The Relative Effectiveness of Homoeopathic Potencies of *Peronospora parasitica* Compared to Acrobat (dimethomorph & mancozeb) & Bravo (chlorothalonil) in the Control of Downy Mildew in Cabbage Seedlings

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I, Janine Margaret Curnow,
declare that this dissertation is my own work.

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DEDICATION

To all my family and friends who supported me in the completion of my studies.

To Sean Haagman for his love and support in all that I do.

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ABSTRACT

The downy mildews are fungal pathogens which cause severe epidemics on many crops, and are difficult to control by either management practices or fungicides.

Homoeopathic medicines have been investigated for their control of fungi, with promising results. However, there are a few well conducted trials in the homoeopathic literature. In particular, the lack of statistical analyses is evident in most of the work done to date.

The purpose of this study was to evaluate the efficacy of a homoeopathic remedy, prepared from a leaf infected with *Peronospora parasitica*, for the control of downy mildew of Brassicas. These results were compared to fungicides used to control downy mildew namely, Acrobat and Bravo.

The subjects of this study were trays of cabbage seedlings. The seedlings were inoculated by introducing infected seedlings at a rate of one per tray. The potencies used in the trials were 9CH, 30CH, 200CH and 1M. Special attention was paid to preventative and curative functions of the treatment sprays. Four replicates of each treatment were used, in a randomised blocks design. The test population was divided into two groups. The first group, Batch A, was treated prophylactically and the second, Batch B, curatively. The trays were placed into randomised positions generated by a computer, in order to nullify subjectivity and the effect of tray position.

The disease was assessed by foliar disease rating which was performed every second day for the duration of each trial.

The parameters assessed were the Area Under Disease Progress Curve (AUDPC) values, wet weight and dry weight. The results were analysed using analysis of variance. Means separation was by the LSD test at the 5% level (i.e., the 95% level of confidence).

In the first trial, there was no significant difference between the action of Acrobat and Bravo in either the curative or preventative trials. In the preventative batch, both fungicides worked significantly better than the homoeopathic sprays, which showed little variation amongst themselves. In the curative batch, the F test was not significant, showing that there was no differences in performance between the homoeopathic treatments or the fungicides.

In the second trial, in the preventative batch, Acrobat performed the best, being significantly better than all the other treatments. The 30CH homoeopathic spray was significantly better than the 200CH. In the curative batch there was again no significant differences between any of the treatments.

In the third trial, in the preventative batch, Bravo performed the best. Both Acrobat and Bravo performed significantly better than all the homoeopathic sprays. In the curative batch, Acrobat performed significantly better than the homoeopathic treatments.

In the first and second trials the prophylactic treatment group (Batch A) generally had less disease when compared with the curative group (Batch B), the exception being those seedlings treated with 200CH in the prophylactic group of Trial Two, which had a higher level of disease. In the third trial the homoeopathic prophylactic treatment group had more disease than the curative group, except for those seedlings treated with Acrobat.

The results indicated that all the treatments, both homoeopathic and fungicidal, when applied preventatively, were much more effective than when they were applied curatively. Most of the curative data was not statistically significant because the disease progressed so fast and thus the curative data was not very useful. The homoeopathic treatments did not provide adequate control of *P.parasitica* and did not perform well when compared to the fungicidal treatments. Acrobat was an outstanding fungicide compared to all other treatments.

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.DEFINITIONS OF TERMS

AUDPC: This is the area under disease progressive curve. The development of the disease is determined by plotting the percentage leaf area infected against time and calculating the area under the curve (Berger, 1988). This form of control assessment has particular value in the context of seedling diseases, such as downy mildew (Channon et al. 1970).

CENTISIMAL SCALE: Introduced by Hahnemann, it is based on the principle that the first potency should contain one hundredth of the base drug and each succeeding potency should contain one hundredth part of the one immediately preceding. It is denoted by suffixing C after the numerals denoting the deconcentration stage of the drug. The suffixing "H" represents "made according to Hahnemann" (Gaier, 1991).

BRASSICA DOWNY MILDEW (*Peronospora parasitica):* Downy mildew is a disease caused by a group of oomycetous fungi that belongs to the family Peronosporacea. They are obligate parasites of higher plants (Agrios, 1997) with strictly biotrophic requirements (Dixon, 1984). *P.parasitica* is specific to crucifers. Infection of *Brassica* seedlings results in the emergence of long white sporangiophores through stomata. Later on, they appear greyish or light brown on the lower or both surfaces of the cotyledons (Agrios, 1997). Cotyledons may then turn yellow and later shrivel and die. The fungus thrives in cool, clammy conditions at high humidity (Spencer, 1981).

FOLIAR DISEASE RATING: Disease severity is visually assessed with the aid of logarithmic rating scales of percentage leaf area infected for foliar diseases (Horsfall and Cowling, 1978).

HOMOEOPATHY: Homoeopathy is a therapeutic method that clinically applies the "Law of similars" and which uses medicinal substances in infinitesimal doses (Jouanny, 1991). It is a system of medicine founded by the physician Dr Samuel Hahnemann. It is based on the principle that "like cures like". In practice this means that a medicine capable of producing certain effects when taken by a healthy individual is capable of curing any illness that displays similar effects (Sankaran 1995).

ISOPATHY: Treatment of disease by means of the presumed exopathic or endopathic causal agent, or by a product of the manifestation of the same disease (Gaier, 1991).

NOSODE: Named from the Greek "nosos" which means disease. Defined as a potency prepared from pathological material - sputum, blood, faeces, pus, neoplastic tissue, etc. - obtained from a patient suffering from a particular disease, and usually containing the organism characteristic of the disease (Harling, 1974).

POTENCY: The specially produced capability in a medicine to effect a dynamic stimulus in the appropriate patient. It is the stage of altered remedial activity to which a drug has been taken by means of deconcentration, with succussion, or by trituration,

of the medicinal substance, which is thus brought to a state of diminutive or infinitesimal subdivision (Gaier, 1991).

SUCCUSSION: Succussion involves the shaking of the fluid in which potentization is carried out, between each successive step of dilution. Succussion is the most remarkable and characteristic feature of the manufacture of potencies. Potency energy varies with the number of succussions. Succussion not only ensures perfect mixture but imparts movement to the fluid thereby creating additional kinetic energy. Succussion thus influences the whole molecular field by changing the electromagnetic state of the solvent (water and alcohol) and the solute (Boyd, 1941, cited by Nicholson, 1961). The more the substance is succussed and diluted, the greater the therapeutic effect while simultaneously nullifying the toxic effect (Frazer,1992, cited by Brammer, 1994).

TRITURATION: This is the reduction of solid bodies to a powder by continuous rubbing. A triturated drug is one which has been rubbed with milk sugar (Albert et al 1988).

CHAPTER ONE

INTRODUCTION

The downy mildews have caused spectacular and catastrophic epidemics on several crops in the past, and some of them continue to the present to cause epidemics and severe losses. In 1979, a devastating epidemic of downy mildew of tobacco spread rapidly through the United States causing losses to growers worth hundreds of millions of dollars (Agrios 1997). Even in the absence of infective conditions, the survival of soil - borne oospores can be a major factor in determining the outbreak of an epidemic. The spread of downy mildew to uninvaded areas has given rise to some of the most spectacular plant disease cases documented in history (Spencer 1981).

Niu (1983) stated that, although chemical pesticides have been the major control for downy mildew in crucifers, due to their limited effectiveness, together with the rising costs and associated ecological problems, it has become necessary to find additional control strategies.

In a study by Brophy and Laing (1992), on the screening of fungicides for the control of downy mildew, it was found that at high levels of disease, protectant fungicides were inadequate. Only systemic fungicides provided some control. A drawback of systemic fungicides is that they should be used in mixtures with standard protectants to broaden their spectrum and therefore avoid a build up of resistant pathogen strains. Furthermore, with any fungicide applied to an edible crop, a limiting factor is that the level of chemical residues must be acceptable (Spencer, 1981).

There have been numerous studies using homoeopathic drugs on phytopathogens and many of these studies have been criticised for their deficiency of statistical analyses, methodological details and repetition of experiments (Scofield 1984). Betti et al. (1994) found that experimental work with plants has often yielded unreliable results, due to the insufficient number of replications or inappropriate use of statistical tools.

According to Pelikan and Unger (1971) one of the advantages of demonstrating the effects of potencies on plants is that there is no possibility of suggestion affecting the results.

Brammer (1994) states that research involving plant pathogens is possible and yields significant statistical results if conducted in a controlled pathosystem. Research on plant pathogens treated homoeopathically opens the door to a new and exciting therapeutic approach in agriculture.

Some research on the effect of homoeopathic remedies on fungi has been conducted, yielding positive results. Bernard (1912) (cited by Scofield 1984) found that low concentrations (10^{-8} - 10^{-10}) of manganese had a stimulatory effect on the development and formation of conidia of *Aspergillus niger* in culture.

A study by Khanna and Chandra (1976b) on the effects of homoeopathic drugs on the spore germination of *Alternaria alternata*, indicated that certain potencies of drugs completely inhibited the germination of spores. Further studies by Khanna and Chandra (1976a, 1977, 1978) on the control of tomato fruit rot, guava fruit rot and mango fruit rot indicates that several of the drugs tested were effective in controlling these fungi.

The ability to destroy specific pest and disease organisims using homoeopathic sprays would, according to Scofield (1984), be a boon to "organic" agriculture.

Downy mildew of brassicas can lead to severe loss of yield to the farmer, and an effective means of control is thus vital. Brammer's (1994) study on the control of downy mildew showed that homoeopathic remedies have an effect on the incidence of disease in cabbage seedlings. Application of low potencies, 5CH, 9CH and 15CH, caused the disease level to increase when compared to an untreated control. The 30CH did not affect disease incidence, which was similar to that of the control.

This study was intended to test which potencies of *Peronospora parasitica*, the causative fungus of downy mildew, would have an effect on the disease incidence by testing a wider range of potencies than those used in the study by Brammer (1994). According to Kayne (1991), before firm decisions can be made on the efficacy of homoeopathic spray preparations, there is much work required to establish not only the right substance but the correct potency and dose level.

CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

2.1 PLANT FUNGAL DISEASE

The downy mildews can cause rapid and severe loss of crop plants still in the seedbed or in the field. They often destroy 40 to 90 percent of the young plants or shoots in the field, causing heavy or total losses of crop yields (Agrios 1997).

Crucifer downy mildew is a major foliar pathogen of crucifer seedlings grown in containerised trays in South Africa (Laing 1984). Downy mildew is particularly destructive in cool and humid temperate regions. The fungus causes defoliation of both seedling and adult plants and often reduces the yield and quantities of the heads (Niu 1983). In addition to the damage caused by the downy mildew itself, the affected cabbage tissues are very susceptible to attack by secondary bacteria and fungi (Spencer 1981).

Chemical pesticides have been the major control of downy mildew. However, their limited effectiveness, together with rising costs and associated ecological problems has necessitated additional control strategies (Niu et al. 1983). Since the 1980's several systemic fungicides such as metalaxyl, propamocarb and fosetyl Al have improved considerably the ability to control these diseases. Downy mildews are, however, still very difficult to control (Agrios 1997).

In a study by Brophy and Laing (1992) on the screening of fungicides in containerised cabbage seedlings, metalaxyl - based fungicides were found to be ineffective owing to fungicide resistance. It has been suggested by Gisi (1988) that to ensure continued effectivity of systemic fungicides, combinations of unrelated chemicals, having different modes of action, should be used.

Other control strategies include the use of host resistance. However, limited information on the sources and nature of resistance to downy mildew has deterred the exploitation of resistance. In glasshouse tests on broccoli and cauliflower, Natti (1958), cited by Spencer (1981) recorded high resistance to an isolate of *P.parasitica* in one out of a total of 75 lines of *Brassica oleracea*. In subsequent studies Natti et al. (1967) identified resistance to two races of *P.parasitica*, in 16 out of 230 plant introduction accessions. In a study by Niu et al. (1983) on sources and nature of resistance to downy mildew in Chinese cabbage, five lines showed resistance. Resistance to downy mildew at the cotyledon stage was under dominant monogenic control. In a study by Leckie et al. (1996) on the location of genes for disease resistance in Brassicas, several new sources of resistance were identified. According to McMeckin (1960) reliance on major genes may give only temporary resistance to mildew in host plants due to the heterothallism in *P.parasitica* producing virulent races.

2.2 HOMOEOPATHY, ISOPATHY AND PHYTOTHERAPY

There has been various studies carried out in order to test the efficacy of using homoeopathic medicine for agricultural purposes.

Betti et al. (1994) carried out two experiments (1991/2 and 1992/3) in order to attempt to establish a methodology that would be useful in future experiments. This was a randomised laboratory trial where homoeopathic potencies of Arsenicum album were tested for their effect on seed germination. The parametric tests showed that the differences between the treatment groups could not be explained as a mere effect of intrinsic seed variability. The 25x, 40x and 45x potencies of Arsenicum album were significantly different to the control.

In a further study, Betti et al. (1997) performed a blind laboratory experiment in order to show the effect of using Arsenicum album 45x on wheat seedlings poisoned with a material dose of Arsenicum album. It was found that there was a positive effect that was limited to the stem length, which showed significant recovery increasing with treatment time, whereas root length was not affected by the homoeopathic treatment.

Khanna and Chandra (1976a) showed the effect of seven homoeopathic drugs, namely Arsenicum album, Thuya occidentalis, Kali iodide, Blatta orientalis, Phosphorus, Lycopodium clavatum and Withania somnifera on the spore germination of *Fusarium roseum*, the causative organism of tomato fruit rot. Each drug was tested in potencies of 1 - 200 prepared in distilled water according to M.Bhattacharyya and CO's Homoeopathic Pharmacopoeia. Spore germination was completely inhibited by potency 1 of Arsenicum

album, 149 of Kali iodide, 35 of Phosphorus and 87 of Thuya occidentalis. Only Kali iodide 149 and Thuya occidentalis 87 inhibited the growth of the pathogen. Tomato fruit that were given pre- and post- inoculation dips with Kali iodide 149 and Thuya occidentalis 87 did not develop rotting.

Pongratz et al. (1993) revived an experiment performed by Kolisko (1924), which studied the influence of three decimal potencies of silver nitrate on the growth of wheat seedlings. The potencies used were 24x, 25x and 26x. A significant difference between the effects of the homoeopathic preparations and the control was demonstrated. The length of the stalk was significantly greater in the group treated with silver nitrate 24x than that of the control.

Pelikan and Unger (1971) performed a detailed study of the effect of potentised silver nitrate ($AgNO_3$) on the growth of seedlings. The potencies used were from 8x to 19x. This involved a series of 40 growth trials that was repeated six times. Each series exhibited the same type of curve, a three part growth curve rising from potencies 8x to 14x, falling to 16x and then rising again.

Khanna and Chandra (1976b) studied the effects of some homoeopathic drugs on the spore germination of four isolates of *Alternaria alternata*, a fungus causing leaf blight of wheat. The drugs used in the trial were 1 - 200 potencies of Arsenicum album, Blatta orientalis, Kali iodide and Thuya occidentalis. On the Triticum isolate spore germination was permanently inhibited by Arsenicum album 90, 199 and Thuya occidentalis 152. The Linum isolate was permanently inhibited by Arsenicum album 150, 199 and Kali iodide

77. The Citrus isolate was permanently inhibited by Arsenicum album 146, Blatta orientalis 187 and Kali iodide 198. The Psidium isolate was permanently inhibited by Arsenicum album 82, 96, Blatta orientalis 191, Kali iodide 105 and Thuya occidentalis 46.

Khanna and Chandra (1977) studied the effects of 1-200 potencies of Kali iodide, Arsenicum album, Thuya occidentalis and Blatta orientalis on the spore germination of *Pestalotia psidii,* the causative organism of guava fruit rot. *In vitro* studies showed complete inhibition of spore germination was caused by potencies 1, 20, 24, 61, 87 of Kali iodide and 60, 65, 181 of Arsenicum album. These potencies were further tested using the agar cup method, and studies showed that only 5 potencies checked the growth of the pathogen. These were 1, 20, 24, 61 of Kali iodide and 60 of Arsenicum album. *In vivo* studies on those drugs which completely inhibited spore germination showed that all eight drug potencies retarded the development of fruit rot. The retarding effects of the drugs were more pronounced when fruits were treated before inoculation, suggesting that the drugs were effective as protectants rather than therapeutants.

Khanna and Chandra (1978) performed both *in vitro* and *in vivo* evaluation of some homoeopathic drugs in the treatment of *Pestalotia mangiferae*, the causal agent of mango fruit rot. The drugs that were used in the study were Arsenicum album, Kali iodatum, Lycopodium clavatum, Phosphorus, Thuja occidentalis, Asvagandh, Blatta orientalis, Zincum sulphuricum, Filix mas and Kalium muriaticum. Fungitoxicity of the drugs was determined in terms of the inhibition of spore germination of the causal fungus. Each drug was tested in potencies of 1-200 which were prepared in distilled water and prior to use were sterilised by filtration. Three replicates were taken for each treatment.

The results showed that Phosphorus 50, Lycopodium clavatum 190, Asvandh 100, Arsenicum album potencies 1, 89 and 90 and Zincum sulphuricum potencies 1 and 2 completely inhibited the spore germination. These drugs were then screened for their efficacy in treating the fruit rot, both preventatively and curatively. It was demonstrated that Lycopodium clavatum potency 190 was the most effective drug in both types of treatment, reducing the percentage fruit infection as well as percentage rot.

This drug was shown not to have caused any change in amino acid, amide, organic acid, sugar and vitamin c content of the fruit. It was thus safely recommended for the treatment of mango fruit rot caused by *P.mangiferae.*

Verma et al. (1969) used homoeopathic drugs against tobacco mosaic virus. The drugs selected were those which are used for the cure of diseases whose symptoms are suspected to be caused by viruses. These were Artemisia vulgaris, Alstonia constricta, Viburnum prunifolium, Aconitum napellus, Belladonna, Lobelia, Digitalis, Echinacea angustifolia, Ipecacuanha, Pyrogenium, Baptisia and Jalapa. The virus used was the type strain of tobacco mosaic virus. The local lesion hosts used were *Nicotinia glutinosa* and *Nicotinia tabacum* var. Xanthi, while systemic host was *N. tabacum* var. N. P. 31. Leaf discs were punched out of the inoculated leaves, and placed on glass wool that was soaked with the respective drugs. Leaf discs were taken out at desired intervals of time, at 24 hours and then 2 weeks, and their sap prepared in water. The activity of the virus in different samples was assayed on *N. glutinosa* leaves. The viral content was measured by counting the number of local lesions. Carbo vegetalis, Chimaphilla, Cedron and Variolinum decreased the viral content in *Nicotinia tabacum* var. N.P. 31 leaf disc by 60 - 90 percent. In *N. glutinosa* leaf discs the inhibition was less marked. The experiments revealed that the

lower potencies of the drugs (7x and 31x) were more effective. The viral content in two week old TMV infected tobacco leaf discs was decreased by 50 percent when floated on Chimaphilla 31 and Lachesis 201. Chenopodium, Chimaphilla, Carbo vegetalis and Arsenicum album decreased the number of local lesions in *N. glutinosa* and systemic virus replication rate in N. P. 31. Ipecacuanha and Jalapa decreased the number of local lesions in *N. glutinosa* by 50 percent. In *N. tabacum* leaf discs, Artemisia, Digitalis, Alstonia and Viburnum decreased the viral content by 50 percent. Artemisia and Alstonia checked the virus multiplication rate by 50 - 75 percent.

McIvor (1980), cited by Kayne (1991), reported success in treating fruit trees isopathically using homoeopathic dilutions of the fungus causing leaf curl. A fine hole was drilled into the tree trunk about six inches above ground level and a 6CH potency was injected under pressure.

Netien et al. (1966) investigated the action of a 15CH solution of copper sulphate on the germination and growth of seeds from plants treated with a concentrated solution of that same substance. It was found that seedlings from copper treated peas, grown on a 15CH dilution of copper sulphate, were markedly different from seedlings grown from the same type of treated seeds, on double distilled water. There was an increase in the length of the radicle and in the development of adventitious roots.

In a study by Brammer (1994) on the control of downy mildew on cabbage seedlings it was demonstrated that the homoeopathic preparations of *Peronospora parasitica* had a statistically measurable effect on downy mildew control. *Peronospora parasitica* was used

in potencies of 5CH, 9CH, 15CH and 30CH. It was demonstrated that the lower potencies (5CH and 9CH) caused an increase in the disease level. The medium potencies (15CH and 30CH) provided some form of control by lowering the disease incidence over a short period of time.

Webb (1997), studied the effect of a homoeopathic preparation of a leaf infected with tobacco mosaic virus, in the control of tobacco mosaic virus of tomato seedlings. The potencies used were 6CH, 12CH, 30CH and 200CH. Curative applications of the 6CH, 15CH and 30CH showed significantly more disease but at 200CH a significant decrease in infection was noted. Prophylactic treatment had significantly less disease than the control, the 200CH potency being the most effective.

From the review of the literature it is evident that homoeopathic medicines do have an effect when used in agricultural applications. However, few of the trials have been replicated in order to establish a definite trend of which remedies, in which potencies, work consistently well. Brammer's (1994) study was well presented and statistically valid and thus provided a good basis for further study. The purpose of this investigation was to evaluate the efficacy of homoeopathy in the control of downy mildew and to compare this effectiveness, if any, with the standard fungicides used, namely Acrobat and Bravo.

CHAPTER THREE

MATERIALS AND METHODS

3.1 STUDY DESIGN

The aim of this project was to control downy mildew on cabbage seedlings using various potencies of homoeopathic preparations of *Peronospora parasitica* and comparing these results to fungicidal treatment of downy mildew.

The trials took place in the controlled environment of the greenhouses at the University of Natal's Microbiology and Plant Pathology Department in Pietermaritzburg.

The study group consisted of:

- a pre- inoculation treatment group (prophylaxis)
- a post- inoculation treatment group (cure)

The design that was used was a randomised blocks design. A computer randomly allocated the position of the seedling trays for each treatment group (See Appendix A, B, C). This was to eliminate the variable effect of a change in the environmental conditions due to plant positioning.

3.2 MATERIALS

Trays: 48 x 24 celled speedling trays

Pre-treatment: Plasdip (copper oxychloride in pva paint)

Medium: Seedling mix composted pine bark (CPB) obtained from Gromed, Crammond. This was available from the Department of Plant Pathology of University of Natal, Pietermaritzburg.

Seeds: There were two seeds planted per cell to compensate for unsuccessful germination, 48 seeds per tray, approximately 2400 seeds for 48 trays.

Cultivar: Cape Spitz from McDonalds seeds.

Inoculum: Infected seedlings were received from a commercial nursery, namely Sunshine Seedlings Nursery.

Treatments: The homoeopathic treatments were used in the following potencies:

9CH

30CH

200CH

1M

The homoeopathic remedy preparation is outlined in Fig 1 (See following page).

Fig 1: Flow diagram of remedy preparation

Step One: Preparation of Triturated Product

1 part infected cabbage leaf + 99 part lactose powder

↓

triturate for one hour = 1CH

↓

take 1 part 1CH + 99 part lactose powder

↓

triturate for one hour = 2CH

↓

take 1 part 2CH + 99 part lactose powder

↓

triturate for one hour = 3CH

Step Two: Role of Pharma Natura

triturated product sent to Pharma Natura

↓

remedies prepared according to German Homoeopathic Pharmacopoeia

↓

potencies prepared were 8CH, 29CH and 199CH

Step Three: Preparation of Korsakovian Potency, 1M

1 part 199CH + 99 part distilled water placed into a 30 ml vial

↓

succuss 100 times = 200CH

↓

tip out the contents of the vial

↓

add 99 part distilled water into the same vial

↓

succuss 100 times to achieve next potency

↓

this process was repeated until the 990 potency was reached

↓

the last steps were performed using 96% alcohol until potency = 999CH

Step Four: Preparation of Final Potencies Prior to Application

1 part previous potency + 99 part distilled water placed into sprayer

↓

succuss 100 times

↓

remedy is now ready to spray onto seedlings

The homoeopathic treatments were prepared from the leaf of a cabbage seedling infected with *Peronospora parasitica*. This was triturated as laid out by Hahnemann in Aphorism 271 in the 6th edition of the Organon, "The physician ... may use the fresh plant itself ...he takes a few grains in a mortar and with 100 grains sugar of milk, three distinct times, brings them to the one millionth trituration..."

This is then the equivalent of 3CH trituration. The advantages of a trituration over solutions is a more powerful action, the retention of constituents, and a guaranteed shelf life (Dellmour, 1994).

The triturated product was than sent to a pharmaceutical company, Pharma Natura, where it was prepared in 96% alcohol, using Methods 43 and 44, according to principles laid down in the German Homoeopathic Pharmacopoeia. The *Peronospora parasitica* remedy was prepared to the previous potencies needed for the trial, namely, 8CH, 29CH and 199CH.

The 1M potency was prepared using the Korsakovian method of preparation at the Technikon Natal Laminar flow room. This was made to the previous potency needed, namely 999CH.

The final potencies were made up just prior to application by adding 1 part of the previous potency to 99 parts of distilled water and then succussing 100 times. These potencies were chosen based on results of previous homoeopathic research on plants. In particular, in Brammer's (1994) study on downy mildew control, the 9CH potency of *Peronospora parasitica* caused the disease incidence to increase when compared to the control. The

30CH provided some level of control over a short period of time, so these two potencies were chosen in order to replicate part of her trial.

In a study by Webb (1997) on the attempt to control tobacco mosaic virus in tomato seedlings, all the potencies used prophylactically produced significantly better results than the inoculated control. The 200CH producing the best results. Webb recommended that even higher potencies than 200CH be used in order to produce even better results. Thus the 200CH and 1M potencies were chosen for this trial.

Fungicides: Two fungicides were used, namely Dimethomorph + Mancozeb (Acrobat) and Chlorothalonil (Bravo). The fungicides were applied in the following concentrations:

Bravo 2ml/l

Acrobat 2g/l

Spraying: 6 high pressure "Efekto Polyspray 2" sprayers were used, one per treatment.

Volume sprayed: seedlings were sprayed to leaf wetness and ended before runoff.

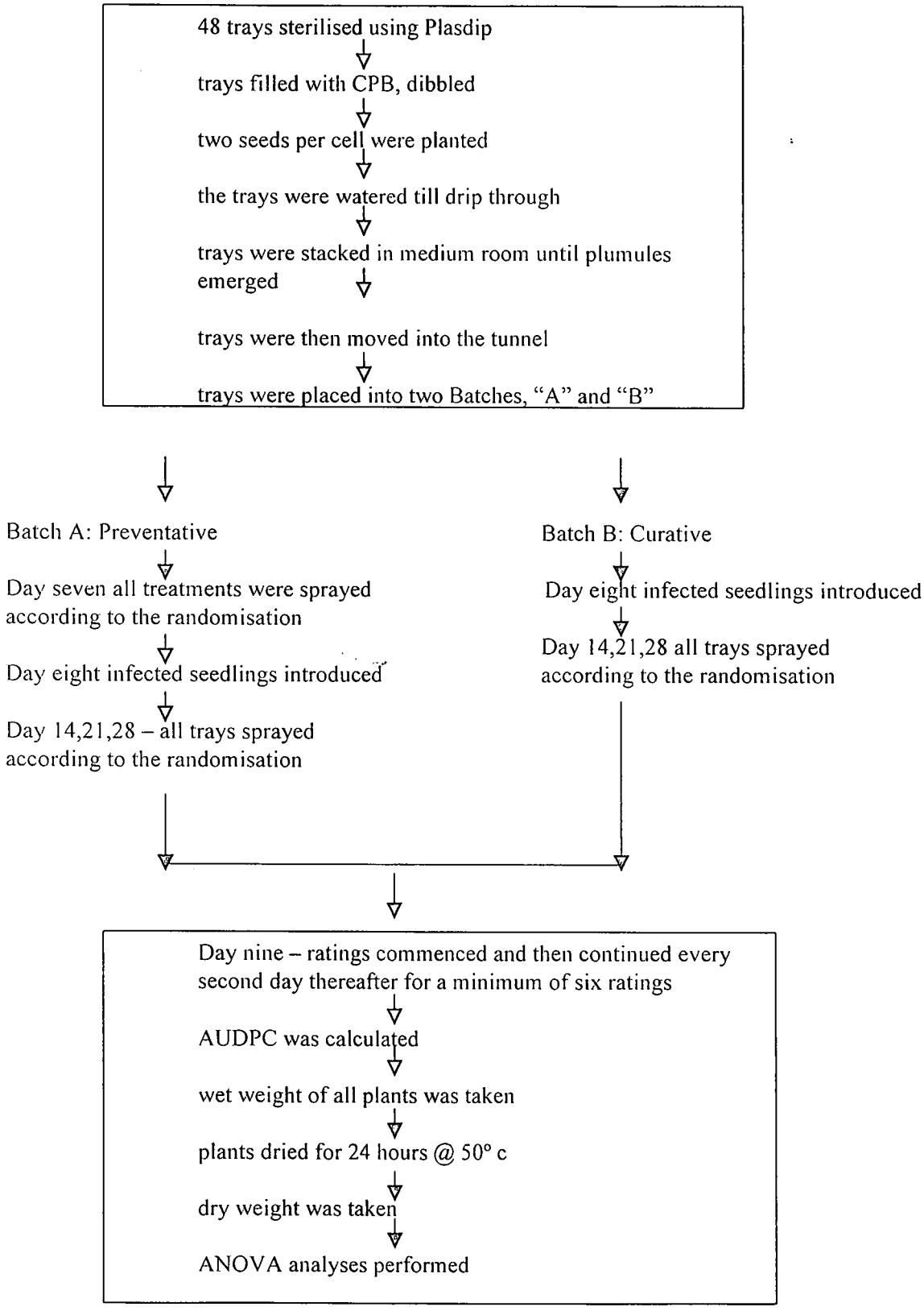
Irrigation: Automatically operated in the plant pathology tunnel and commenced three times a day at 07H30, 11H00 and 13H00.

Fertiliser: 3.1.3.(38) @ 1g /l (100ppm N). This was injected into the irrigation system.

Insecticide: There was a once weekly spraying for caterpillars when needed using Karbaspray (active ingredient is carbaryl). Aphids were sprayed for when required using Malathion (active ingredient is mercaptothion).

3.3 METHODOLOGY

Fig 2: Flow diagram outlining the spraying process



The seedling trays were sterilised with a sterilant known as Plasdip, ensuring that the entire surface area was covered. The trays were then left to dry for approximately 24 hours depending on the prevailing weather conditions. Complete drying of the trays was essential to prevent any burning of the seedlings by the copper component of the sterilant.

Speedling 24 trays were used so that each replicate contained 24 seedlings. Four replicates of each treatment were planted. This ensured that the statistics would be valid.

The trial was aimed at seeing whether the homoeopathic treatments were effective in controlling downy mildew, as well as comparing their ability to Acrobat and Bravo, both prophylactically and curatively.

Before the trays were filled the seedling trays were thoroughly moistened as water runs off the surface of dry medium without penetrating. After filling the trays a pencil was used as a dibbler to insure uniformity of depth of seed sowing.

Two seeds were planted per cell to compensate for unsuccessful germination. Once the seeds were sown the trays were watered by using a hand sprayer till drip- through to ensure good germination.

The trays were stacked in the medium room until the plumules began to emerge, which took from 48 to 72 hours, depending on the prevailing temperature.

When the plumules appeared the trays were moved to the tunnel. The trays were arranged into two groups "A", the preventative batch and "B", the curative batch. The trays were arranged parallel to each other. They were placed in groups according to the computerised randomised block design. This ensured that each block contained one of each treatment. The trays were randomised so that the researcher rating the trays did not know which tray received which treatment. The trays were placed in the tunnel near the wet wall, to reduce the effects of environmental gradients within the testing site.

On the seventh day, the seedlings were manually thinned out to one plant per cell, and the preventative sprays were put on Batch "A"; i.e., the six treatments were each sprayed on the four appropriate trays according to the randomisation. On the fourteenth day both Batches "A" and "B" were sprayed with the six treatments according to the randomisation chart. The plants were subsequently sprayed once a week with the required treatments.
The seedlings were sprayed to the standard point before leaf wetness and spray runoff. In each case the sprayers were filled with 500ml of treatment. The treatments were prepared immediately before spraying in order to ensure optimum activity. The spraying was performed at the end of the day, a few hours after the final irrigation.

On the eighth day infected cabbage seedlings were collected from Sunshine Seedlings nursery and these were introduced to the healthy seedlings at a rate of one per tray for both batches "A" and "B". The disease rating of the seedlings commenced three days after the introduction of the infected seedlings. The ratings were done every second day as the disease was particularly virulent due to the high humidity levels. The level of disease

symptoms was visually assessed by foliar disease rating of the undersurface of the cotyledons (See Appendix L).

In each tray the middle eight seedlings were rated, this was to eliminate the possibility of cross infection caused by neighbouring plants touching.

In the first trial six ratings were obtained, at which stage the disease had progressed to such an extent that the plant's growth was inhibited and thus the dry weight of the plants was not taken.

In the second and third trials, where eight and nine ratings were taken respectively, the plants exhibited normal growth, thus the dry weight of the plant matter was taken. This was done by cutting the plants down to the soil level, for both batches "A" and "B". Each tray of plants was placed in a brown paper packet and marked with the tray number as well as the number of plants in that tray. Each packet was weighed and then placed in a 50°c oven for 24 hours. The weight of each packet was then recorded again. The mean dry weight gives an indication of the growth of the plants.

3.4 STATISTICAL ANALYSIS

ANOVA (analysis of variance) was the method used to analyse the data. The parameters that were assessed were the AUDPC values for all three trials, and wet weight, dry weight and number of surviving plants for Trial Two and Three.

Statsgraphics Plus was used to process the data.

CHAPTER FOUR

RESULTS

4.1 RESULTS OF TRIAL ONE

The Area Under Disease Progress Curve (AUDPC) values for the data were calculated for Batch A and B (Appendix D and E). The averages of the AUDPC values are graphically represented in Fig. 3 and 4.

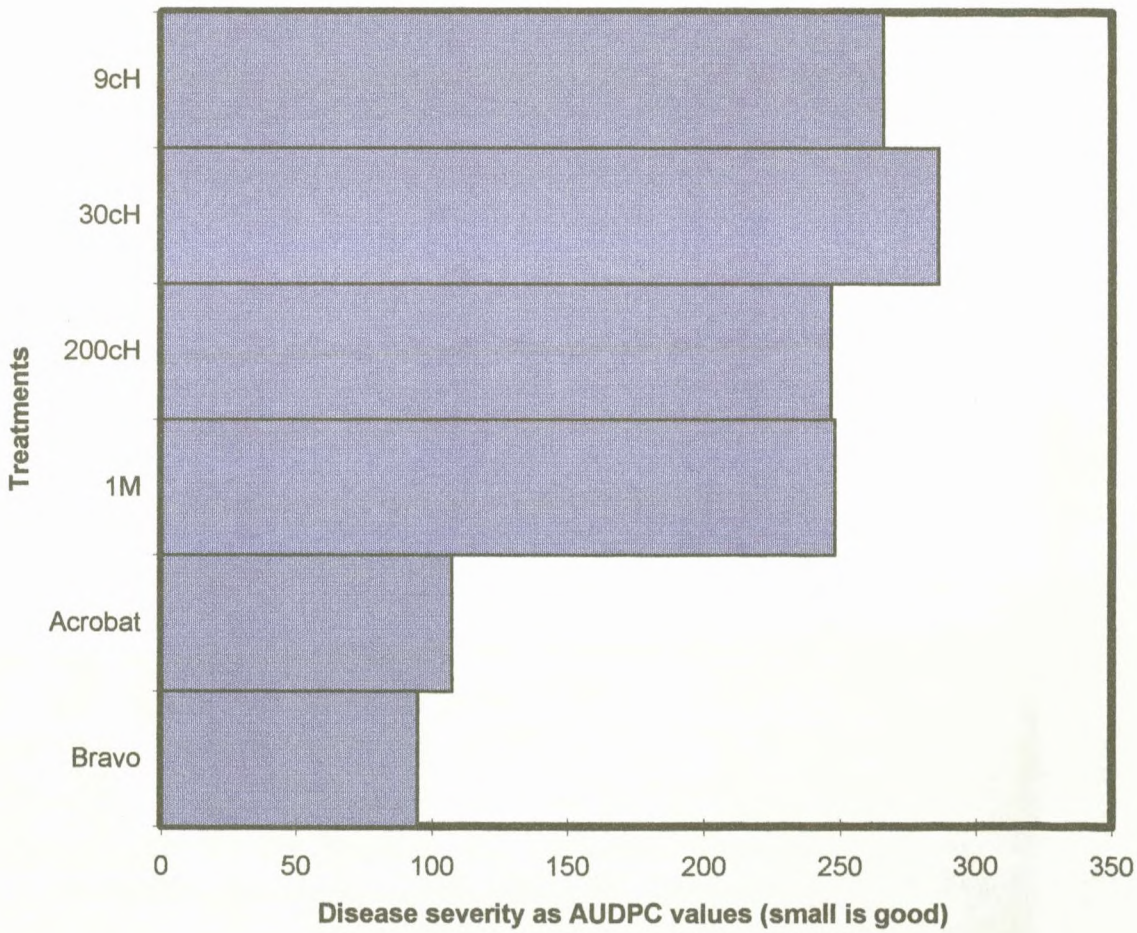


Fig 3.Trial 1A (preventative): Downy mildew severity on cabbage seedlings treated with fungicides and homoeopathic remedies

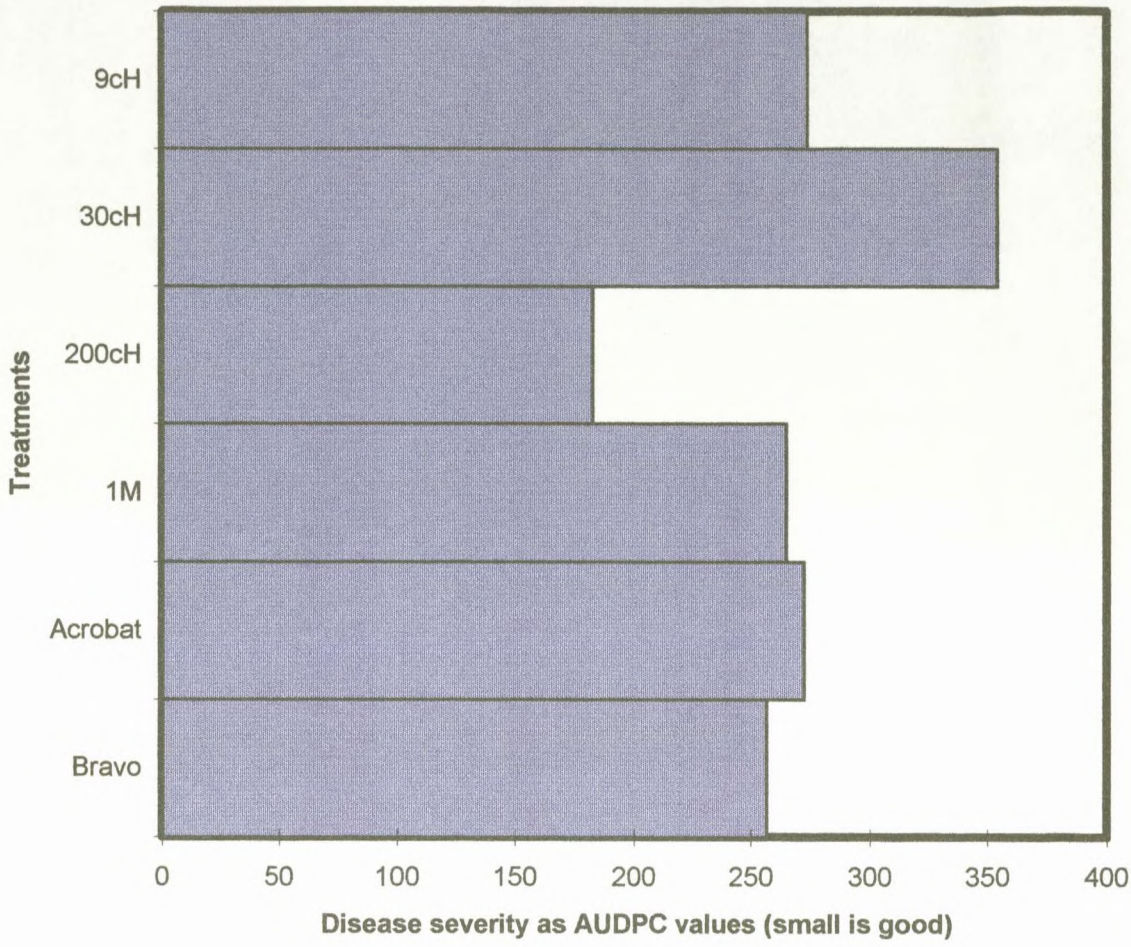


Fig 4.Trial 1B (curative): Downy mildew severity on cabbage seedlings treated with fungicides and homoeopathic remedies

Table1. Trial 1A and B: Rankings of AUDPC values of cabbage seedlings treated preventatively and curatively with fungicides and homoeopathic remedies

	Preventative (Batch A)		Curative (Batch B)	
Treatment	AUDPC	Rank	AUDPC	Rank
Bravo	94.5 a	1	256.6	4
Acrobat	107.2 a	2	272.3	2
1M	247.7 b	5	264.9	3
200CH	246.5 b	3	182.5	1
30CH	286.4 b	6	353.9	6
9CH	265.7 b	4	273.5	5
F test	1.51 **		NS	
P value	0.0151		0.3228	
CV%	40.7%		36%	

Figures with the same letter do not differ significantly at the level, P=0.05, using Fisher's LSD Test.

The percentage leaf area infected was plotted against time to show progression of the disease for Batch A and B (Fig 5 and 6).

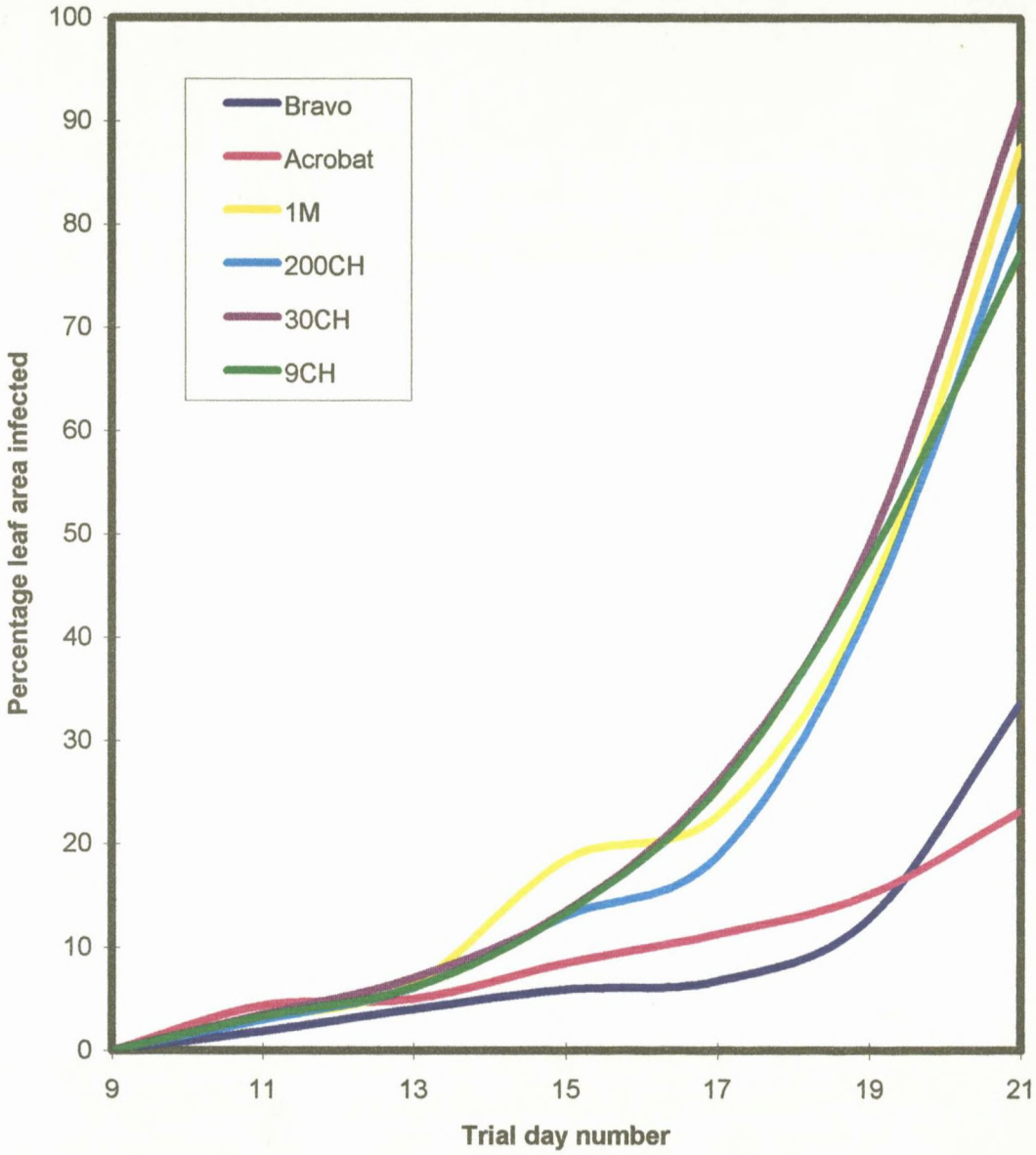


Fig 5. Trial 1A (preventative): Disease progress curves of downy mildew on cabbage seedlings treated with fungicides and homoeopathic remedies

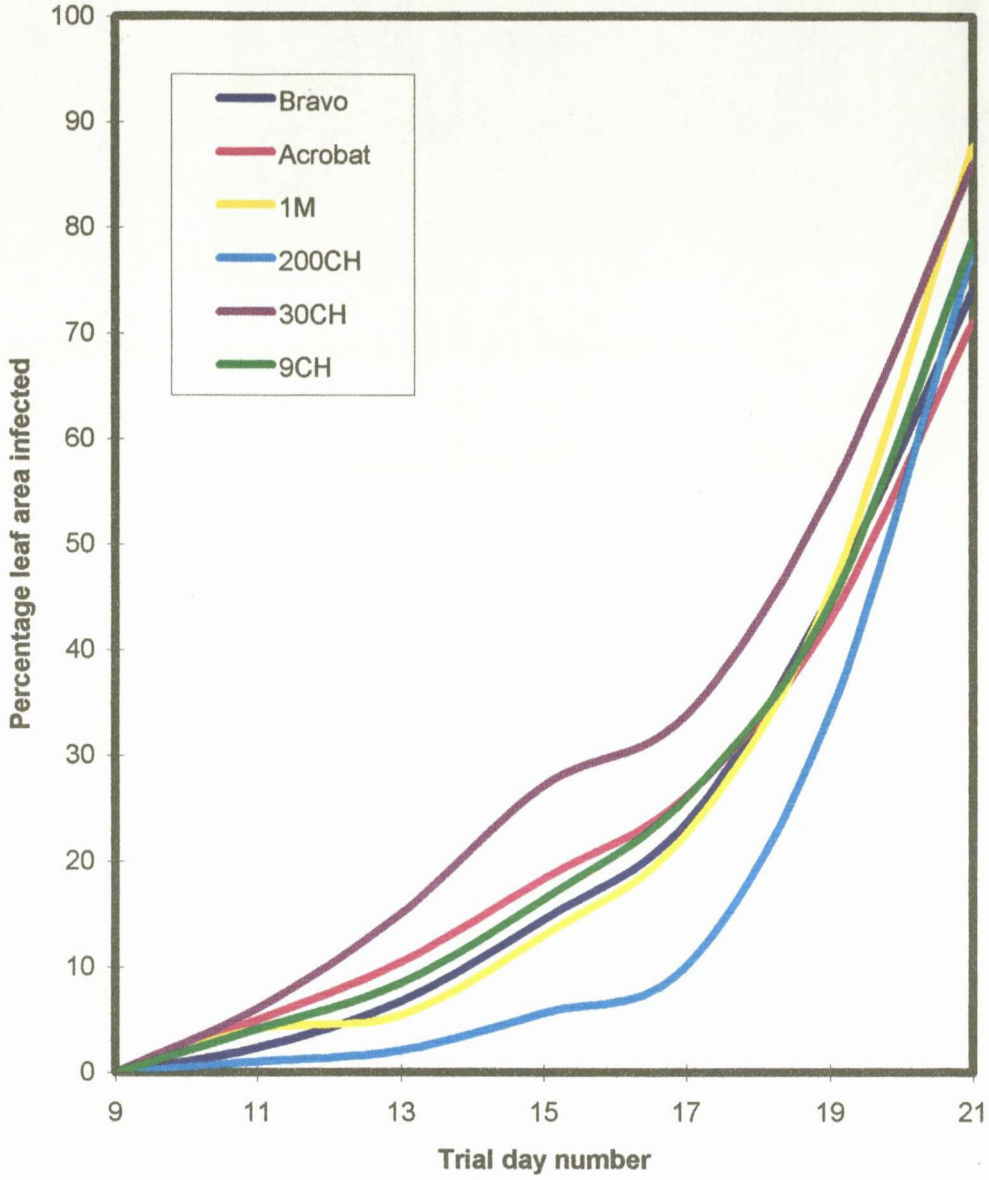


Fig 6. Trial 1B (curative): Disease progress curves of downy mildew on cabbage seedlings treated with fungicides and homoeopathic remedies

4.2 TRIAL TWO

The AUDPC values for the data of this trial were calculated (see Appendix F and G). The mean AUDPC values for Batch A and B are graphically represented in Fig 7 and 8.

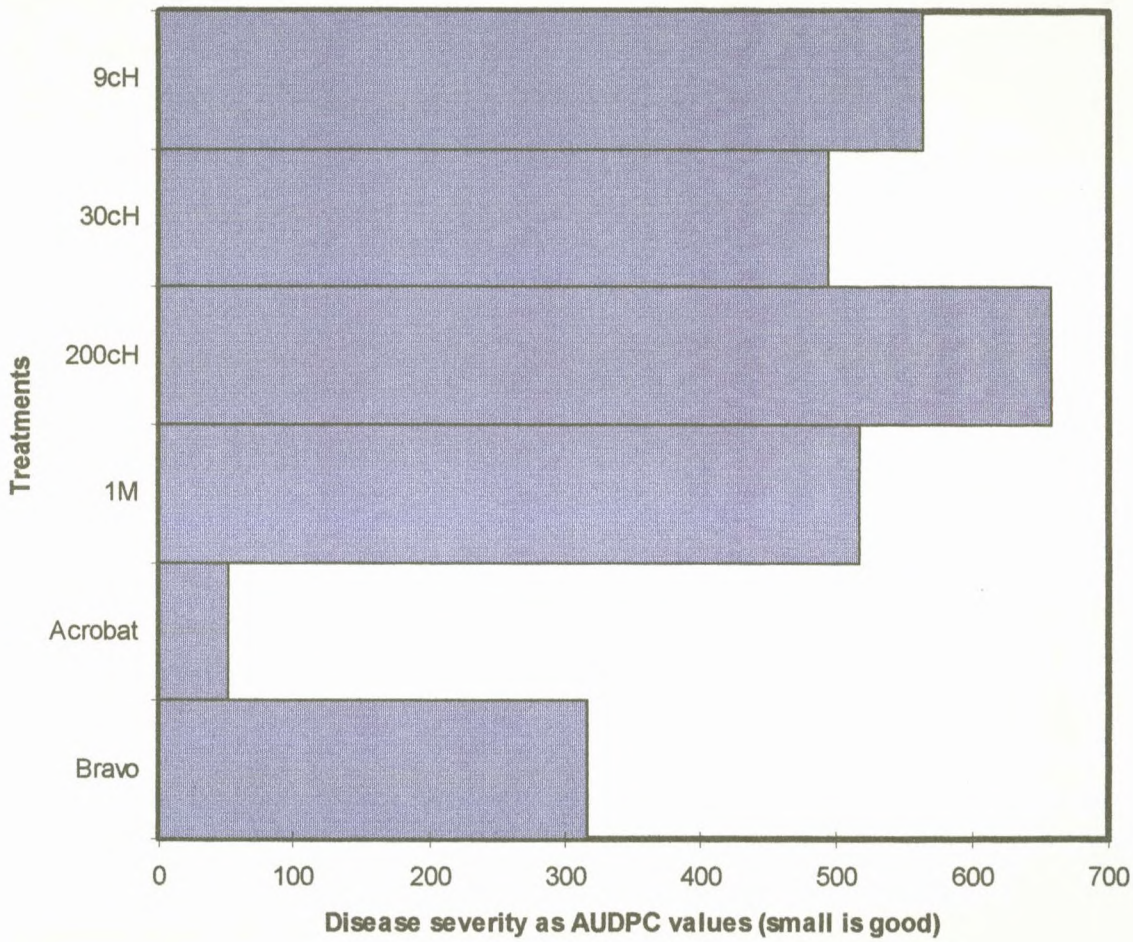


Fig 7. Trial 2A (preventative): Downy mildew severity on cabbage seedlings treated with fungicides and homoeopathic remedies

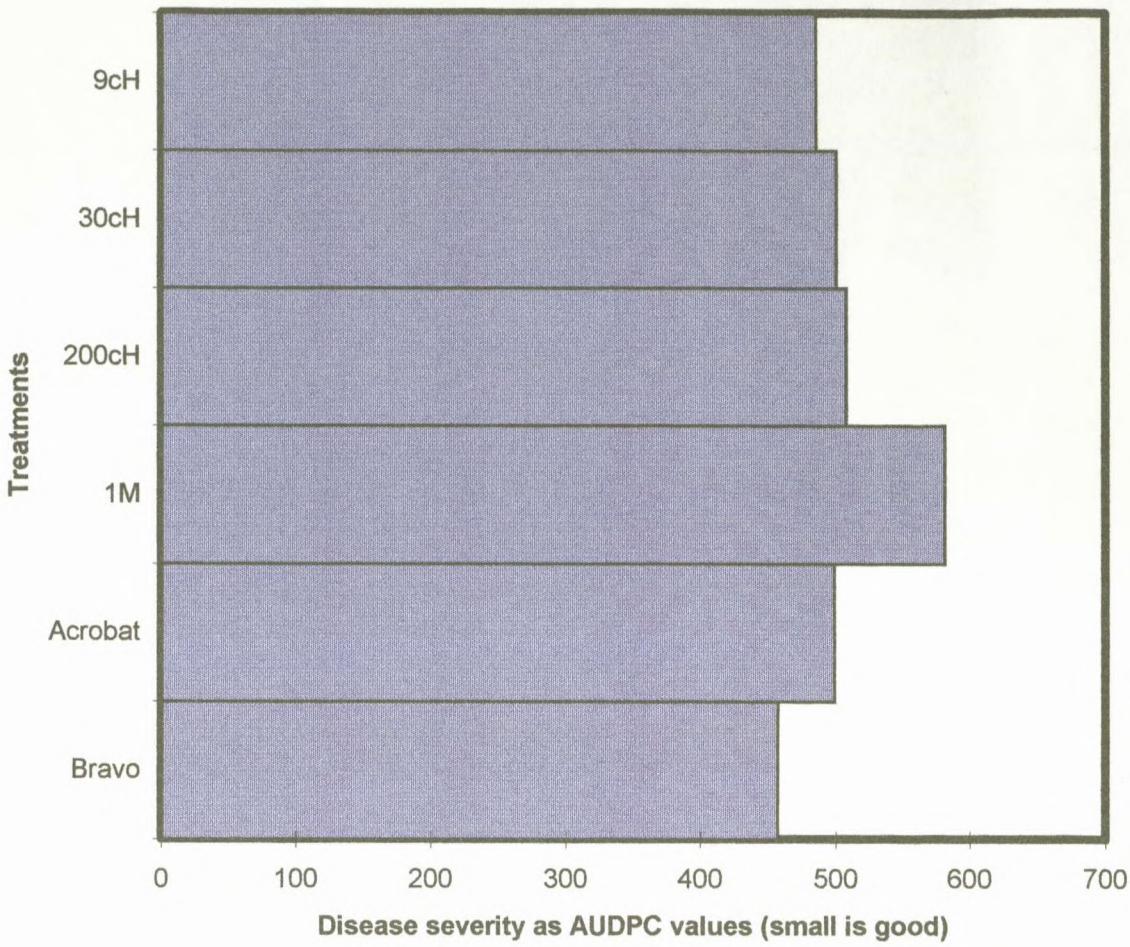


Fig 8. Trial 2B (curative): Downy mildew severity on cabbage seedlings treated with fungicides and homoeopathic remedies

Table 2. Trial 2A (preventative): Overview of all results of cabbage seedlings treated preventatively with fungicides and homoeopathic remedies

Treatments	AUDPC	Wet weight(g)	Dry weight(g)
Bravo	316.6 b	35.3 b	21.3
Acrobat	51.5 a	60.3 c	21.2
1M	516.8 cd	16.7 a	10.0
200CH	657.8 d	26.6 ab	12.8
30CH	493.9 c	38.5 b	16.2
9CH	563.8 cd	29.8 ab	16.2
F-test	16.2 ***	8.7 ***	1.7 NS
P value	0.0000	0.0005	0.1845
CV%	24.9%	28.9%	37.1%

Figures with the same letter do not differ significantly at the level, P=0.05, using Fisher's LSD Test.

Table 3. Trial 2B (curative): Overview of all results of cabbage seedlings treated curatively with fungicides and homoeopathic remedies

Treatment	AUDPC	Wet weight(g)	Dry weight(g)
Bravo	456.6	26.8	13.1
Acrobat	498.7	34.5	15.9
1M	581.1	32.9	16.8
200CH	507.6	40.5	23.8
30CH	500.1	24.2	12.0
9CH	484.8	39.5	15.9
F-test	0.57 NS	1.5 NS	1.1 NS
P value	0.7188	0.2542	0.4079
CV%	21.7%	32.6%	49.1%

Figures with the same letter do not differ significantly at the level, P=0.05, using Fisher's LSD Test.

The treatments for both Batch A and B were ranked according to their AUDPC ratings, wet weights and dry weights (See Appendix J) (Table 4 and 5).

Table 4. Trial 2A (preventative): Rankings of AUDPC values, wet weight and dry weight of cabbage seedlings treated with fungicides and homoeopathic remedies.

Treatment	Rank AUDPC	Rank wet weight (g)	Rank dry weight (g)	Mean rank
Bravo	2	3	4	2.75
Acrobat	1	1	1	1
1M	4	6	6	5.5
200CH	6	5	5	5.25
30CH	3	2	3	2.75
9CH	5	4	2	3.75

Table 5. Trial 2B (curative): Ranking of AUDPC values, wet weight and dry weight of cabbage seedlings treated with fungicides and homoeopathic remedies.

Treatment	Rank AUDPC	Rank wet weight (g)	Rank dry weight (g)	Mean rank
Bravo	1	5	5	3.75
Acrobat	3	3	3	3.5
1M	6	4	2	3.75
200CH	5	1	1	2.25
30CH	4	6	6	5.5
9CH	2	2	4	2.25

The percentage leaf area infected was plotted against time to show progression of the disease for Batch A and B (Fig 9 and 10).

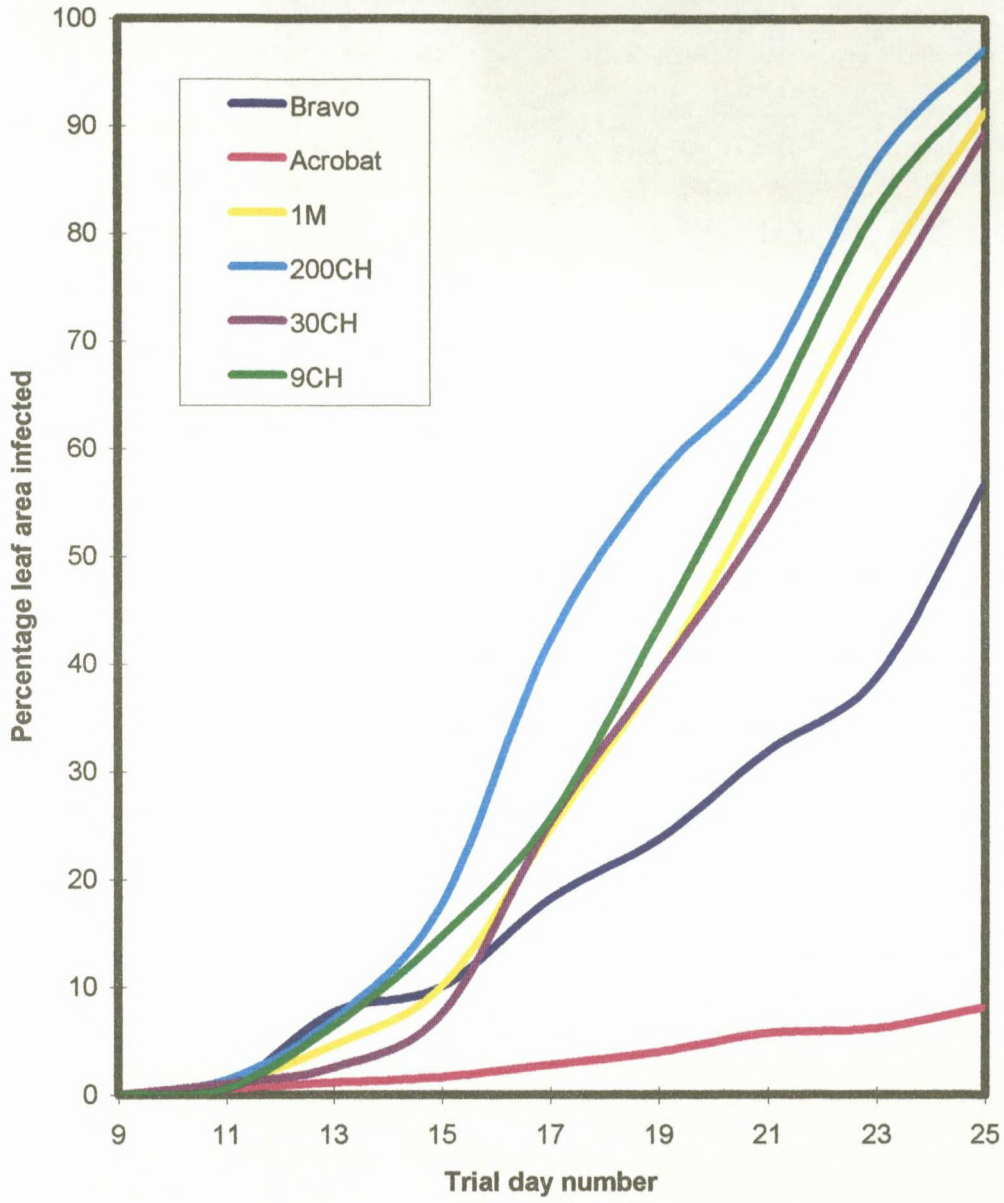


Fig 9. Trial 2A (preventative): Disease progress curves of downy mildew on cabbage seedlings treated with fungicides and homoeopathic remedies

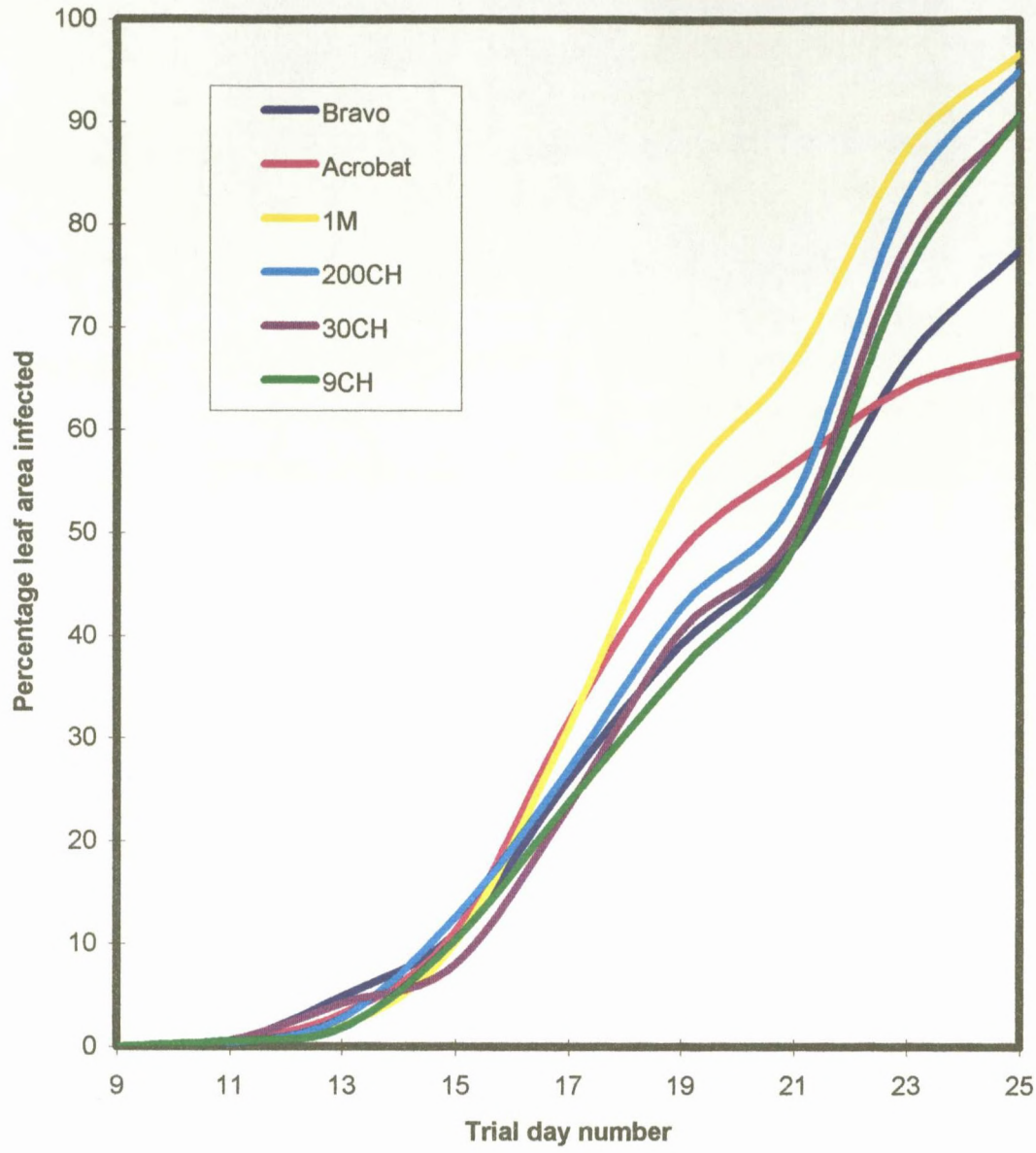


Fig 10. Trial 2B (curative): Disease progress curves of downy mildew on cabbage seedlings treated with fungicides and homoeopathic remedies.

4.3 TRIAL THREE

The AUDPC values for the data of this trial were calculated (See Appendix H and I). The mean AUDPC values for Batch A and B are graphically represented in Fig. 11 and 12.

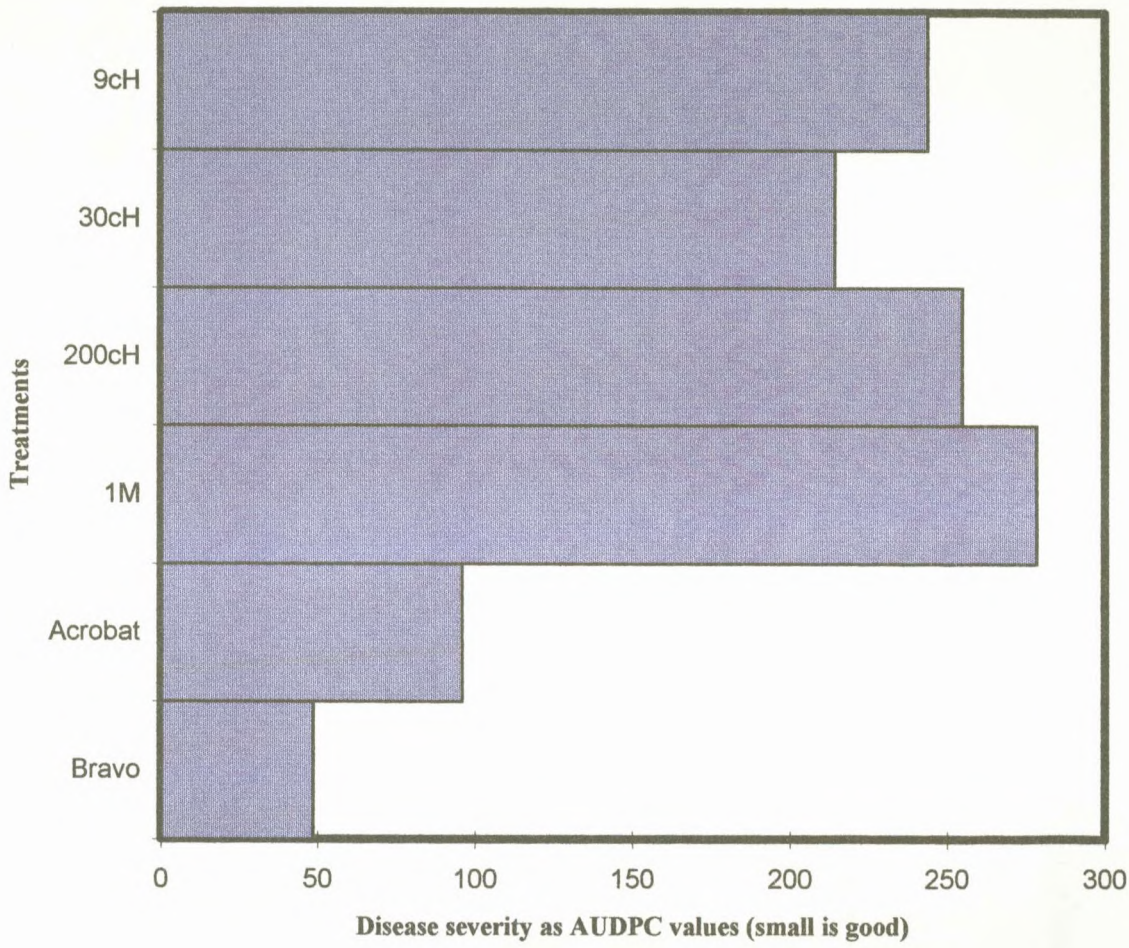


Fig 11. Trial 3A (preventative): Downy mildew severity on cabbage seedlings treated with fungicides and homoeopathic remedies

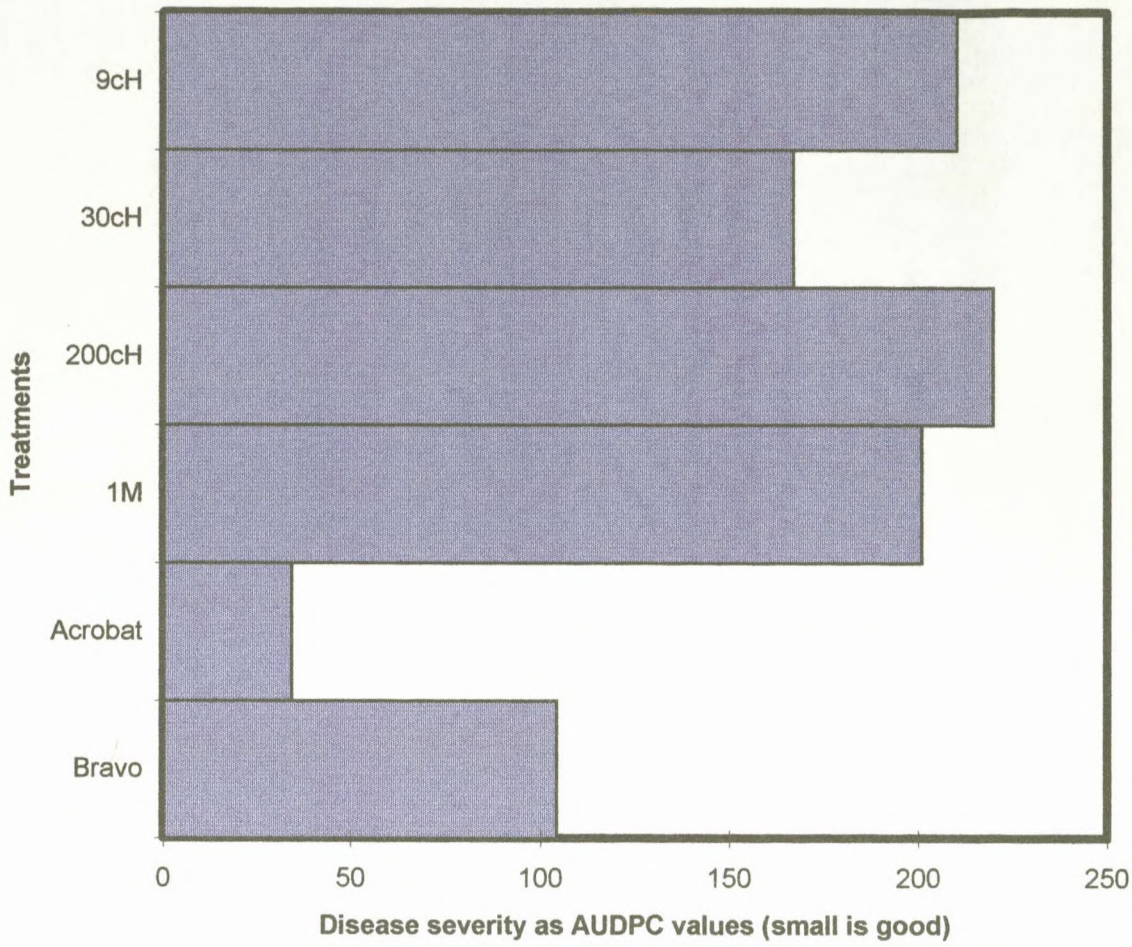


Fig 12. Trial 2B (curative): Downy mildew severity on cabbage seedlings treated with fungicides and homoeopathic remedies

Table 6. Trial 3A (preventative): Overview of all results of cabbage seedlings treated with fungicides and homoeopathic remedies

Treatments	AUDPC	Wet weight (g)	Dry weight (g)
Bravo	48.5 a	31.7	10.7
Acrobat	24.0 a	28.0	10.9
1M	278.1 b	24.1	10.4
200CH	254.7 b	27.1	10.7
30CH	214.0 b	25.8	10.7
9CH	243.7 b	27.4	10.8
F test	5.7 **	1.9 N.S	0.95 N.S
P value	0.0039	0.1394	0.4779
CV%	52.7%	13.2%	3.5%

Figures with the same letter do not differ significantly at the level, P= 0.05, using Fisher's LSD Test.

Table 7. Trial 3B (curative): Overview of all results of cabbage seedlings treated with fungicides and homoeopathic remedies

Treatments	AUDPC		Wet weight (g)	Dry weight (g)
Bravo	104.2	a	26.5	10.5
Acrobat	34.1	a	32.9	11.2
1M	200.9	b	26.9	10.5
200CH	219.9	b	26.9	10.8
30CH	166.9	b	28.5	10.4
9CH	210.2	b	27.6	10.9
F test	3.1 *		1.8 N.S	1.02 N.S
P value	0.0394		0.1652	0.4421
CV%	52.9%		12.7%	5.8%

Figures with the same letter do not differ significantly at the level, P=0.05, using Fisher's LSD Test.

Table 8. Trial 3A (preventative): Rankings of AUDPC values, wet weight and dry weight of cabbage seedlings treated with fungicides and homoeopathic remedies

Treatments	Rank AUDPC	Rank wet weight (g)	Rank dry weight (g)	Mean rank
Bravo	2	2	5	2=
Acrobat	1	1	1	1
1M	6	6	6	6
200CH	5	4	3	4=
30CH	3	5	4	4=
9CH	4	3	2	2=

Table 9. Trial 3B (curative): Rankings of AUDPC values, wet weights and dry weights of cabbage seedlings treated with fungicides and homoeopathic remedies

Treatments	Rank AUDPC	Rank Wet weights (g)	Rank Dry weights (g)	Mean rank
Bravo	4	6	4	4=
Acrobat	1	1	1	1
1M	5	4	5	4=
200CH	3	5	3	3
30CH	6	2	6	4=
9CH	2	3	2	2

The mean percentage leaf area infected was plotted against time to show progression of the disease for both Batch A and B (Fig 13 and 14).

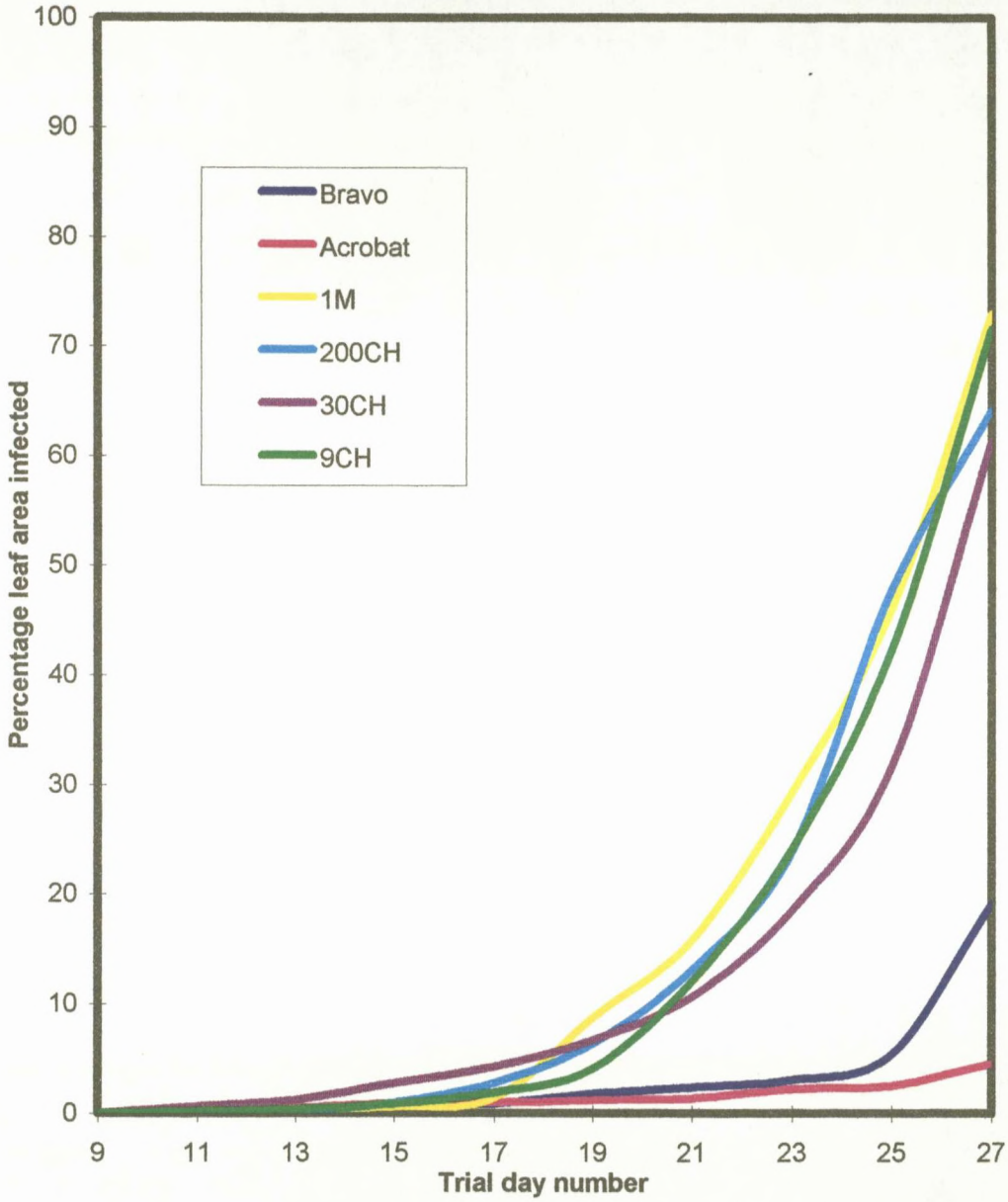


Fig 13. Trial 3A (preventative): Disease progress curves of downy mildew on cabbage seedlings treated with fungicides and homoeopathic remedies

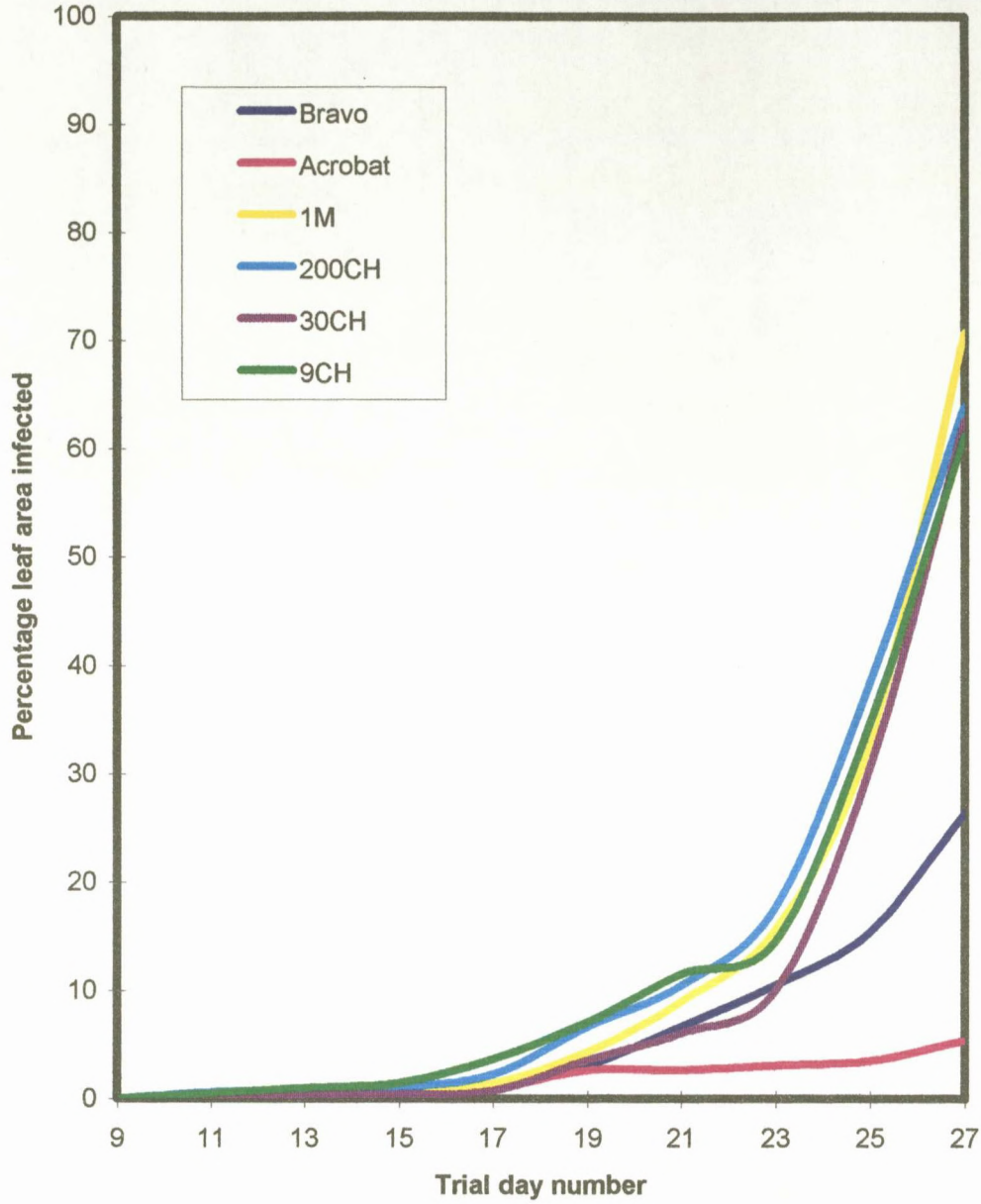


Fig 14. Trial 3B (curative): Disease progress curves of downy mildew on cabbage seedlings treated with fungicides and homoeopathic remedies

Table 10: Overall ranks of all parameters of all three trials

	Ranks of all parameters of preventative trials							Ranks of all parameters of curative trials						
	1A AUDPC	2A AUDPC	3A AUDPC	2A Wt wt	3A Wt wt	2A Dry wt	3A Dry wt	1B AUDPC	2B AUDPC	3B AUDPC	2B Wet wt	3B Wet wt	2B Dry wt	3B Dry wt
Bravo	1	2	2	3	2	4	5	2	1	2	5	6	5	4
Acrobat	2	1	1	1	1	1	1	4	3	1	3	1	3	1
1M	4	4	6	6	6	6	6	3	6	4	4	4	2	5
200CH	3	6	5	5	4	5	3	1	5	6	1	5	1	3
30CH	6	3	3	2	5	3	4	6	4	3	6	2	6	6
9CH	5	5	4	4	3	2	2	5	2	5	2	3	4	2

CHAPTER FIVE

DISCUSSION

In the first trial, the F test of ANOVA of the AUDPC values for the preventative sprays revealed a 1.5 % level of significance. Multiple range analysis of AUDPC values for the preventative sprays revealed that there was not much difference between the action of Bravo and Acrobat. Bravo did, however, perform slightly better than Acrobat, and both fungicides performed significantly better than all the homoeopathic sprays. There was no significant differences in action between the homoeopathic sprays, although the results suggest that the 200CH spray performed slightly better than the 9CH, 30CH and 1M sprays.

The F test of ANOVA of the AUDPC values of the curative sprays was not significant. However, the results suggest that the 200CH spray was the best and performed much better than the 30CH spray. This was also found by Webb (1997) in her homoeopathic study on Tobacco mosaic virus on tomato seedlings, where the 200CH produced the best results. There was not much difference in the action between the fungicides Acrobat and Bravo, or the 1M and 9CH homoeopathic sprays. The seedlings that were sprayed before inoculation did, on a whole, show a lower incidence of disease in terms of the AUDPC values when compared with the curative sprays over the same amount of time.

In the second trial, the F test of ANOVA of AUDPC values for the preventative sprays was highly significant, P = 0.000. Multiple range analysis of AUDPC values revealed a statistically significant difference between the action of Acrobat and Bravo where Acrobat

performed significantly better. Both fungicides performed better than each of the homoeopathic sprays. The 30CH spray was significantly better than the 200CH, and the other homoeopathic sprays showed little differences amongst themselves. The F test of ANOVA of the wet weight was highly significant at a level of 0.05 %. Seedlings treated with Acrobat were significantly heavier than those treated with Bravo, 30CH, 200CH, 1M and 9CH. When comparing the homoeopathic sprays, seedlings treated with 30CH were significantly heavier than those treated with 1M. The results of the dry weights were not significant. However, they indicate that the seedlings treated with Acrobat were the heaviest.

In the curative sprays the F test of ANOVA of the AUDPC values was not significant. There were no significant differences in the performance of the fungicides or any of the homoeopathic sprays when applied on a curative level. However, the results suggest that Bravo was the most effective spray. The results of the wet weights were not significant, but the seedlings treated with the 200CH spray were the heaviest. Results of the dry weights were not significant, however, the results indicate that the seedlings sprayed with 200CH was the heaviest overall. The seedlings sprayed prophylactically did, on a whole, show a lower disease incidence than those sprayed curatively, except for those treated with 200CH.

In the third trial the F test of ANOVA of the AUDPC ratings for the preventative sprays was highly significant at 0.39 %. Multiple range analysis of AUDPC values revealed that Acrobat and Bravo performed at a similar level and both fungicides performed significantly better than all the homoeopathic sprays. The results suggest that when

comparing the homoeopathic sprays the 30CH performed the best. When comparing wet weights Acrobat was significantly heavier than those seedlings treated with 30CH and 1M. There was no significant differences between the dry weights of any of the sprays.

The F test of ANOVA of AUDPC ratings for the curative sprays was significant at a level of 3.94%. Multiple range analysis for AUDPC values showed that Acrobat performed significantly better than all the homoeopathic treatments. The results indicate that when comparing the homoeopathic treatments the 30CH spray performed the best. There was no significant differences in the wet weights between any of the treatment sprays. The results suggest that the seedlings treated with Acrobat were the heaviest. There was no significant differences between the dry weights of any of the treatment sprays. In this trial seedlings sprayed preventatively with homoeopathic sprays generally showed a higher level of disease than when applied curatively. The fungicides performed better when applied preventatively.

From the three trials it is evident that Acrobat was the best treatment overall and consistently produced the best results when applied prophylactically. It did not work as well on a curative level. In Trial One and Two most treatments applied prophylactically produced a lower level of disease than those applied curatively. This trend is consistant with the findings by Webb (1997) in her homoeopathic study in the control of tobacco mosaic virus, where the prophylactic treatment group generally had less disease than the inoculated control. The results suggest that the prophylactic sprays may have an immunising effect when applied in low potencies (9CH and 15 CH) when the disease is

virulent as is demonstrated in Trial One and Two. This effect was not seen when the disease progressed much more slowly as in Trial Three.

In the third trial all the preventative homoeopathic treatment sprays resulted in a higher level of disease when compared with the curative batch. This result was unexpected considering the trend established in the first and second trial. These variations could be due to the different periods (and varying temperatures) in which the trials were run. The first and second trials were performed in summer when there was a high level of humidity, and thus the disease was extremely virulent and progressed very rapidly. The third trial took place in autumn where the humidity and temperatures levels were much lower. As a result the disease progressed much more slowly and the levels of disease obtained were much lower than in Trial One and Two.

The severity of downy mildew is very dependent on temperature and humidity levels and thus trials run over different times of the year are likely to produce different results. (Laing, personal communication 1998).

In this study one would have expected that the 1M potency would have performed better than the 200CH. Perhaps this was not so due to the manufacture of the 1M using the Korsakovian method of preparation, where the deconcentration of the substance is slower than theoretically expected. Another possibility is the existance of an alternating dose response as suggested by Pelikan and Unger (1971) where seedlings exhibited a three part growth curve, rising from potencies 8x to 14x, falling to 16x and then rising again.

These trials indicate that the homoeopathic remedies were not adequate in controlling downy mildew nor was their action comparable to that of the fungicides. There was very little differences between the action of the homoeopathic remedies when looking at all parameters analysed. This is inconsistant with results obtained by Brammer (1994) in her study on the use of homoeopathic remedies on the control of downy mildew, where there were significant differences between the action of the 9CH and 30CH. In Brammer's (1994) study the 9CH caused the disease incidence to increase when compared to the control and the 30CH provided some control when applied over a short period of time. These variations could be due to differences in manufacture of the homoeopathic remedies, in particular because Brammer did not define exactly how the homoeopathic remedies in her trial were made.

When comparing the rankings it appeared that the 30CH spray worked the best when compared to the other homoeopathic sprays. It consistantly ranked third behind the two fungicides.

The major findings of this series of trials is that the homoeopathic preparations did not work. The explanation of this result lies in one or more of the following scenarios:

a) They did not work because either:

   i. they do not work on plant diseases. However, various studies which have been discussed previously have shown the efficacy of homoeopathic remedies on plants.

   ii. they do not work on plant fungi. However, the literature discussed previously does not support this proposition, as seen in the work of Brammer (1994).

iii. the remedies take time to work, therefore they are best applied to a slowly progressing disease. This possibility is a testable proposition, one could run a trial using plant diseases which are slow to progress e.g. Leaf blight.

Or,

b) Preparation of the homoeopathic remedies was incorrect because either:

i. the leaf contained too little *P. parasitica*. This is testable, a leaf which is 90 – 100% infected could be used to make up the trituration.

ii. only pure *P. parasitica* should be used. This theory can be tested by using only pure *P. parasitica* which has been scraped off an infected leaf.

iii. the manufacture of the 3CH and 1M was inaccurate. The way to test this proposition would be to run trials using three people to make up the same remedy, in the same manner, and then see if there are any differences in the results of the trials.

iv. the manufacture of the 8CH, 29CH and 199CH was inaccurate. This can only be tested by allowing two companies to make up the remedies, and see if any differences in the results of the trial exist.

Or,

c) Application of the remedy was incorrect because either:

i. the homoeopathis applications were too infrequent. This is testable, trials could be run using 15CH, 30CH and 200CH potencies, looking at daily, two days, four days and weekly applications of the remedies and compare these to each other, to find the optimal number of applications.

ii. the applications should have been as a drench and not as a foliar spray. This is testable, by running a trial using three homoeopathic potencies and applying them as a foliar spray to one half of the seedlings, and as a drench on the other half of the seedlings.

iii. the dose was too low (not the potencies used, but the volumes applied of the various potencies). The leaf can't hold anymore spray so the homoeopathic treatments can only be applied as a drench or more often.

The negative results for the homoeopathic remedies used for this series of trials therefore pose a series of questions for the committed homoeopathic practitioner. However, further research, as suggested above, may answer these questions and advance our understanding of homoeopathy in the process.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

From the results obtained, the homoeopathic sprays seem to have inconsistent effects on the control of downy mildew when compared to recent studies performed. Before any definite conclusions can be drawn as to the efficacy of homoeopathic treatments sprays on downy mildew, further studies need to be performed. It is important to reproduce and build upon previous studies as it is only through exploring all possiblities that definite conclusions can be drawn.

Further trials could be done using a homoeopathic preparation made from only *P.parasitica.* This would eliminate any inconsistent results which could be attributed to remedy preparation.

These trials could include the addition of homoeopathic sprays to fungicides to see if this influences the effect that the fungicides have on controlling the downy mildew.

The CV% were high, and therefore one could include a fifth repetition in any further trials.

A further spray containing only water could be introduced into the trial, in order to establish whether the homoeopathic treatments have a better effect than treating the seedlings with nothing. This would confirm that the homoeopathic remedies do have an effect on the cabbage seedlings.

The application of the homoeopathic remedies on a more frequent basis could also be adopted and determine whether repetition of the dose has an effect on the results.

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APPENDICES

APPENDIX A: LAYOUT OF THE SEEDLING TRAYS FOR AS GENERATED BY COMPUTER FOR EACH BATCH OF TRIAL ONE

POSITION	TREATMENT
1	9CH
2	Bravo
3	1M
4	30CH
5	200CH
6	Acrobat
7	200CH
8	30CH
9	9CH
10	1M
11	Bravo
12	Acrobat
13	9CH
14	1M
15	30CH
16	200CH
17	Bravo
18	Acrobat
19	200CH
20	1M
21	30CH
22	Bravo
23	9CH
24	Acrobat

APPENDIX B: LAYOUT OF THE SEEDLING TRAYS AS GENERATED BY COMPUTER FOR THE SECOND TRIAL

POSITION	TREATMENTS
1	9CH
2	200CH
3	Acrobat
4	1M
5	Bravo
6	30CH
7	200CH
8	1M
9	30CH
10	Acrobat
11	Bravo
12	9CH
13	Bravo
14	9CH
15	Acrobat
16	30CH
17	200CH
18	1M
19	Acrobat
20	200CH
21	30CH
22	9CH
23	1M
24	Bravo

APPENDIX C: LAYOUT OF SEEDLING TRAYS AS GENERATED BY COMPUTER FOR THE THIRD TRIAL

POSITION	TREATMENT
1	9CH
2	1M
3	200CH
4	Bravo
5	Acrobat
6	30CH
7	1M
8	9CH
9	30CH
10	Bravo
11	200CH
12	Acrobat
13	Acrobat
14	200CH
15	1M
16	9CH
17	30CH
18	Bravo
19	Bravo
20	30CH
21	200CH
22	Acrobat
23	1M
24	9CH

APPENDIX D: TABLE OF RATINGS AND AUDPC VALUES FOR TRIAL ONE : BATCH A

Treatment no 1= Bravo							
Tray no.	rating 2/3/98	rating 4/3/98	rating 6/3/98	rating 8/3/98	rating 10/3/98	rating 12/3/98	AUDPC
5	0.68	0.75	0.94	1.63	15.5	41.13	79.4
11	0.56	1.0	1.0	1.06	3.81	23	37.3
13	1.25	1.13	2.5	2.75	8	18.31	48.32
24	4.94	13.13	19.25	21.56	23.88	52.5	213.08
mean	1.86	4	5.92	6.75	12.8	33.73	94.53
Treatment no 2= Acrobat							
3	1.88	3.31	3.94	7	7.69	24.19	69.96
10	4.5	5.94	14.31	16.25	22.44	30.5	152.88
15	7	6.13	9.94	16.19	19.75	21.63	132.65
19	4	4.75	5.56	5.63	10.56	16.44	73.44
mean	4.34	5.03	8.44	11.27	15.11	23.19	107.23
Treatment 3= 1M							
4	4.75	10.56	29.81	33.63	68.13	94.50	383.5
8	1.19	0.81	3.25	6.25	25.19	67.75	139.94
18	5.63	11	33.13	33.38	53.38	98	365.41
23	0.63	3.38	7.88	18	30.38	90.13	210.06
mean	3.05	6.44	18.52	22.82	44.27	87.6	247.73
Treatment 4= 200CH							
2	3.5	7.88	12.69	13.88	38.88	77.38	227.6
7	2.94	3.69	16	20.25	39.5	75.88	237.7
17	2.63	7.5	15	22.75	54.38	95.63	297.52
20	3	5.19	8.39	18.56	38.63	78.75	223.27
mean	13.01	6.07	13.02	18.86	42.85	81.91	246.52
Treatment 5= 30CH							
6	1.125	1	7.5	28.69	39.38	96.63	250.9
9	8.25	17	33	51	75.75	96.25	458.0
16	1.44	1.56	4.63	12.13	43.75	86.5	212.08
21	3.13	8.56	8.94	12.13	37.13	87.88	224.53
mean	3.49	7.03	13.52	25.99	49	91.82	286.38
Treatment 6= 9CH							
1	0.5	2.13	10.5	29.25	65.25	94.63	309.39
12	4.56	5.69	16.38	24.44	50.88	69.38	268.72
14	4.25	6.5	10.06	24.56	41	81	249.99
22	4.06	10.13	16.5	23.25	33.5	64	234.82
mean	3.34	6.11	13.36	25.38	47.66	77.38	265.73

APPENDIX E: TABLE OF RATINGS AND AUDPC VALUES FOR TRIAL ONE: BATCH B

Treatment no 1= Bravo							
Tray no.	rating 2/3/98	rating 4/3/98	rating 6/3/98	rating 8/3/98	rating 10/3/98	rating 12/3/98	AUDPC
5	0.31	1.63	1.88	5.63	29.56	66.44	144.15
11	3.0	10.75	17.94	32.13	56.13	81.25	318.15
13	3.25	9.5	18.56	28.75	43.25	83.38	286.75
24	2.75	5.06	19.63	28	51.75	65.75	277.38
mean	2.32	6.74	14.5	23.63	45.17	74.2	256.61
Treatment no 2= Acrobat							
3	3.94	9.5	16.25	27.38	43.25	78.38	275.08
10	6.38	19.19	31.13	41.69	63.13	81.75	398.41
15	2.63	5.19	12.75	18.44	33.75	64.88	207.77
19	6.88	8.0	13.75	17.25	31.69	59.5	207.76
mean	4.95	10.47	18.34	26.19	42.95	71.13	272.26
Treatment 3= 1M							
4	0.88	1	8.06	16.5	41.63	92.63	227.89
8	12	15.5	22.19	36.75	63.63	99.38	387.52
18	0.94	2.44	13.94	20.19	39.88	85.88	239.72
23	2.56	2.75	7.88	17.25	36.88	73.25	205.33
mean	4.09	5.42	13.02	22.67	45.5	87.78	264.9
Treatment 4= 200CH							
2	1.13	3.69	8.44	12.69	28.5	97	204.77
7	1.06	2.56	6.75	12.63	46.75	82	220.44
17	1.63	1.63	6.88	13.13	40.5	75.88	201.79
20	0.31	0.38	0.5	2.06	20.19	56.25	102.80
mean	1.03	2.06	5.64	10.13	33.98	77.78	182.46
Treatment 5= 30CH							
6	1.69	11.94	19.94	35.13	58.5	91.63	344.34
9	4.56	11	15.5	20.5	37.13	80.88	253.7
16	7.81	13.06	48.4	40.5	60.5	83.38	416.11
21	10.19	24.31	24.63	39.25	63.38	88.25	401.58
mean	6.06	15.07	27.12	33.85	54.88	86.04	353.93
Treatment 6= 9CH							
1	1.88	6.31	16.88	33.06	49.38	86	299.14
12	0.63	1.69	1	2.5	14.75	55.75	96.26
14	10.25	21.31	30.88	45.25	75.63	99.38	455.77
22	3.69	4.5	16.88	23.13	37.75	74.63	242.84
mean	4.11	8.45	16.41	25.99	44.38	78.94	273.5

APPENDIX F: TABLE OF RATINGS AND AUDPC VALUES FOR TRIAL TWO: BATCH A

Tray no	rating 27/3/98	rating 29/3/98	rating 31/3/98	rating 2/4/98	rating 4/4/98	rating 6/4/98	rating 8/4/98	rating 10/4/98	AUDPC
Treatment no 1= Bravo									
2	0.63	13.63	24.63	44.38	44.88	49.5	57	72.5	541.17
11	0.63	7.63	9.38	20.81	33.63	52.57	61.29	78.5	449.75
17	1.38	4.13	5.31	7	15.31	22.63	29.63	40.13	209.53
22	0.38	0.88	0.88	0.94	1.38	3.13	7.5	36.25	66.05
mean	0.76	7.66	10.05	18.28	23.8	31.96	38.86	56.85	316.63
Treatment no 2= Acrobat									
6	0.44	1.38	2.44	3.38	5.63	11.81	12	17.25	90.97
12	1	2.19	2.25	2.31	2.4	2.63	2.75	3.5	33.56
18	0.31	0.5	1.44	5	7.19	7.5	8.5	9	69.57
24	0.25	0.44	0.5	0.5	0.64	1	1.38	2.75	11.92
mean	0.5	1.13	1.66	2.8	3.97	5.74	6.16	8.13	51.51
Treatment no 3=1M									
3	0.5	2.06	4.75	26.38	34.25	59	66.63	87.88	474.52
10	1	5.13	9.5	17.38	42.75	59.75	71.5	90.38	503.4
14	2.44	10.56	20.31	39.13	52.38	63.25	86.13	90.25	636.21
20	0.19	0.69	6.06	16.13	27.94	46.63	80.25	97.5	453.09
mean	1.03	4.61	10.16	24.76	39.33	57.16	76.13	91.5	516.81
Treatment no 4= 200CH									
5	0.25	1.75	16.63	45.75	57.75	74.5	77.5	95.38	643.39
7	1.69	9.44	24	53.75	73.25	75.13	97.5	98.25	766.08
16	1.81	2.88	7.94	28.63	46.63	56.5	89.88	98.13	564.86
19	1.88	14.13	22.5	41	52.63	65.38	83.13	97.5	656.92
mean	1.41	7.05	17.77	42.28	57.57	67.88	87	97.32	657.81
Treatment no 5=30CH									
4	0.5	2.69	8.5	23.25	35.38	49.88	66.13	85	457.16
8	0.94	4.38	10.25	37.38	59.63	75.13	85.34	99.38	644.54
15	1.81	1.75	3.06	22.25	38.38	57.5	71.5	80.88	471.57
21	0.94	1.31	8.69	18.5	24	33.63	68.29	92.88	402.66
mean	1.05	2.53	7.63	25.35	39.35	54	72.82	89.54	493.98
Treatment no 6= 9CH									
1	0.38	7.13	32.63	44	59.38	77	86.5	95.63	709.2
9	0.38	2.06	3.84	16.25	29.88	63	85.38	100	501.2
13	0.81	11.5	16.44	26.38	44.13	64	88.5	99.38	602.9
23	0.75	1.5	5.88	16	40.94	45.88	69.75	81.25	441.9
Mean	0.58	6.49	14.7	25.66	43.58	62.47	82.53	94.07	563.8

APPENDIX G: TABLE OF RATINGS AND AUDPC VALUES OF TRIAL TWO: BATCH B

Tray no	rating 27/3/98	rating 29/3/98	rating 31/3/98	rating 2/4/98	rating 4/4/98	rating 6/4/98	rating 8/4/98	rating 10/4/98	AUDPC
Treatment no 1= Bravo									
2	0.38	0.69	2.69	13.75	35.0	44.5	61.38	71.25	387.65
11	0.5	2.13	7.69	29.5	44.38	52.5	69.13	76.5	487.66
17	0.44	9.5	22.63	35.38	48.5	52.5	71.63	82.63	505.34
22	0.56	7.13	11.06	25.25	28.5	45.13	65.5	80.13	445.83
Mean	0.47	4.86	11.02	25.97	39.1	48.66	66.91	77.63	456.62
Treatment no 2= Acrobat									
6	1.13	2.75	14.5	34.88	51.38	60.38	65	72.88	531.79
12	0.25	6.81	19	48.25	68.75	75.25	80.75	81.75	679.5
18	0.63	0.65	7.5	25	41.63	45.75	58.63	59.75	418.7
24	0.31	2.25	4	18.13	31.38	46	52.75	55.5	364.83
Mean	0.58	3.12	11.25	31.57	48.29	56.85	64.28	67.44	498.71
Treatment no 3=1M									
3	0.88	1.31	10.13	21.75	55.75	71.5	92.5	98.13	527.39
10	0.38	3.63	18	42.25	59.5	76	90.13	97.5	676.9
14	0.25	1.5	8.88	38	55	66.5	85.63	972.5	608.52
20	0.63	1.13	3.75	22.13	46.88	53.25	81.38	93.88	511.55
Mean	0.54	1.9	10.19	31.03	54.28	66.81	87.41	96.69	581.09
Treatment no 4= 200CH									
5	0.75	5.13	21.75	36.63	61.63	79.5	84.63	96.63	675.92
7	0	1.56	4.81	26.75	44.63	50.25	83	95.13	517.13
16	0.19	3.44	17.19	28.13	38.38	46.88	79.5	93.38	520.61
19	0.19	0.94	6.63	16.13	26.13	37.63	84	95.38	316.86
Mean	0.28	2.77	12.6	26.91	42.7	53.57	82.78	95.13	507.63
Treatment no 5=30CH									
4	1.25	6.63	8.25	38.25	51.63	66.25	89.13	96.25	617.78
8	0.5	1.5	1.81	7.13	23.63	37	66.5	89.25	364.89
15	0.13	4.69	9.06	19.38	34.38	39	65.63	81.75	426.16
21	0.31	3.88	13.06	28.88	52	58.5	91.38	96	591.71
Mean	0.55	4.18	8.05	23.41	40.41	50.19	78.16	90.81	500.14
Treatment no 6= 9CH									
1	0.38	2.89	16.63	42.5	55.13	74.88	86.38	98.75	655.95
9	0.38	1.31	10.63	22.25	33.75	49.63	72.63	92.13	472.91
13	0.81	1.44	7.75	16.5	33	34.75	70.88	86.63	416.08
23	0.75	1.63	6.63	13.88	24.75	35.63	71.5	85.63	394.42
Mean	0.58	1.82	10.41	23.78	36.66	48.72	75.35	90.79.	484.84

APPENDIX H: TABLE OF RATINGS AND AUDPC VALUES OF TRIAL THREE: BATCH A

Tray no	rating 1/5/98	rating 3/5/98	rating 5/5/98	rating 7/5/98	rating 9/5/98	rating 11/5/98	rating 13/5/98	rating 15/5/98	rating 17/5/98	AUDPC
Treatment no 1= Bravo										
4	0	0	0	0.06	0.13	0.13	0.38	0.38	0.63	2.77
10	0.13	0.13	0.31	0.31	0.38	0.5	0.56	0.56	10.5	16.13
18	0.69	1.3	1.38	1.56	2.19	3	4.63	9.38	24.75	72.34
19	0.19	0.38	0.625	1.5	4.38	5.94	6.63	11.5	40.63	102.74
Mean	0.25	0.45	0.58	0.86	1.77	2.39	3.05	5.46	19.13	48.5
Treatment no 2= Acrobat										
5	0	0	0	0.63	0.13	0.25	0.5	0.5	1.63	4.52
12	0.25	0.38	0.63	0.69	1	1	1.44	1.88	6.88	21.15
13	0.13	0.19	0.25	0.44	0.5	0.56	0.69	0.88	1.75	8.89
22	0.69	1.31	2.69	2.69	3.13	3.63	6.25	6.75	7.88	61.47
Mean	0.27	0.47	0.9	0.97	1.19	1.36	2.22	2.5	4.53	96.01
Treatment no 3=1M										
2	0.13	0.13	0.5	0.625	0.81	5.63	16.5	41.25	70.88	201.89
7	0.31	0.38	0.5	0.63	0.69	2.63	13.88	24.5	50.38	137.09
15	0.19	0.13	0.5	0.88	7.88	19.38	42.5	57.5	82.75	340.46
23	0.5	0.69	0.81	3.5	25.56	35.75	44.38	61.5	88.13	433.01
Mean	0.28	0.33	0.58	1.41	8.74	15.85	29.32	46.19	73.03	278.11
Treatment no 4=200CH										
3	0	0	1.44	2.94	4.5	11.06	23.25	42.38	66.63	237.77
11	0.38	0.5	0.81	1.25	1.56	1.63	2.44	2.44	8.88	30.52
14	0.06	0.06	0.94	5.94	11.94	23.63	44.5	77.88	93.75	423.6
21	0.13	0.19	0.63	0.88	7.56	16.25	25.38	68.63	87.75	326.9
Mean	0.14	0.19	0.95	2.75	6.39	13.14	23.89	47.83	64.25	254.69
Treatment 5= 30CH										
6	0	0	0	0.69	1.31	1.31	1.63	7.63	24.25	49.39
9	0.25	0.31	0.38	0.44	0.88	11.5	29.5	51.13	81	269.53
17	0.63	1.56	3.19	4.63	9.88	14.38	19.38	30.25	60.88	228.05
20	1.56	3	7.5	11.31	14.69	15.63	23.75	38.13	79.5	309.08
Mean	0.61	1.22	2.77	4.27	6.69	10.71	18.57	31.79	61.4	214.01
Treatment 6= 9CH										
1	0.13	0.13	0.63	0.69	0.88	2.69	5.44	17.75	43.13	99.65
8	0	0.13	0.89	2.38	5.38	16.63	37.5	67.3	94.13	354.51
16	0.38	0.75	1.44	1.88	4.75	8.5	24.13	39.38	80.13	242.17
24	0.38	0.5	0.56	2.56	5.34	20.75	29.56	45.13	69	278.18
Mean	0.22	0.38	0.88	1.88	4.09	12.14	24.16	42.39	71.59	243.63

APPENDIX I: TABLE OF RATINGS AND AUDPC VALUES OF TRIAL THREE: BATCH B

Tray no	rating 1/5/98	rating 3/5/98	rating 5/5/98	rating 7/5/98	rating 9/5/98	rating 11/5/98	rating 13/5/98	rating 15/5/98	rating 17/5/98	AUDPC
Treatment no 1= Bravo										
4	0.38	0.81	0.88	1.063	2.063	4.06	4.5	7.5	12.13	54.26
10	0.38	0.75	1	1.5	2.5	3.25	8.5	8.63	10.5	63.14
18	0.44	0.44	0.5	0.75	1	1.5	1.5	2.13	8.38	24.45
19	0.75	1.06	1.31	1.63	6.75	17.75	27.63	43.63	74.7	274.97
mean	0.49	0.77	0.92	1.23	3.08	6.64	10.53	15.47	26.43	104.20
Treatment no 2= Acrobat										
5	0.38	0.44	0.63	0.69	1.25	1.25	2	2.38	3.5	21.14
12	0.56	0.69	0.75	1.06	1.5	1.5	1.75	2.25	8.13	28.83
13	0.13	0.13	0.25	0.38	0.81	0.94	1	1.63	2.06	12.45
22	0.38	0.69	1.13	1.75	6.94	6.94	7.63	7.88	7.88	74.16
mean	0.36	0.48	0.69	0.97	2.63	2.66	3.10	3.54	5.39	34.15
Treatment no 3=1M										
2	0.89	1.13	1.18	2.88	5.19	8	15.63	46	59	219.87
7	0.19	0.38	1	1.63	4.31	8.13	11.75	22.25	59	158.06
15	0.13	0.13	0.38	1.19	7.5	18.63	33.25	43.25	86.25	295.01
23	0	0	0.06	0.06	0.38	1.25	2.5	21.63	79.13	130.89
mean	0.3	0.41	0.65	1.44	4.34	9	15.78	33.28	70.85	200.96
Treatment no 4=200CH										
3	1.19	2.13	2.19	3.5	5.06	6.06	8.69	21	38.13	136.57
11	1	1.06	1.88	2.94	6.75	8.75	12.5	15.75	35.13	135.39
14	0.19	0.19	0.31	1.31	7.13	13	20.88	48.75	85	268.34
21	0	0	0	1.19	7.63	14.19	29.13	68.38	98.13	339.17
mean	0.59	0.84	1.09	2.24	6.64	10.5	17.8	38.47	64.10	219.87
Treatment 5= 30CH										
6	0.13	0.19	0.25	0.25	1.25	2.06	4.38	10.63	15.38	53.53
9	0.06	0.19	0.31	1.13	5.63	10.31	11.88	37.75	71.38	205.84
17	0.25	0.63	0.63	1	5.75	6.81	8.25	27.63	71.13	172.76
20	0.38	0.5	0.63	0.63	1.69	5.01	16	46.75	92.75	235.63
mean	0.2	0.38	0.45	0.75	3.58	6.06	10.13	30.69	62.66	166.94
Treatment 6= 9CH										
1	1.19	2.5	4.31	8.63	10.75	15	16.63	23.5	41	204.82
8	0.25	0.5	0.44	0.88	4.31	11.38	16.25	41.88	68.88	220.4
16	0.31	0.5	0.63	4.51	12.44	18.5	23	53.13	80	305.83
24	0.19	0.38	0.56	0.69	0.94	1.13	2.75	20.5	55.5	109.57
mean	0.48	0.97	1.48	3.69	7.11	11.5	14.66	34.75	61.35	210.16

APPENDIX J: WET WEIGHT AND DRY WEIGHT RESULTS OF TRIAL TWO

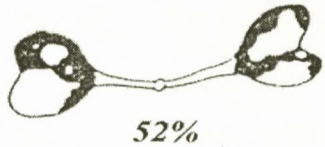
Tray number	Wet weight(g) Batch A	Dry weight(g) Batch A	Wet weight(g) Batch B	Dry weight(g) Batch B
1	24.4	18.4	39.7	15.1
2	41.7	27.6	16.15	9.6
3	13.4	9.6	14.6	8.9
4	37.1	16.4	32.6	10.9
5	24.3	12.2	34.8	14.5
6	58.9	14.1	36.4	20.2
7	23.3	11.4	25.8	10.6
8	39.6	20.9	12.5	9.2
9	18.1	9.8	40.9	17.2
10	19.3	11.2	45.8	29.4
11	56.0	13.1	30.3	10.2
12	56.6	24.7	38.9	14.6
13	40.7	19.4	37.9	11.3
14	21.7	10.2	43.8	16.2
15	29.5	10.5	30.8	17.4
16	31.9	17.2	46.9	27.0
17	21.9	10.3	25.9	18.2
18	57.2	30.3	45.2	18.5
19	27	10.5	54.5	43.2
20	12.3	9.1	27.4	12.9
21	47.9	16.8	21.2	10.6
22	21.8	10.3	35	14.4
23	35.9	17.2	39.3	19.8
24	68.4	15.8	17.6	10.2

APPENDIX K: WET WEIGHT AND DRY WEIGHT RESULTS OF TRIAL THREE

Tray number	Wet weight Batch A (g)	Dry weight Batch A (g)	Wet weight Batch B (g)	Dry weight Batch B (g)
1	30.	10.9	30.4	11.2
2	26.8	10.5	26.6	10.8
3	27.9	10.7	22.8	10.3
4	30.7	10.7	29.4	10.7
5	38.4	11.4	30.4	10.7
6	31.1	11.2	33.8	9.4
7	23.9	10.5	26.1	10.7
8	27.5	10.8	28.8	10.9
9	20.8	10.3	28.3	10.8
10	31.8	11.1	30.8	10.9
11	36.1	11.6	25.6	10.5
12	32.9	11.2	35.4	11.6
13	29.6	10.7	34.3	11.5
14	20.8	10.1	31.9	11.5
15	25.8	10.6	23.3	9
16	28.9	11.1	25.8	10.6
17	25.7	10.6	25.6	10.5
18	26.5	10.7	24.2	10.2
19	23.2	10.3	21.7	10.1
20	25.6	10.7	26.5	10.8
21	23.7	10.5	27.1	10.9
22	25.8	10.3	31.9	11.1
23	19.9	9.90	31.6	11.4
24	22.3	10.3	25.4	10.8

APPENDIX L: VISUAL RATING SCALE (Brophy and Laing, unpublished)

1.5%



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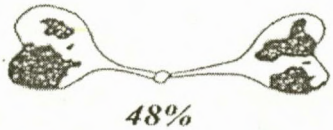
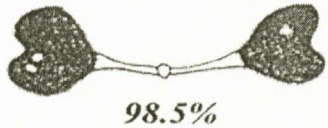


48%



98.5%

APPENDIX M: ANOVA OF AUDPC VALUES OF CABBAGE SEEDLINGS TREATED WITH FUNGICIDES AND HOMOEOPATHIC REMEDIES FOR TRIAL ONE

ANOVA table of Batch A

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	15 3281.82	5	30656.364	4.105	0.0151
Data rep	2101.93	3	700.645	0.094	0.9623
Residual	112010.77	15	7467.3844		
Total	267394.52	23			
(corrected)					

All F- ratios are based on the residual mean square error.

ANOVA table of Batch B

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	59543.961	5	11908.792	1.281	0.3228
Data rep	14333.248	3	4777.749	0.514	0.6788
Residual	139434.92	15	9295.6610		
Total	213312.12	23			
(corrected)					

All F- ratios are based on the residual mean square error

APPENDIX N: ANOVA OF AUDPC VALUES OF CABBAGE SEEDLINGS TREATED WITH FUNGICIDES AND HOMOEOPATHIC REMEDIES FOR TRIAL TWO

ANOVA table of Batch A

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	949911.28	5	189982.26	16.209	0.0000
Data rep	85559.93	3	28519.98	2.433	0.1052
Residual	175808.58	15	11720.572		
Total	1211279.8	23			
(corrected)					

All F- ratios are based on the residual mean square error

ANOVA table of Batch B

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	34427.161	5	6885.432	0.574	0.7188
Data rep	57473.146	3	19157.715	1.598	0.2315
Residual	179781.44	15	11985.429		
Total	271681.75	23			
(corrected)					

All F- ratios are based on the residual mean square error

APPENDIX O: ANOVA OF WET WEIGHTS OF CABBAGE SEEDLINGS TREATED WITH FUNGICIDES AND HOMOEPATHIC REMEDIES FOR TRIAL TWO

ANOVA table of Batch A

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	4330.4018	5	866.08036	8.658	0.0005
Data rep	23.3092	3	7.76974	0.078	0.9711
Residual	1500.4125	15	100.02750		
Total	5854.1235	23			
(corrected)					

All F- ratios are based on the residual mean square error

ANOVA table of Batch B

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	860.23115	5	172.04623	1.480	0.2542
Data rep	273.57903	3	91.19301	0.784	0.5210
Residual	1743.6958	15	116.24639		
Total	2877.5060	23			
(corrected)					

All F- ratios are based on the residual mean square error

APPENDIX P: ANOVA OF DRY WEIGHTS OF CABBAGE SEEDLINGS TREATED WITH FUNGICIDES AND HOMOEPATHIC REMEDIES FOR TRIAL TWO

ANOVA table of Batch A

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	281.76033	5	56.352067	1.748	0.1845
Data rep	37.50417	3	12.501389	0.388	0.7635
Residual	483.67423	15	32.244949		
Total	802.93873	23			
(corrected)					

All F- ratios are based on the residual mean square error

ANOVA table of Batch B

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	345.39423	5	69.078847	1.085	0.4079
Data rep	113.84063	3	37.946878	0.596	0.6272
Residual	954.86567	15	63.657711		
Total	1414.1005	23			
(corrected)					

All F- ratios are based on the residual mean square error

APPENDIX Q: ANOVA OF AUDPC VALUES OF CABBAGE SEEDLINGS TREATED WITH FUNGICIDES AND HOMOEPATHIC REMEDIES FOR TRIAL THREE

ANOVA table of Batch A

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	247964.43	5	49592.886	5.698	0.0039
Data rep	89617.07	3	29872.356	3.432	0.0443
Residual	130552.41	15	8703.4943		
Totai	468133.91	23			
(corrected)					

All F- ratios are based on the residual mean square error

ANOVA table of Batch B

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	106734	5	21346.848	3.128	0.0394
Data rep	24743.00	3	8247.666	1.208	0.3407
Residual	102377.68	15	6825.1787		
Total	233854.92	23			
(corrected)					

All F- ratios are based on the residual mean square error

APPENDIX R: ANOVA OF WET WEIGHTS OF CABBAGE SEEDLINGS TREATED WITH FUNGICIDES AND HOMOEPATHIC REMEDIES FOR TRIAL THREE

ANOVA table of Batch A

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	129.07370	5	25.814740	1.985	0.1394
Data rep	191.17888	3	63.726294	4.901	0.0144
Residual	195.03667	15	13.002444		
Total	515.28925	23			
(corrected)					

All F- ratios are based on the residual mean square error

ANOVA table of Batch B

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	118.65284	5	23.730568	1.841	0.1652
Data rep	15.05095	3	5.016982	0.389	0.7624
Residual	193.34828	15	12.889885		
Total	327.05206	23			
(corrected)					

All F- ratios are based on the residual mean square error

APPENDIX S: ANOVA OF DRY WEIGHTS OF CABBAGE SEEDLINGS TREATED WITH FUNGICIDES AND HOMOEPATHIC REMEDIES FOR TRIAL THREE

ANOVA table of Batch A

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	0.6502375	5	0.1300475	0.950	0.4779
Data rep	1.3372458	3	0.4457486	3.256	0.0513
Residual	2.0536792	15	0.1369119		
Total	4.0411625	23			
(corrected)					

All F- ratios are based on the residual mean square error

ANOVA table of Batch B

Source of Variation	Sum of squares	d.f	Mean square	F.ratio	Sig level
Main effect					
Data treat	1.9720708	5	0.3944142	1.017	0.4421
Data rep	0.7333792	3	0.2444597	0.630	0.6067
Residual	5.8182458	15	0.3878831		
Total	8.5236958	23			
(corrected)					

All F- ratios are based on the residual mean square error