the world. These diseases are diverse, ranging from infectious disease to physiological disturbance causing considerable damages to the mulberry plants and consequently affect sericulture production (Ting-Zing.et al., 1988). The economic importance of the disease should never be under-estimated.

Mulberry red rust (*Aecidium mori* B.) is parasitic to mulberry and several other related plants. This disease primarily infects mulberry leaves and can cause total defoliation of the plants. Red rust is widely distributed in China, Japan, U.S.S.R, Korea and the Philippines. In Sulawesi Island, Indonesia, this disease is found more frequently on *Morus Alba* L. and *Morus latifolia* Poiveit. The disease occurs during the cool period of the rainy season and almost throughout the year in relatively cool, high altitude areas with moderately high rainfall (Ting-Zing. et al., 1988).

The pathogenic fungus produces aecia and aeciospores. The spores fly and become the source of the subsequent outbreak of the disease. The disease results to a reduced yield and inferior quality of leaves, thus, causing great loss of cocoon production. Red rust mainly affects young buds, leaf blades, petioles and shoots. The affected portions usually swell, curls up in an abnormal shape and many densely and slightly protruded yellow spots are found on the malformed parts which are aecidia of the fungus. This condition reduced nutrition intake by silkworm resulting to prolonged duration of feeding period and eventually malnutrition (Ting-Zing. et al., 1988).

Importance of the Study

Mulberry red rust causes 90-100 % damage to mulberry leaves and sometimes the total defoliation of the plants. Besides, rust-infected leaves directly affect the mulberry silkworm nutrition. Inferior quality cocoons that have short silk filament and thinner denier size are produced from silkworms fed with rusted mulberry leaves (UNDP-ESCAP, 1999).

Mulberry red rust is observed to be the primary disease affecting mulberry fields in Benguet particularly in La Trinidad (Macanes, 2004). It was mentioned likewise that the outbreak of red rust is a great problem to the local sericulture farmers because it normally results to the reduction of cocoon production.

The results of this study will enlighten the local sericulturists on the importance of using the right and economical fungicides for the prevention and control of red rust. Recently, the municipality of Kapangan, Benguet has adapted sericulture as its One-Town-One Product (OTOP) under the Department of Trade and Industry-CAR (Baguio

Midland Courier, February 2005). Thus, the production of quality mulberry leaves is the aim of this research. This knowledge together with other optimum cultural practices contributes much to the success of mulberry leaf production. Likewise, this study may also contribute to the sericulture researchers in the correct choice of fungicide/fungicides for the control of mulberry red rust in the locality.

Objectives of the Study

This study aims to:

1. To gather information on the prevention or control efficacy of five locally available fungicides against red rust of mulberry.
2. To determine the disease severity of mulberry red rust from each of the treatments and,
3. To identify the most effective and economical fungicide/fungicides for the control mulberry red rust.

Time and Place of Study

The study was conducted at the Benguet State University Sericulture Project in Puguis, La Trinidad, Benguet from September 2005 to March 2006.

REVIEW OF LITERATURE

Economic Importance Of Mulberry

Mulberry is the sole food of mulberry silkworm (*Bombyx mori* L.). The quality of mulberry leaves influenced the development of the silkworms and therefore in order to be successful in silkworm rearing and cocoon production, high quality mulberry leaves must be offered (Omura, 1980).

Alos (1986) as cited by Langbis (2001) stated that mulberry leaf varieties have a predominating influence on the development of the worm and the quality of cocoons. Mulberry leaves can also be an answer to the existing livestock feed industry problem by being a substitute as feeds for domestic livestock because it has high crude protein content of 80%. The fruit are likewise edible for human consumption. Some of the processed preparations of the fruits are jam, jelly or candy. It can also be eaten raw.

Ray (1989) quoted: “A guess, a hope which may yet save the mankind.” Aside from the sericultural importance of mulberry, it is equated as medicines to various diseases. The mulberry leaves are considered as diaphoretic and emollient. A decoction of leaves is used as a gargle in the inflammation of the throat. The fruit is laxative and refrigerant and is used for soar throat, dyspepsia, and melancholia. The juice of black mulberry is medicinal for convalescence after febrile disease. It also checks thirst and cools the blood. The root of the mulberry plant possesses astringent and anthelmintic properties. The bark is used as purgative and vermifuge. *Morus nigra* L. or black mulberry is now in the headlines for its omnipotent medicinal properties. It could even cure the disease AIDS.

Economic Importance of Red Rust

The plant rusts caused by Basidiomycetes of the Order Urticales are among of the most destructive plant diseases. They have been notorious for their destructiveness on crops.

Agrios (1997) stated that rust-infected plants show increase water loss because they transpire more water through the ruptured epidermis. In addition, the fungus competes with the plants by absorbing more nutrients and water. Photosynthesis of diseased plants is likewise reduced considerably. The fungus also interferes in root development and uptake of nutrients and alters normal growth of the plant. Likewise, it reduces the quantity and quality of the plant hence the economic importance of red rust should never be underestimated.

Importance of Fungicides

Fungicide is a chemical substance that kills fungi and checks the growth of fungus spores. Usually, fungicides are classified as organic and inorganic. On the other hand, the use of organic fungicides has largely replaced by the inorganic fungicides. The most important inorganic fungicides that are commonly used are Bordeaux mixture and sulfur (New Standard Encyclopedia, 1998).

Most fungicides are protective and must be present on the surface of the plant before the pathogen in order to prevent infection. Some new fungicides have direct effect on pathogens on the leaves, fruits and stem, and in this case, they act as radicands which kill the fungus inside the host or may suppress the sporulation of the fungus. Some fungicides are effective in post infection applications that they can be used as rescue treatments of crops and therefore can be applied effectively after infection has already taken place. Fungicides applied as sprays are generally more efficient in creating a protective residue layer on the plant surfaces than when applied as dusts. Neither dust nor sprays stick well when applied during a rain (Agrios, 1997).

The Pathogenic Fungus

The pathogenic fungus of the mulberry red rust disease is *Aecidium mori* B. It belongs to Sub-division: Basidio; Class: Aecidiomycetes; Order: Urediorates; Family: Imperfect and Genus: Aecidium. The fungus produces aecia and aeciospores.

Generally, the aecium is about 150 u. in diameter. A layer of protective membrane made of oval, polyhedral cells on the surface of which are found small prickles, surrounds it. The aeciospores are colorless and polyhedral at the beginning and later on become gradually circular in shape. When mature, the aeciospores are circular and oval, orange in color with tiny prickles on the surface, 13-20 x 10-17 u. They disperse through the opening of the aecium and germinate quickly under adequate temperature and humidity (Ting-Zing. et al., 1988).

Disease Infection

The young buds and leaves are the infection sites. The infected parts thickened, curved and the color turns orange. The new shoots stop on growing, the infected parts remains as black spots and becomes the source of inoculum for infection (Morimoto, 1981).

The affected parts of the young bud becomes swollen, the young bud curls up in an abnormal shape and many densely and slightly protruded yellow spots are found on the malformed bud which are the aecidia of the fungus. Numerous small, round and shiny spots are found on both surfaces of the affected leaves. These will later protrude gradually, turning yellow in color. Finally, the epidermis on the yellow spot is broken and a yellowish powdery substance, the aeciospores scatters everywhere on the leaf. The mycelia of the fungus stay in the branches of the mulberry especially in the tissues of the buds. Aecia are formed as the buds sprouts and aeciospores are disseminated by rain and wind on the host plants. After the aeciospores have germinated, the tips of the germ tubes adhere tightly to the host's epidermis, penetrate into the cuticle and the epidermal cells develop to a mycelia. The mycelia spread into the host's tissue and absorb nutrients from the host's cells (Ting-Zing. et al., 1988).

Affecting Factors

The incidence of mulberry red rust is closely related to climatic conditions. The temperature range for the outbreak of the disease is 10-27 ^{0}C while the optimum for the growth of the pathogenic fungus is 20-25 ^{0}C. When the temperature is 18-30 ^{0}C, the rate of infection would increase but the formation of aeciospores would be inhibited in a temperature higher than 30 ^{0}C. Humidity likewise plays an important role during the infection. If the relative humidity is more than 80 percent, the rate of infection is higher; sometimes it may reach infection to as high as 100 percent. If the relative humidity is 77-78 percent, the rate of infection decreases to 85 percent according to Ting-Zing. et al. (1988).

According to Strange (1993), fungal pathogens in particular are affected by moisture since it is important for spore germination and infection of the host. It is likewise very necessary for sporulation and in some instances for dissemination. Free water is necessary for the germination of several rust fungi. Uredospores are hydrophobic and when present in mass in a pustule, they are not easily wetted. A high incidence of many diseases is associated with the rain. Not only does precipitation provide the humidity requirements of many fungal pathogens for sporulation and infection but it may also contribute for dispersal.

A number of fungal pathogens has rather specific requirement for light or darkness in order to sporulate. Blue or near UV light has been known to promote sporulation in some fungi as cited by Reuveni et al. (1989) as stated by Strange (1993).

MATERIALS AND METHODS

The materials used in this study were bolos, pruning shears, 1.5 L knapsack sprayer, measuring container, gloves and other cleaning tools. The existing Batac mulberry variety was selected for this study considering their susceptibility to mulberry red rust. The study was conducted during the period wherein the disease is observed to be severe.

The site of the study was cleaned prior to the experiment. Mulberry plants were pruned and cleaned from weeds. After new shoots were produced, the mulberry plants were tagged with paraffin-coated cardboard to distinguish the sample plants of the treatments before the application of different fungicides.

There were five chemical fungicides used in this study. They were Microthiol DF (Sulfur), Redeem (Mancozeb), Funguran OH (Copper Hydroxide), Curazeb (Mancozeb) and Kocide 101 (Cupric Hydroxide). Each fungicide was prepared into a solution by following the dosage as recommended by the manufacturer. Data gathering was done day before the scheduled treatment applications.

The study was conducted by adapting the randomized complete block design (RCBD). Each of the treatments was replicated three times. The treatments were as follows:

Treatments	Brand Name	Common Name
T_0	Untreated	No fungicide applied
T_1	Microthiol DF	Sulfur
T_2	Redeem	Mancozeb

T_3	Funguran OH	Copper Hydroxide
T_4	Curazeb	Mancozeb
T_5	Kocide 101	Cupric Hydroxide

Treatment application was based on the manufacturer's recommendation until the termination of the study. Plastic sheets were used as barriers to the plants during the fungicide application to prevent the spray mists from drifting to other treatment plants. Treatment applications were done at seven-day intervals. All the treatments received the same recommended cultural practices such as weeding, fertilizer application and irrigation.

Data Gathered:

1. Disease severity on the whole plant. Rust incidence evaluation was done day before the scheduled application of the treatments. The whole plants were thoroughly observed for disease infection. The 9-point field scale for rust infection reading was used as recommended by Subba Rao. et al. (1991) as stated by Strange (1993):

Infection Type	Symptoms	Disease Severity (%)
1	No disease	0
2	Lesions sparsely distributed on lower leaves	1-5

3	Many lesions on lower leaves, necrosis evident, very few lesions present on middle leaves	6-10
4	Numerous lesions present on lower and middle leaves; severe necrosis on lower leaves	11-20
5	Severe necrosis of lower and middle leaves. Lesions may be present on top of leaves but less severe.	21-30
6	Extensive damage to lower leaves. Lesions densely present on middle leaves with necrosis, lesions present on top leaves.	31-40
7	Severe damage on lower and middle leaves; lesions densely distributed on top leaves.	41-60
8	100 % damage to lower and middle leaves; lesions present on top leaves with severe necrosis.	61-80
9	Almost all leaves withering, bare stems present	81-100

2. Leaf and petiole cleanliness. The presence of red rust on leaves and petioles were observed using the following scale as stated by Castillo (2000):

Scale	Description
1	No rust (0%)
3	Slight rust incidence (1-25%)
5	Moderate rust incidence (26-50%)
7	Less severe rust incidence (51-75%)
9	Severe rust incidence (76-100%)

3. Weather data. The weather data particularly on temperature, relative humidity, and rainfall counts was gathered from the PAG-ASA Weather Station at Balili, La Trinidad, Benguet during the duration of the study.

RESULTS AND DISCUSSION

Initial Assessment on the Disease Severity Before the Treatment Applications

Table 1 shows the initial assessment on the disease severity of red rust on the treatment. The rating ranged from 2.89-3.33, which means that plants had 6% to 10% infection of the disease.

TABLE 1. Initial leaf assessment on plants when fungicides were not yet applied

TREATMENTS	INITIAL ASSESSMENT
Control	3.22
Microthiol DF	3.33
Redeem	3.00
Funguran Oh	3.22
Curazeb	3.33
Kocide 101	2.89

Means are not significantly different at 5% DMRT

Disease Severity of the
Plants After First to Fourth
Treatment Applications

Table 2 revealed that there were no significant differences observed among the treatments as shown by the ANOVA. However, the untreated plants gave the highest disease severity of 3.31, which means that there are many lesions on lower leaves, necrosis evident and very few lesions present on middle leaves. On the other hand, the plants sprayed with Kocide 101had the lowest rating of 2.52 (lesions sparsely distributed on the lower leaves). The result shows that the duration of time was not enough to measure the efficacy of fungicides.

TABLE 2. Severity rating (%) of mulberry red rust after the first to fourth application of the treatments

TREATMENTS	DOSAGE tbsp/ 16 L H_2O	RATING				MEAN AVE.
		1st	2nd	3rd	4th	
Untreated		3.22	3.22	3.22	3.56	3.31
Microthiol DF	5	2.66	2.66	2.66	2.33	2.58
Redeem	4	2.89	2.89	2.89	2.67	2.84
Funguran OH	2	2.78	2.78	2.78	2.55	2.72
Curazeb	4	2.89	2.89	2.89	2.22	2.72
Kocide 101	2	2.55	2.55	2.55	2.44	2.52

Means are not significantly different at 5% level by DMRT

Disease Severity of the
Plants After Fifth to Eighth
Treatment Applications

Table 3 shows the disease severity results after the fifth to eighth applications of the treatments. During the fifth application of the treatments, a highly significant difference between the untreated plants and the fungicide-treated plants were observed. The unsprayed plants had a disease severity rating of 4.0 which means that there were no numerous lesions on the lower and middle leaves with severe necrosis on the lower leaves. In the case of the fungicide-applied mulberry plants, the ANOVA showed no significant differences. However, Kocide 101 showed the least disease severity of 1.89 which indicates that the lesions are sparsely distributed on the lower leaves.

It was also during this period when the temperature was 24 ^{0}C and the relative humidity was 82%. These environmental conditions were highly favorable for the disease to develop and spread (Ting-Zing. et al., 1988).

The ANOVA showed highly significant differences between the treated and the untreated plants after the sixth application of the treatments. The result implies that the fungicides tested were all effective against the disease. However, the lowest rating was recorded on Kocide 101-sprayed plants with a mean of 1.67 followed by Redeem with mean of 2.00 and a mean of 2.11 for Microthiol DF. The untreated plants had the highest rating of 4.22. The damage ratings on the treatments were the lowest ratings ever recorded during the study period.

TABLE 3. Severity rating (%) of mulberry red rust after fifth to eighth application of the treatments

TREATMENTS	DOSAGE Tbsp/ 16 L H_2O	RATING				MEAN AVE.
		5th	6th	7th	8th	
Untreated		4.00[a]	4.22[a]	4.22[a]	4.44[a]	4.22[a]
Microthiol DF	5	2.11[b]	2.11[b]	2.11[b]	2.11[b]	2.11[b]
Redeem	4	2.11[b]	2.00[b]	2.00[b]	2.00[b]	2.03[b]
Funguran OH	2	2.33[b]	2.22[b]	2.22[b]	2.22[b]	2.19[b]
Curazeb	4	2.33[b]	2.22[b]	2.11[b]	2.22[b]	2.22[b]
Kocide 101	2	1.89[b]	1.67[b]	1.89[b]	2.00[b]	1.86[b]

Means followed by similar letters are not significantly different at 5% level by DMRT

The efficacy of the different fungicides tested against mulberry red rust remains evident until the seventh application. There was a significant difference between the sprayed and the unsprayed plants. The unsprayed mulberry gave the highest disease infection of 4.22. There were no significant differences observed on the fungicide-treated plants. However, Kocide 101 exhibited the best control with the lowest disease infection of 1.89.

A highly significant differences were noted between the plant-sprayed with fungicides against the unsprayed plants after the eighth application of the treatments. The unsprayed mulberry plants gave the highest disease infection of 4.44. On the other hand, there were no significant infection differences between fungicides treatments. Numerically, the treatment of Kocide 101 exhibited the lowest disease infection.

Disease Severity of the
Plants After Ninth to Twelfth
Treatment Applications

Table 4 presents the disease severity results after ninth to twelfth application of the treatments. As revealed by the ANOVA, there were a highly significant differences between the treated plants and the untreated plants. The untreated plants gave the highest disease infection rating of 4.44 or approximately 11-20% of disease infection in comparison with the treated plants. Significant differences were not noted on the mulberry plants sprayed with fungicides. Among the test fungicides, Kocide 101 and Redeem showed the lowest infection by red rust (Table 4).

TABLE 4. Severity rating (%) of mulberry red rust after ninth to twelfth application of the treatments

TREATMENTS	DOSAGE tbsp/ 16 L H_2O	RATING				MEAN AVE.
		9th	10th	11th	12th	
Untreated		4.44^a	4.44^a	4.66^a	4.67^a	4.55^a
Microthiol DF	5	2.11^b	2.00^b	2.22^b	2.22^b	2.14^b
Redeem	4	2.00^b	2.11^b	2.11^b	2.22^b	2.11^b
Funguran OH	2	2.22^b	2.11^b	2.11^b	2.22^b	2.17^b
Curazeb	4	2.22^b	2.22^b	2.33^b	2.33^b	2.28^b
Kocide 101	2	2.00^b	2.00^b	2.00^b	2.11^b	2.03^b

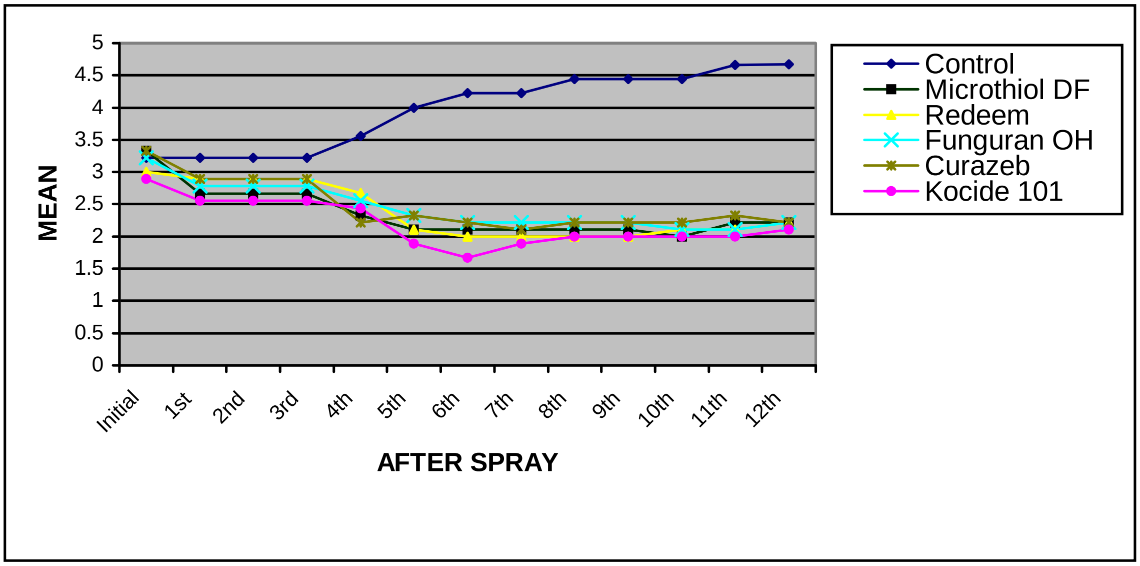
Means followed by similar letters are not significantly different at 5% level by DMRT

The tenth application of the treatments showed a highly significant difference between the fungicide-treated plants and the untreated plants. The untreated plants showed the highest disease infection of 4.44. There was no significant disease infection difference on the fungicide-treated mulberry plants. Numerically however, the Kocide 101 and Microthiol DF-sprayed plants showed the lowest disease infection of 2.00, a result which implies that Microthiol DF and Funguran OH needs a longer period of time in order to have an evident efficacy.

The eleventh spraying of test fungicides showed that there was a highly significant difference between the treated and the untreated plants. The untreated plants gave the highest disease infection rating of 4.66 which is approximately 21-30% infection or severe necrosis on lower and middle leaves. On the other hand, no significant differences were observed among the treated plants. Numerically, Kocide 101 was noted with the lowest disease infection of 2.00.

The twelfth application of test fungicides showed a highly significant difference between the treated and the untreated plants as shown by the ANOVA. There was no significant infection difference between the treated plants. However, Kocide 101 gave the lowest rating of 2.11. Gradual increase on disease infection was observed on the treatments except the Curazeb with a disease infection of 2.33, the highest infection rating among the treated plants.

The effect of the different fungicides on the severity of red rust of mulberry is summarized in Fig. 1. Kocide 101 was the most effective fungicide against the disease with the lowest degree of rust infection.



FI8GURE 1. The effect of the different fungicides on the severity of red rust of mulberry.

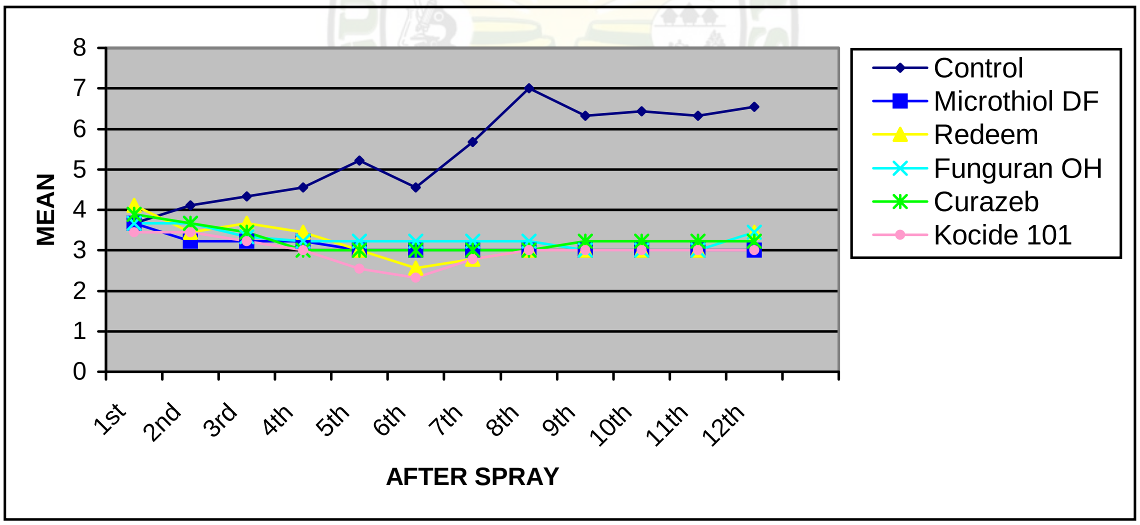


FIGURE 2. Leaf and petiole cleanliness of mulberry after twelve applications of the treatments

<u>Initial Leaf Assessment
on Leaf and Petiole Cleanliness
Before Treatment Applications</u>

Table 5 shows the results of the initial assessment on the leaf and petiole cleanliness on the treatments. The rating ranged from 3.67 to 4.11, which means that there was a moderate rust incidence on the leaves of the mulberry.

TABLE 5. Leaf assessment on the respective plants before treatment applications

TREATMENTS	INITIAL ASSESSMENT
Untreated	3.67
Microthiol DF	3.67
Redeem	4.11
Funguran OH	3.89
Curazeb	3.89
Kocide 101	3.67

Means are not significantly different at 5% level by DMRT

Leaf and Petiole Cleanliness
After First to Second
Treatment Applications

Table 6 shows the results of the leaf and petiole cleanliness after the first to second application of the treatments. The quality of leaf and petiole cleanliness obtained from the treatments did not differ significantly as revealed by the ANOVA. The mean quality ranged from 3.45 to 3.89 that is, 20%-35% of the leaves were infected by rust.

TABLE 6. Leaf and petiole cleanliness of mulberry after first to second application of the treatments

TREATMENTS	DOSAGE tbsp/ 16 L H_2O	RATING 1st	2nd	MEAN AVE.
Untreated		3.67	4.11	3.89
Microthiol DF	5	3.67	3.22	3.45
Redeem	4	4.11	3.44	3.78
Funguran OH	2	3.67	3.67	3.67
Curazeb	4	3.89	3.67	3.78
Kocide 101	2	3.45	3.44	3.45

Means are not significantly different at 5% level by DMRT

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The ANOVA revealed a significant difference among the treatments after the third application of treatments. The untreated plants gave the lowest quality of leaf and petiole cleanliness with mean of 4.33 while the plants sprayed with Kocide 101 and Microthiol DF had the highest quality of leaf and petiole cleanliness with mean of 3.22 (slight rust incidence).

TABLE 7. Leaf and petiole cleanliness of mulberry after third application of the treatments

TREATMENTS	DOSAGE tbsp/ 16 L H^2O	AFTER SPRAY
Untreated	No Fungicide	4.33[a]
Microthiol DF	5	3.22[b]
Redeem	4	3.67[ab]
Funguran OH	2	3.33[ab]
Curazeb	4	3.45[ab]
Kocide 101	2	3.22[b]

Means followed by the same letters are not significantly different at 5% level by DMRT

The fourth application of treatments showed no significant differences among the treatments as revealed by the ANOVA. However, the DMRT specified that plants sprayed with Curazeb and Kocide 101 showed a quality of leaf and petiole cleanliness mean of 3.00, significantly different with the untreated plants with the cleanliness rating of 4.55.

TABLE 8. Leaf and petiole cleanliness of mulberry after fourth application of the treatments

TREATMENTS	DOSAGE tbsp/ 16 L H^2O	AFTER SPRAY
Untreated	No Fungicide	4.55[a]
Microthiol DF	5	3.22[b]
Redeem	4	3.44[ab]
Funguran OH	2	3.22[b]
Curazeb	4	3.00[b]
Kocide 101	2	3.00[b]

Means followed by the same letters are not significantly different at 5% level by DMRT

A highly significant difference of the treated and the untreated plants was observed during the fifth application of the treatments. The untreated plants showed the lowest leaf quality and petiole cleanliness of 5.22. The plants treated with fungicides had no significant differences as revealed by the ANOVA. Among the fungicide treatments, the plants sprayed with Kocide 101 were observed with slightly higher leaf quality and petiole cleanliness with a mean of 2.55 mean.

TABLE 9. Leaf and petiole cleanliness of mulberry after fifth application of the treatments

TREATMENTS	DOSAGE tbsp/ 16 L H^2O	AFTER SPRAY
Untreated	No Fungicide	5.22[a]
Microthiol DF	5	3.00[b]
Redeem	4	3.00[b]
Funguran OH	2	3.22[b]
Curazeb	4	3.00[b]
Kocide 101	2	2.55[b]

Means followed by the same letters are not significantly different at 5% level by DMRT

While the ANOVA in Table 10 showed no significant differences among treatments, the DMRT revealed that the untreated plants significantly differ with all the test fungicides except the treatment of Funguran OH. The highest leaf quality and petiole cleanliness was recorded on plants sprayed with Kocide 101 with mean a of 2.33.The untreated plants gave the lowest leaf quality and petiole cleanliness of 4.56 a rating with a rust incidence of 26% to 50%. The untreated plants were observed to be waterless and with rough surfaces which corresponds to the claimed of Agrios (1997) that rust-infected plants show increase water loss as a result of quick transpiration because of the presence of ruptured epidermis.

TABLE 10. Leaf and petiole cleanliness of mulberry after sixth application of the treatments

TREATMENTS	DOSAGE tbsp/ 16 L H^2O	AFTER SPRAY
Untreated	No Fungicide	4.56^{a}
Microthiol DF	5	3.00^{b}
Redeem	4	2.56^{b}
Funguran OH	2	3.22^{ab}
Curazeb	4	3.00^{b}
Kocide 101	2	2.33^{b}

Means followed by the same letters are not significantly different at 5% level by DMRT

The seventh application of the treatments showed that there was a highly significant difference between the treated and untreated plants. Highest rust infection of 5.67 was noted on the untreated plants by having the lowest leaf quality and petiole cleanliness. There was no significant rust infection difference between the fungicide-sprayed plants. The plants sprayed with Redeem and Kocide 101 gave the lowest numerical rust infection of 2.78, the best leaf quality and petiole cleanliness

TABLE 11. Leaf and petiole cleanliness of mulberry after seventh application of the treatments

TREATMENTS	DOSAGE Tbsp/ 16 L H^2O	AFTER SPRAY
Untreated	No Fungicide	5.67[a]
Microthiol DF	5	3.00[b]
Redeem	4	2.78[b]
Funguran OH	2	3.22[b]
Curazeb	4	3.00[b]
Kocide 101	2	2.78[b]

Means followed by the same letters are not significantly different at 5% level by DMRT

The eighth application of treatments showed that there was a highly significant difference between the treated and untreated plants. The untreated plants gave rust infection of 7.00 or the lowest leaf quality and petiole cleanliness characterized by having a dull leaf and stem due to the destruction by the fungus. According to Agrios (1997), rust reduces photosynthesis of plants and eventually leaf development.

The plants treated with fungicides showed no significant differences based on the ANOVA. However, the plants sprayed with Microthiol DF, Redeem, Curazeb and Kocide 101 had similar infection of 3.00 or a leaf with slight rust incidence.

TABLE 12. Leaf and petiole cleanliness of mulberry after eighth application of the treatments

TREATMENTS	DOSAGE tbsp/ 16 L H^2O	AFTER SPRAY
Untreated	No Fungicide	7.00[a]
Microthiol DF	5	3.00[b]
Redeem	4	3.00[ab]
Funguran OH	2	3.22[b]
Curazeb	4	3.00[b]
Kocide 101	2	3.00[b]

Means followed by the same letters are not significantly different at 5% level by DMRT

Leaf and Petiole Cleanliness
After Ninth to Twelfth
Treatment Applications

A highly significant difference between the treated and untreated plants was observed after the ninth application of the treatments. Untreated plants gave the highest mean of 6.33 or the leaf with lowest quality and petiole cleanliness. The plants treated with fungicides showed no significant differences as revealed by the ANOVA. The plants sprayed with Microthiol DF, Redeem, Funguran OH and Kocide 101 showed a similar rating of 3.00 which means that the leaves were slightly infected by rust.

TABLE 13. Leaf and petiole cleanliness of mulberry after ninth to twelfth applications of the treatments

TREATMENTS	DOSAGE tbsp/ 16 L H_2O	RATING 9th	10th	11th	12th	MEAN AVE.
Untreated		6.33[a]	6.44[a]	6.33[a]	6.55[a]	5.66[a]
Microthiol DF	5	3.00[b]	3.00[b]	3.00[b]	3.00[b]	3.00[b]
Redeem	4	3.00[b]	3.00[b]	3.00[b]	3.44[b]	3.11[b]
Funguran OH	2	3.00[b]	3.00[b]	3.00[b]	3.44[b]	3.11[b]
Curazeb	4	3.22[b]	3.22[b]	3.22[b]	3.22[b]	3.22[b]
Kocide 101	2	3.00[b]	3.00[b]	3.00[b]	3.00[b]	3.00[b]

Means followed by the same letters are not significantly different at 5% level by DMRT

After the tenth applications of the test fungicides, a highly significant difference was observed between the treated and the untreated plants. The untreated plants showed the highest infection with a mean of 6.44, the leaf with the lowest quality and petiole cleanliness.

The eleventh application of the treatments showed a highly significant difference between the treated and the untreated plants. The results of the treatments remain stable from the last application while the untreated plants showed the highest infection of rust with a mean of 6.33 or the leaf with the lowest quality and petiole cleanliness.

After the twelfth application of treatment, there was a highly significant difference noted between the treated and the untreated plants. The untreated plants produced leaves and petioles that were highly infected by rust. The plants treated with fungicides had no significant differences as revealed by the ANOVA. The plants treated with Microthiol DF and Kocide 101 produced the highest leaf quality and petiole cleanliness and the plants treated with Microthiol DF and Kocide 101 produced less rust infected leaves and petioles. The untreated plants were heavily infected by rust.

Figure 2 summarized the leaf and petiole cleanliness of mulberry after several applications of the treatments.

Figure 3. T_0-Sample leaves from the untreated plants. Shoots and young leaves are curled and numerous lesions are present on the surface of the leaves.

Figure 4. T_1- Sample plant sprayed with Microthiol DF. Lesions are sparsely distributed on the lower leaves.

Figure 5. T_2- Sample plant sprayed with Redeem.
Lesions are sparsely distributed to the lower leaves.

Figure 6. T_3-Sample plant sprayed with Funguran OH.
Many lesions are present on the lower leaves.

Figure 7. T_4-Sample plant sprayed with Curazeb.
Many lesions on lower leaves and
few lesions present on middle leaves.

Figure 8. T_5- Sample plant sprayed with Kocide 101.
Very few lesions are present on
the lower leaves.

TABLE 14. Market price of the test fungicides during the duration of the study

BRAND NAME	CHEMICAL NAME	PRICE/Kg (Ph.p)
Microthiol DF	Sulfur	189.00
Redeem	Mancozeb	295.00
Funguran OH	Copper Hydroxide	345.00
Curazeb	Mancozeb	380.00
Kocide 101	Cupric Hydroxide	330.00

General Observations

Young leaves or leaves at the upper portion of the stem of mulberry were first infected by rust. Orange powdery substances which are circular in shape were found on the leaf surfaces and petioles of the infected leaves. There was a gradual increase of the disease infection on the untreated or unsprayed plants while the disease infection on the treated plants decreases up to the seventh observation. There was a slight increased of red rust infection towards the termination of the study. The study therefore, proved that the incidence of red rust of mulberry is closely related to climatic conditions. The temperature range of 19.1-25.6 ^{0}C and the relative humidity (RH) range of 79-80% occurred in the area during the period of the study. Meanwhile an average rainfall of 36.8 mm was obtained. These environmental conditions were highly favorable for the disease as stated by Ting-Zing. et al. (1988).

SUMMARY, CONCLUSION AND RECOMMENDATION

Mulberry red rust is parasitic to mulberry and other several related plant varieties. It is a prevalent disease during the summer season. Thus, this study was conducted on time (September, 2005 to March, 2006).

Each mulberry plant was tagged and assigned as sample in accordance with the treatments leaving two plants as borders in between the sample plants. Different fungicide treatments were applied/sprayed in seven days interval. The rate and frequency of application of the fungicides were based on the dosage as recommended by the manufacturer. Data on disease severity and quality of leaf and petiole cleanliness were gathered before the application of the treatments.

Results of the study revealed that all the test fungicides were significantly effective against the red rust of mulberry. Those plants that were spayed produced clean and healthy leaves, favorable as food by the silkworms. Nevertheless, Kocide 101 appeared to be slightly more effective than the other test fungicides. This fungicide produced plants that were least infected by rust.

Redeem and Microthiol DF gave effective control but it took a longer period of time for its effectivity to be evident. The Microthiol DF, Redeem and Kocide 101 had a price of Php 189/kg, Php 295/kg and Php 330/kg, respectively, making them economical and effective in controlling the red rust of mulberry. On the other hand, Curazeb and Funguran OH showed the lowest efficacy in the control of mulberry red rust. Besides they were expensive with a price of Php 380/kg and Php 345/kg respectively. The unsprayed plants were heavily infected by red rust.

Environmental factors particularly temperature and relative humidity greatly affected the occurrence of the disease. It was noted that there were a favorable temperature range of 19.1-25.6^{o}C and relative humidity of 79-80% in the disease during the study period.

The study further found out that spraying could be done from one month to 1½ month to control the mulberry rust. However, further study needs to be conducted especially the time as to when the fungicide-treated mulberry is safe as food for the silkworms.

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APPENDICES

APPENDIX TABLE 1. Disease Severity. Initial leaf assessment on plants when fungicides were not yet applied

TREATMENTS	INITIAL ASSESSMENT
Control	3.22
Microthiol DF	3.33
Redeem	3.00
Funguran Oh	3.22
Curazeb	3.33
Kocide 101	2.89

APPENDIX TABLE 2. Disease Severity. First application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	3.33	3.33	3.33	9.99	3.22
Microthiol DF	3.33	3.67	3.00	10.00	2.66
Redeem	2.33	2.67	4.00	9.00	2.89
Funguran OH	3.33	3.33	3.00	9.66	2.78
Curazeb	2.67	3.67	3.33	9.67	2.89
Kocide 101	2.33	3.00	3.33	8.66	2.55

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.71	0.35	1.62		
Treatment	5	0.50	0.10	0.46^{ns}	3.33	5.64
Error	10	2.18	0.22			
Total	17	3.39				

ns = not significant　　Coefficient of Variation =14.76%

APPENDIX TABLE 3. Disease Severity. Second application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	3.00	3.33	3.33	9.66	3.22
Microthiol DF	2.33	3.33	2.33	7.99	2.66
Redeem	2.00	3.00	3.67	8.67	2.89
Funguran OH	2.67	2.67	3.00	8.34	2.79
Curazeb	2.67	3.00	3.00	8.67	2.89
Kocide 101	2.33	2.33	3.00	7.66	2.55

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	1.03	0.52	3.31		
Treatment	5	0.80	0.16	1.02^{ns}	3.33	5.64
Error	10	1.56	0.16			
Total	17	3.39				

ns = not significant

Coefficient of Variation =13.95%

APPENDIX TABLE 4. Disease Severity. Third application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	3.00	3.33	3.33	9.66	3.22
Microthiol DF	2.33	3.33	2.33	7.99	2.66
Redeem	2.00	3.00	3.67	8.67	2.89
Funguran OH	2.67	2.67	3.00	8.34	2.78
Curazeb	2.67	3.00	3.00	8.67	2.89
Kocide 101	2.33	2.33	3.00	7.66	2.55

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	1.03	0.52	3.31		
Treatment	5	0.80	0.16	1.02^{ns}	3.33	5.64
Error	10	1.56	0.16			
Total	17	3.39				

ns = not significant

Coefficient of Variation =13.95%

APPENDIX TABLE 5. Disease Severity. Fourth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	3.67	3.00	4.00	10.67	3.56
Microthiol DF	2.00	3.00	2.00	7.00	2.33
Redeem	1.67	2.67	3.67	8.01	2.67
Funguran OH	2.33	2.33	3.00	7.66	2.55
Curazeb	2.00	2.00	2.67	6.67	2.22
Kocide 101	2.33	2.00	3.00	7.33	2.44

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	1.72	0.86	3.33		
Treatment	5	3.46	0.69	2.68^{ns}	3.33	5.64
Error	10	2.58	0.26			
Total	17	7.77				

ns = not significant

Coefficient of Variation =19.32%

APPENDIX TABLE 6. Disease Severity. Fifth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	4.00	4.00	4.00	12.00	4.00
Microthiol DF	2.00	2.33	2.00	6.33	2.11
Redeem	1.33	2.00	3.00	5.33	2.11
Funguran OH	2.00	2.33	2.67	7.00	2.33
Curazeb	2.00	2.33	2.67	7.00	2.33
Kocide 101	1.67	1.67	2.33	5.67	1.89

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	1.13	0.56	5.12		
Treatment	5	8.92	1.78	16.24**	3.33	5.64
Error	10	1.10	0.11			
Total	17	11.15				

** = highly significant

Coefficient of Variation =13.46%

APPENDIX TABLE 7. Disease Severity. Sixth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	4.33	3.67	4.67	12.67	4.00
Microthiol DF	2.00	2.33	2.00	6.33	2.11
Redeem	1.33	2.00	2.67	6.00	2.11
Funguran OH	2.00	2.33	2.33	6.66	2.33
Curazeb	2.00	2.33	2.33	6.66	2.33
Kocide 101	1.33	1.67	2.00	5.00	1.89

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.76	0.37	3.45		
Treatment	5	12.51	2.50	22.77**	3.33	5.64
Error	10	1.10	0.11			
Total	17	14.37				

** = highly significant Coefficient of Variation =13.78%

APPENDIX TABLE 8. Disease Severity. Seventh application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	4.33	4.00	4.33	12.66	4.32
Microthiol DF	2.00	2.33	2.00	6.33	2.11
Redeem	1.67	2.00	2.33	6.00	2.00
Funguran OH	2.00	2.33	2.33	6.66	2.22
Curazeb	2.00	2.33	2.00	6.33	2.11
Kocide 101	1.67	2.00	2.00	5.67	1.89

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.19	0.10	2.50		
Treatment	5	11.79	2.36	60.89**	3.33	5.64
Error	10	0.39	0.04			
Total	17	12.37				

** = highly significant

Coefficient of Variation =8.11%

APPENDIX TABLE 9. Disease Severity. Eighth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	4.33	4.00	5.00	13.33	4.44
Microthiol DF	2.00	2.33	2.00	6.33	2.11
Redeem	2.00	2.00	2.00	6.00	2.00
Funguran OH	2.00	2.33	2.33	6.66	2.22
Curazeb	2.00	2.33	2.33	6.66	2.22
Kocide 101	2.00	2.00	2.00	6.00	2.00

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.15	0.07	1.25		
Treatment	5	13.76	2.75	46.66**	3.33	5.64
Error	10	0.59	0.06			
Total	17	14.49				

** = highly significant

Coefficient of Variation =9.72%

APPENDIX TABLE 10. Disease Severity. Ninth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	4.33	4.00	5.00	13.33	4.44
Microthiol DF	2.00	2.33	2.00	6.33	2.11
Redeem	2.00	2.00	2.00	6.00	2.00
Funguran OH	2.00	2.33	2.33	6.66	2.22
Curazeb	2.00	2.33	2.33	6.66	2.22
Kocide 101	2.00	2.00	2.00	6.00	2.00

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.15	0.07	1.25		
Treatment	5	13.76	2.75	46.66**	3.33	5.64
Error	10	0.59	0.06			
Total	17	14.49				

** = highly significant

Coefficient of Variation =9.72%

APPENDIX TABLE 11. Disease Severity. Tenth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	4.33	4.00	5.00	13.33	4.44
Microthiol DF	2.00	2.00	2.00	6.00	2.00
Redeem	2.00	2.00	2.33	6.33	2.11
Funguran OH	2.00	2.00	2.33	6.33	2.11
Curazeb	2.00	2.33	2.33	6.66	2.22
Kocide 101	2.00	2.00	2.00	6.00	2.00

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.31	0.15	3.55		
Treatment	5	13.97	2.79	64.85**	3.33	5.64
Error	10	0.43	0.04			
Total	17	14.71				

** = highly significant

Coefficient of Variation =8.37%

APPENDIX TABLE 12. Disease Severity. Eleventh application of the treatments

Treatment	Block			Total	Mean
	I	II	III		
Untreated	4.67	4.33	5.00	14.00	4.66
Microthiol DF	2.00	2.33	2.33	6.66	2.22
Redeem	2.00	2.00	2.33	6.33	2.11
Funguran OH	25.00	2.00	2.33	6.33	2.11
Curazeb	2.00	2.67	2.33	7.00	2.33
Kocide 101	2.00	2.00	2.00	6.00	2.00

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.23	0.11	2.63		
Treatment	5	15.97	3.19	73.11**	3.33	5.64
Error	10	0.44	0.04			
Total	17	16.63				

** = highly significant

Coefficient of Variation =8.12%

APPENDIX TABLE 13. Disease Severity. Twelfth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	4.67	4.33	5.00	14.00	4.67
Microthiol DF	2.33	2.33	2.00	6.66	2.22
Redeem	2.00	2.00	2.67	6.67	2.22
Funguran OH	2.00	2.33	2.33	6.66	2.22
Curazeb	2.00	2.67	2.33	7.00	2.33
Kocide 101	2.00	2.00	2.33	6.33	2.11

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.23	0.12	1.59		
Treatment	5	15.02	3.00	40.98**	3.33	5.64
Error	10	0.73	0.07			
Total	17	15.99				

** = highly significant   Coefficient of Variation =10.30%

APPENDIX TABLE 14. Leaf and Petiole Cleanliness. Leaf assessment on plants when fungicides were not yet applied

TREATMENTS	INITIAL ASSESSMENT
Untreated	3.67
Microthiol DF	3.67
Redeem	4.11
Funguran OH	3.89
Curazeb	3.89
Kocide 101	3.67

APPENDIX TABLE 15. Leaf and Petiole Cleanliness. First application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	3.00	4.33	3.67	11.00	3.67
Microthiol DF	3.67	4.33	3.00	11.00	3.67
Redeem	3.00	4.33	5.00	12.33	4.11
Funguran OH	3.67	3.67	3.67	10.71	3.67
Curazeb	3.00	5.00	3.67	11.67	3.89
Kocide 101	3.67	3.00	3.67	10.34	3.45

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	1.82	0.91	2.06		
Treatment	5	0.78	0.16	0.36^{ns}	3.33	5.64
Error	10	4.40	0.44			
Total	17	7.00				

ns = not significant   Coefficient of Variation =17.72%

APPENDIX TABLE 16. Leaf and Petiole Cleanliness. Second application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	3.67	4.33	4.33	12.33	4.11
Microthiol DF	3.00	3.67	3.00	9.67	3.22
Redeem	3.00	3.00	4.33	10.33	3.44
Funguran OH	3.67	3.67	3.67	11.01	3.67
Curazeb	3.00	4.33	3.67	11.00	3.67
Kocide 101	3.67	3.00	3.67	10.34	3.45

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.64	0.32	1.38		
Treatment	5	1.38	0.28	1.19^{ns}	3.33	5.64
Error	10	2.31	0.23			
Total	17	4.33				

ns = not significant

Coefficient of Variation =15.56%

APPENDIX TABLE 17. Leaf and Petiole Cleanliness. Third application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	4.33	4.33	4.33	12.99	4.33
Microthiol DF	3.00	3.67	3.00	9.67	3.22
Redeem	3.00	3.00	5.00	11.00	3.67
Funguran OH	3.33	3.67	3.00	10.00	3.33
Curazeb	3.00	3.67	3.67	10.34	3.45
Kocide 101	3.00	3.00	3.67	9.67	3.22

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.76	0.38	1.25		
Treatment	5	2.68	0.54	1.77^{ns}	3.33	5.64
Error	10	3.03	0.30			
Total	17	6.47				

ns = not significant

Coefficient of Variation =13.39%

APPENDIX TABLE 18. Leaf and Petiole Cleanliness . Fourth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	4.33	4.33	5.00	13.66	4.55
Microthiol DF	3.00	3.67	3.00	9.67	3.22
Redeem	2.33	3.00	5.00	10.33	3.44
Funguran OH	3.00	3.67	3.00	9.67	3.22
Curazeb	3.00	3.00	3.00	9.00	3.00
Kocide 101	3.00	2.33	3.67	9.00	3.00

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	1.39	0.69	1.63		
Treatment	5	5.14	1.03	2.41^{ns}	3.33	5.64
Error	10	4.27	0.43			
Total	17	10.80				

ns = not significant Coefficient of Variation =19.17%

APPENDIX TABLE 19. Leaf and Petiole Cleanliness. Fifth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	5.00	5.00	5.67	15.67	5.22
Microthiol DF	3.00	3.00	3.00	9.00	3.00
Redeem	1.67	3.00	4.33	9.00	3.00
Funguran OH	3.00	3.67	3.00	9.67	3.22
Curazeb	3.00	3.00	3.00	9.00	3.00
Kocide 101	2.33	2.33	3.00	7.66	2.55

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	1.33	0.67	2.15		
Treatment	5	13.58	2.72	8.75**	3.33	5.64
Error	10	3.10	0.31			
Total	17	18.01				

** = highly significant   Coefficient of Variation =16.71%

APPENDIX TABLE 20. Leaf and Petiole Cleanliness. Sixth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	5.67	5.00	7.00	17.67	4.56
Microthiol DF	3.00	3.00	3.00	9.00	3.00
Redeem	1.67	3.00	3.00	7.67	2.56
Funguran OH	3.00	3.67	3.00	9.67	3.22
Curazeb	3.00	3.00	3.00	9.00	3.00
Kocide 101	1.67	2.33	3.00	7.00	2.33

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.44	0.22	0.38		
Treatment	5	9.12	1.82	3.15^{ns}	3.33	5.64
Error	10	5.78	0.58			
Total	17	15.34				

ns = not significant

Coefficient of Variation =24.43%

APPENDIX TABLE 21. Leaf and Petiole Cleanliness . Seventh application of the treatments

Treatment	Block I	II	III	Total	Mean
Untreated	5.67	5.00	6.33	17.00	5.67
Microthiol DF	3.00	3.00	3.00	9.00	3.00
Redeem	2.33	3.00	3.00	8.33	2.78
Funguran OH	3.00	3.67	3.00	9.67	3.22
Curazeb	3.00	3.00	3.00	9.00	3.00
Kocide 101	2.33	3.00	3.00	8.33	2.78

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.35	0.17	1.21		
Treatment	5	18.80	3.76	26.18**	3.33	5.64
Error	10	1.44	0.14			
Total	17	20.58				

** = highly significant Coefficient of Variation =11.12%

APPENDIX TABLE 22. Leaf and Petiole Cleanliness. Eighth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	8.30	5.67	7.00	20.97	7.00
Microthiol DF	3.00	3.00	3.00	9.00	3.00
Redeem	3.00	3.00	3.00	9.00	3.00
Funguran OH	3.00	3.67	3.00	9.67	3.22
Curazeb	3.00	3.00	3.00	9.00	3.00
Kocide 101	3.00	3.00	3.00	9.00	3.00

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.34	0.17	0.49		
Treatment	5	39.23	7.85	22.45**	3.33	5.64
Error	10	3.49	0.35			
Total	17	43.07				

** = highly significant

Coefficient of Variation =15.96%

APPENDIX TABLE 23. Leaf and Petiole Cleanliness. Ninth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	6.33	5.67	7.00	19.00	6.33
Microthiol DF	3.00	3.00	3.00	9.00	3.00
Redeem	3.00	3.00	3.00	9.00	3.00
Funguran OH	3.00	3.00	3.00	9.00	3.00
Curazeb	3.00	3.67	3.00	9.67	3.22
Kocide 101	3.00	3.00	3.00	9.00	3.00

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.05	0.02	0.22		
Treatment	5	27.16	5.43	47.87**	3.33	5.64
Error	10	1.13	0.11			
Total	17	28.34				

** = highly significant

Coefficient of Variation =9.38%

APPENDIX TABLE 24. Leaf and Petiole Cleanliness . Tenth application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	6.33	6.67	6.33	19.33	6.44
Microthiol DF	3.00	3.00	3.00	9.00	3.00
Redeem	3.00	3.00	3.00	9.00	3.00
Funguran OH	3.00	3.00	3.00	9.00	3.00
Curazeb	3.00	3.67	3.00	9.67	3.22
Kocide 101	3.00	3.00	3.00	9.00	3.00

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.11	0.06	2.12		
Treatment	5	29	5.80	220.52**	3.33	5.64
Error	10	0.26	0.03			
Total	17	29.37				

** = highly significant

Coefficient of Variation =4.49%

APPENDIX TABLE 25. Leaf and Petiole Cleanliness. Eleventh application of the treatments

Treatment	Block I	Block II	Block III	Total	Mean
Untreated	6.33	5.67	7.00	19.00	6.33
Microthiol DF	3.00	3.00	3.00	9.00	3.00
Redeem	3.00	3.00	3.00	9.00	3.00
Funguran OH	3.00	3.00	3.00	9.00	3.00
Curazeb	3.00	3.67	3.00	9.67	3.22
Kocide 101	3.00	3.00	3.00	9.00	3.00

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.05	0.02	0.22		
Treatment	5	27.16	5.43	47.87**	3.33	5.64
Error	10	1.13	0.11			
Total	17	28.34				

** = highly significant Coefficient of Variation =9.38%

APPENDIX TABLE 26. Leaf and Petiole Cleanliness. Twelfth application of the treatments

Treatment	Block			Total	Mean
	I	II	III		
Untreated	6.33	6.33	7.00	19.66	6.55
Microthiol DF	3.00	3.00	3.00	9.00	3.00
Redeem	3.00	3.00	4.33	10.33	3.44
Funguran OH	3.00	3.67	3.67	10.34	3.44
Curazeb	3.00	3.67	3.00	9.67	3.22
Kocide 101	3.00	3.00	3.00	9.00	3.00

Analysis of Variance

Source of Variation	DF	Sum of Square	Mean of Squares	F_C	$F_{.05}$	$F_{.01}$
Block	2	0.59	0.30	2.00		
Treatment	5	28.33	5.67	38.20**	3.33	5.64
Error	10	1.48	0.15			
Total	17	30.40				

** = highly significant   Coefficient of Variation =10.19%

APPENDIX TABLE 27.Weekly Weather Data gathered from the PAG-ASA Weather Station, Balili, La Trinidad, Benguet

Months	Temperature (^{0}C)	Relative Humidity (%)	Rainfall Counts (mm)
October			
1st week	16.0-23.5	84	20
2nd week	15.6-22.6	81	10.4
3rd week	16.0-23.7	79	1.0
4th week	16.2-23.6	81	3.0
November			
1st week	16.2-24.0	82	0.9
2nd week	15.4-23.9	82	4.2
3rd week	14.4-22.9	79	1.3
4th week	15.6-23.6	80	1.5
December			
1st week	15.7-23.4	75	3.9
2nd week	15.0-21.4	84	0.4
3rd week	14.8-22.6	79	0.4
4th week	14.6-22.5	79	1.6