THE EFFECT OF A HOMOEOPATHIC PREPARATION IN THE CONTROL OF TOBACCO MOSAIC VIRUS.

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A dissertation submitted in partial compliance with the requirements for the Masters Degree in Technology in the Department of Homoeopathy at Technikon Natal.

I, Kathleen Ann Webb hereby declare that the research and results presented in this dissertation are of my own work and have not been presented for any other degree at another University or Technikon.

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DEDICATION

To Frank and Belinda Webb, my parents, for all their love and support in the completion of my studies.

To Merek Svacha for his enthusiasm and ongoing interest in the work I do.

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ABSTRACT

Most economically important crop plants may become infected with viruses. Several of these virus diseases are limiting factors in agricultural production and have contributed to serious economic and social hardship in many countries, especially in tropical and subtropical regions.

Homoeopathic microdoses have been investigated for their role in the control of virus diseases, with good results. However, few of the studies contain statistical analyses.

The object of this study was to assess the effect of a homoeopathic preparation of a leaf infected with tobacco mosaic virus (TM Viricum) in the contol of tobacco mosaic virus (TMV). The potencies used were 6CH, 12CH, 30CH and 200CH.

Trays of 24 tomato seedlings per tray were the subjects of this study. Tomato plants were systemically infected with TMV. Four trays were used per treatment. There was an uninoculated and an inoculated control group. The rest of the test population was divided into two groups. The

first group was treated prophylactically, the second, curatively. The trays were placed into computor randomised positions.

The disease was assessed by foliar disease rating. Using a scale of 0 to 10, a rating of 0 was given to a healthy plant and a rating of 10 given to a heavily diseased plant. The plants were rated once a week for six weeks.

The data was analysed by the Kruskal- Wallis non-parametric method.

The uninoculated control was disease free.

The prophylactic treatment plants generally had significantly less disease than the inoculated control at all potencies , the 200CH being the most effective.

The curative applications of the 6CH, 15CH and the 30CH showed significantly more disease than the inoculated control but at 200CH a significant decrease in infection was noted.

The 200CH of TM Viricum used prophylactically and curatively would result in the best disease control.

TABLE OF CONTENTS

LIST OF TABLES, GRAPHS AND APPENDICES

7. APPENDIX D: Table of Kruskal-Wallis analysis of AUDPC values of pre- and post- TMV inoculated tomato seedlings treated with different potencies of TM Viricum.

DEFINITION OF TERMS

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 the suffix C after the numerals denoting the deconcentration stage of the drug. The suffixing H represents made according to Hahnemann (Gaier, 1991: 448).

FOLIAR DISEASE RATING: Disease severity is visually assessed with the aid of logarithmic rating scales of percentage leaf area infected (Horsfall & Cowling, 1980, cited by Brophy and Laing, 1992). A scale of 0 to 10 is used with 0 denoting a healthy plant and 10 a heavily infected plant.

HOMOEOPATHY: Homoeopathy is a therapeutic method which clinically applies the "Law of Similars" and which uses medicinal substances in infinitesimal doses (Jouanny, 1991: 11).

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: 290).

MOSAIC VIRUS: Dark-green, light-green mottling (which often begins as 'vein clearing') of the leaves which may also show varying degrees of distortion from slight puckering to complete loss of the lamina (C.M.I. Plant Pathologist's Pocketbook, 1968: 29).

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: 94).

POTENCY: The especially 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 (Twentyman, 1979).

Succussion is the most remarkable and characteristic feature of the manufacture of potencies. Potency energy varies with the number of succussions. Succusion not only ensures perfect mixing but imparts movement to the fluid thereby creating additional internal 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).

CHAPTER ONE

INTRODUCTION

"Viruses cause many economically important diseases of crop plants. Several virus diseases are limiting factors in agricultural production and have contributed to serious economic and social hardships in many countries and especially those in tropical and subtropical regions." (Pappu,*et al.* 1995.) Pappu *et al* (1995), also state that although complete estimates are not available, annual world-wide losses due to virus diseases total several thousand million US$.

As yet there are few antiviral drugs which are clinically safe and effective in curing viral infections, and none available for plant viruses (da Graca, *pers. comm.,1997*). In spite of efforts the world over for a considerable period, the drugs or chemicals reported for their antiviral effects are meant for external use or can be used only in a restricted manner. (Singh and Gupta, 1985.)

There has been previous research using homoeopathic drugs on phytopathogens.

Research by Verma *et al.* (1969) showed that results with homoeopathic and pharmacopoeial drugs have yielded some encouraging results. They found it possible to cure virus diseased plants partially, which raises great possibilities for the future. Effective cure might be possible by the judicious manipulation of homoepathic drug.

Verma *et al.* (1969) also found that homoeopathic drugs had no adverse morphological effect on the host plant, whereas they decreased the viral content in plants where the virus was actively multiplying.

In most of the previous research using homoeopathic drugs on phytopathogens, there is a deficiency of critical evaluation and statistically analysed data available.

Scofield (1984), in his critical review of experimental research in homoeopathy states that much of the experimental research done in homoeopathy is open to a number of criticisms. Despite a great deal of experimental and clinical work there is only a little scientific evidence to suggest that homoeopathy is effective. This is possibly due to bad design, execution, reporting or failure to repeat experimental work and not

necessarily because of the inefficiency of the system which has yet to be tested on a large enough scale.

Brammer (1994) states that research involving homoeopathy on plant pathogens is possible and yields significant statistical results if conducted in a controlled pathosystem. Future research conducted in a professional, systematic and scientific way may contribute greatly to create a more positive view of homoeopathy. Research on plant pathogens treated homoeopathically opens the door to a new and exciting therapeutic approach in agriculture.

Research on plants and plant pathogens has the advantage that the placebo effect can be discounted (Kayne, 1991).

Ullman (1991) in his discussion on research and homoeopathy, concludes saying "The implications of homoepathic research encourages us to investigate not only how the (homoeopathic) medicines can be used in treating human ills, but when and how they can be applied to problems of animals, plants and various organisms and ecosystems."

From the studies discussed, it can be concluded that viral infection in plants leads to serious loss of yields and no treatment is readily available. There are indications that homoeopathy may control viral diseases but no statistical evidence is available. In this study it was intended to test the effect of homoeopathic treatment on a plant virus in a scientifically designed trial with the application of proper statistics.

CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

2.1. PLANT VIRAL DISEASES

Most, if not all economically important crop plants may become infected with viruses (Walkey 1991:6).

Annual crops are usually grown from seed, and virus infection in such crops may be serious and result in complete crop loss within a particular season (Walkey,1991:8).

Walkey (1991:8-9) cites several examples of the serious losses caused by viruses in wheat, rice, oat, barely, sugar beet, potato, tomato and tobacco crop yields. (See table,Appendix A.)

"...the economic importance of plant viruses is seen not only in the value of crop losses they cause, but also in the high cost of preventative or control measures required to avoid infection." Walkey (1991). These preventative measures include chemical sprays to control insect vectors, the provision of virus-free seed to prevent seed-borne viral diseases,

breeding for disease resistance, and certification schemes to provide healthy planting stock for vegetatively propagated plants (Walkey, 1991:9).

2.2.HOMOEOPATHY AND ISOPATHY

Homoeopathy views the living organism as unceasingly reacting to its environment, attempting to ward off danger and repair damage. The patient's symptoms are not the impact of some morbific stimulus on the organism but are a *reaction* of the organism to the morbific stimulus. (Coulter,1980.)

Homoeopathy deals with the stimulation of the patient (or plant) by means of the infinitesimal dose, which is small, or even non-existent materially. The Arndt-Shulz Law (cited by Rawson,1972) expresses this homoeopathic approach very succinctly in the following manner: "Large doses of a poisonous substance may prove lethal, smaller doses of the same substance inhibit, but minimal doses of the same poison can actually stimulate vital cellular activity."

All this is of course inherent in the original Hahnemannian homoeopathic Law "Similia similibus curentur", which translated stipulates "let likes be treated by likes " (Rawson 1972:116).

An extension of this is "Aequalia aequalibus curantur" which is translated as "let equal be treated with equal" or "isopathy" ('iso' meaning 'same') (Gaier,1991:290).

Isopathy is a general method of therapeutics, which utilises the morbid product itself (Julian,1980:92).

The choice of homoeopthic remedies is obvious in the use of isopathic preparations in the relevant cases or remedies prescribed for conditions in humans are used under experimental conditions with similar symptoms or aetiology (Scofield, 1984).

"The isopathic medicines represent the similimum par excellence, the faithful image of the morbid state of the moment and they may be successful where homoeopathy hesitates or fails even with the exact medicine. It is a powerful adjuvant of a well-conducted homoeopathic treatment " Dano (cited by Gaier ,1991:301).

Although isopathy is the use of the same disease product on the same disease, it has been argued by the best people, including Hahnemann (cited by Harling ,1974), that potentisation alters a substance so that the potency becomes similar to, and not identical with, the original source (Harling, 1974) .

2.3.HOMOEOPATHY AND BOTANY

Various herbal and homoeopathic preparations have been used for many years in the practice of biodynamic farming and gardening inspired by the ideas of Steiner (1924,cited by Kayne, 1991).

The stimulus for much of the work on the effect of homoeopathic potencies on the growth of plants was provided by Kolisco who conducted various research from 1923-1959 (cited by Kayne,1991). They performed numerous experiments to demonstrate the effect of homoeopathic dilutions mostly on wheat seeds, finding that growth was promoted by lower dilutions, inhibited with higher dilutions and finally stimulated at even higher dilution (Kayne,1991).

Pelikan and Unger (1971) provided statistically significant evidence that potentised substances do have an effect on plant growth in their experiment on the effect of potentised silver nitrate on the growth of wheat seedlings.

As homoeopathic medicines are non-toxic, non-poisonous to plants, animals and man, and have already been proved on human beings, these drugs will find their direct and immediate use both in the prophylaxis and cure of viral infections of man, animals, and plants. (Singh and Gupta, 1985.)

2.4. HOMOEOPATHY, ISOPATHY AND PHYTOTHERAPY

Various workers have tested the effect of homoeopathic drugs on controlling or preventing virus infections in plants. Verma *et al.* (1969) tested a variety of drugs, selected from those used in human medicine for the treatment of diseases whose symptoms are suspected to be caused by viruses, against the symptoms caused by tobacco mosaic virus (TMV) in

local lesion and systemic hosts. A variety of drugs were claimed to have an inhibitory effect on virus multiplication rate and local lesion production. Singh and Gupta (1985) found that homoeopathic drugs can inhibit plant viruses in local and systemic infections, increase resistance of plants if applied before, and increase the incubation period of plant viruses. They further contemplate that homoeopathic drugs will be of tremendous use in increasing agricultural production and as a plant protection measure for controlling phytopathogens.

Homoeopathic literature contains many reports of the successful use of remedies in the treatment of disease. But, since most of these reports are of non-controlled trials, they are of little value in making a scientific assessment of the efficacy of homoeopathy.

Scofield (1984) criticised the previous work done on TMV in local lesion and systemic hosts by Verma *et al.* (1969) and Singh *et al.* (1980) because the number of replicates is not given and no statistics are presented.

Khurana (1971), (cited by Scofield 1984), tested the effect of homoeopathic remedies on the response of host plants to papaya and cucumber viruses. He concluded that the treatment of infected plants (i.e.

cure) was not as effective as prophylactic treatment. Prophylactic treatment resulted in reducing the severity of the symptoms and in delaying their appearance in distortion ring spot virus of papaya seedlings. No statistics are available.

Work was done by Shukla and Joshi (1982) in which various homoeopathic remedies were tested for their ability to inhibit the pathological effects of sugar cane mosaic virus in sorghum. Inhibition was claimed with some of the drugs tested, but the trial was small, there was no statistical analysis, and few practical details were given.

Sinha (1976) has stated that when a papaya plant infected by a virus was treated with *Tabacum* 30CH, the leaves which had mosaic symptoms and were curled and closed, began to spread open within four days (Kayne,1991).

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 the 6CH potency injected under pressure.

Netien *et al.* (1972) and Netien and Graviou (1978&1979), showed that homoeopathic potencies of $CuSO_4$ had curative effects on pea seedlings that are partially poisoned with $CuSO_4$. Poisoned seedlings grew better in $CuSO_4$ 15CH than in distilled water. Growth rhythms could be detected in the seedlings and these were altered by poisoning or by treatment with $CuSO_4$ 15CH. The papers are difficult to follow and often made no attempt at statistical analysis. (Scofield, 1984.)

In research conducted by Brammer (1994), the effect of a homoeopathic preparation of *Peronospora parasitica* (downy mildew) in the treatment of downy mildew on cabbages (using the principles of isopathy) was studied. Her results showed that the lower potencies (5CH and 9CH) always stimulated the disease. The 15CH and 30CH potencies lowered the disease incidence when applied over a short time. This suggests that higher potencies decreased the disease incidence when compared to the lower potencies.

Any therapy needs statistical evaluation with regards to its efficacy if it is to be accepted as a useful modality for the treatment of disease (Apte, 1993). Scofield (1984) states that "Future experiments conducted in a professional, systemic and scientific way, may contribute greatly to create a positive view of homoeopathy."

There are oportunities to conduct statistically valid trials using homoeopathic remedies on plants and plant pathogens. The key element is to use a stable, well-defined pathosystem as well as a sample size large enough to obtain viable statistics.

From the review of the literature, it follows that the purpose of this investigation was to evaluate the efficacy of homoeopathy in the control of plant viruses.

CHAPTER THREE

MATERIALS AND METHODS

3.1 STUDY DESIGN

The aim of this project was to control tobacco mosaic virus with the use of a homoeopathic preparation, in several potencies.

The trial 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:

-an inoculated control

-an uninoculated control

-a pre-inoculation treatment group (prophylaxis)

-a post-inoculation treatment group (cure)

The design was a completely random design. A computor randomly allocated the position of the seedling trays. (See Appendix B) This was to

eliminate the variable effect of a change in the environmental conditions due to plant positioning.

Once the layout of the trial was completed, the computor printout was left with the supervisor in order to conduct the rating in a blind manner.

3.2 MATERIALS

3.2.1 The Seedlings

The subjects of this investigation were *Lycopersicum esculentum* (tomato) seedlings. The seeds chosen were "Rodade" tomato seeds and were obtained from Mayford.

Tomato seedlings were chosen because they can be systemically infected with tobacco mosaic virus and show the symptoms adequately. Seedlings are convenient to use as they need little space and are easy to handle. They also do not undergo a metabolic change, such as reproduction, for the duration of the trial.

The seeds were sown directly into 24 celled speedling trays, using composted pine bark as the soil medium. The seeds spent 2 days in the germination room. They were then transferred to the glasshouse for 2 weeks and were given water only. After this they were moved to the tunnel, where the trial took place. Here they were fertigated three times daily. The seedlings were four weeks old when the trial began.

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

Thus, there were eight samples and four replicates for each intervention and control.

3.3.2 Interventions

The chosen treatment was homoeopathic preparations of a tobacco leaf infected with tobacco mosaic virus (named "TM Viricum" for differentiation from the actual tobacco mosaic virus.)

The treatment was prepared as a trituration of the fresh plant material as laid out by Hahnemann in aphorism 271 in the 6th edition of the *Organon*, (cited by Dellmour,1994)" 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 a 3CH trituration. The advantages of the 3CH trituration over medicines produced from mother tinctures and solutions are a more powerful action, the retention of constituents , and a guaranteed shelf life (Dellmour, 1994).

From the 3CH the TM Viricum was prepared in 96% ethanol to the previous potency needed i.e. 5CH, 14CH, 29CH, 199CH, by the pharmaceutical company "Pharma Natura". This was done according to the principles laid out in the German Homoeopathic Pharmocopoeia. The final potency was made up of 1 part of previous potency to 99 parts distilled water and succussed 100 times, just prior to application.

The final potencies were placed into "Effecto polyspray 2" sprayer.

The potencies of 6CH, 15CH and 30CH were chosen because they are the most commonly prescribed potencies (Cook,1984). The 200CH was selected following the results of Brammer's research (1994), where she found that the lower potencies stimulated the disease and the medium potencies (i.e.15CH and 30CH) produced results similar to or slightly better than the control. It was hypothesised that the 200CH may result in a better disease control

3.2.3 The inoculation

The inoculum used to infect the plants was a tobacco leaf infected with tobacco mosaic virus. The leaf was ground in a pestle and mortar together with a phosphate buffer.

The method of inoculation of TMV:

The extract of sap containing the virus was applied to the leaf with a cotton bud. The entry of the virus into the living cells was facilitated by including an abrasive (carborundum powder) in the inoculum (Stevens, 1983).

3.3 METHODOLOGY

A pilot trial was initially conducted on tobacco plants. There was a pre-inoculation treatment group (prophylaxis), a post-inoculation group (cure) and an inoculated but untreated control group. The treatment used was the TM Viricum in the four potencies described above.

There were fifteen plants per treatment group. For practical reasons the plants were placed in their treatment groups and not randomly.The researcher knew which plants received which treatments.

The pre-inoculation group was divided into the four treatment groups and each one sprayed with a different potency of TM Viricum. The plants were inoculated one week later with tobacco mosaic virus. The level of disease symptoms was assessed by foliar disease rating once, six weeks later.

The post-inoculation group was inoculated . One week later the group was divided into the four treatment groups and each group treated with a different potency of the TM Viricum. The plants were assessed and every 3 days and the dates noted when the symptoms first appeared. The level of

disease symptoms was visually assessed by foliar disease rating once, six weeks later.

The control group was inoculated and then rated by foliar disease rating once, six weeks later.

The results of this trial were discarded. There was an insufficient amount of data collected to enable satisfactory statistical analysis. There were not enough repetitions (i.e. too few plants), the plants were not randomly positioned and there was too much variation within the treatment groups. The plants also started flowering during the trial period. The trial was not blind.

For this reason, a re-trial was done using tomato seedlings. A greater number of repititions was possible and the trial was redesigned to allow randomisation in plant positioning and researcher blindness.

The re- trial started when the seedlings were 4 weeks old.

Day 1: -The "prophylaxis" trays were divided into four trays per treatment and sprayed with the homoeopathic interventions (i.e. 6CH, 12CH, 30CH and 200CH of TM Viricum). The leaves were sprayed until the standard point before leaf wetness. An average of 150mls of treatment was used to spray the four trays.

- The "cure" trays were inoculated with tobacco mosaic virus. A leaf of each plant was sprinkled with carborundum powder and then inoculated with the inoculum using a fingertip and dragging it through the carborundum on the leaf to ensure viral entry.

-The infected control was inoculated as above.

-The uninfected control was sprayed with distilled water.

Day 2: - The " prophylaxis" trays were inoculated as described above.

-The "cure" trays were divided into four trays per treatment and were sprayed as described above.

The plants were then numbered and placed into four rows of ten plants as per the computor generated randomisation (See Appendix B).

Days 9,15,22,29,36,43: The percentage of leaf area infected was rated visually using foliar disease rating. The researcher was aided by an independant assessor and thus did not know what previous ratings were given.

After the final ratings, the plants were cut down at ground level, placed into a separate paper bag per tray and dried for 48 hours at 50^0 Celsius. The dry weight was taken which gives an indication of the growth of the plants.

3.4 STATISTICAL ANALYSIS

Initially ANOVA (Analysis of Variance) was the method used to analyse the data. However, the coefficient of variation (CV%) was above 20%. The Kruskal-Wallis method of data analysis was then used. This non-parametric form of analysing data is often used for many plant pathological

and horticultural data sets which are not normally distributed (Laing, *pers comm*, 1997).

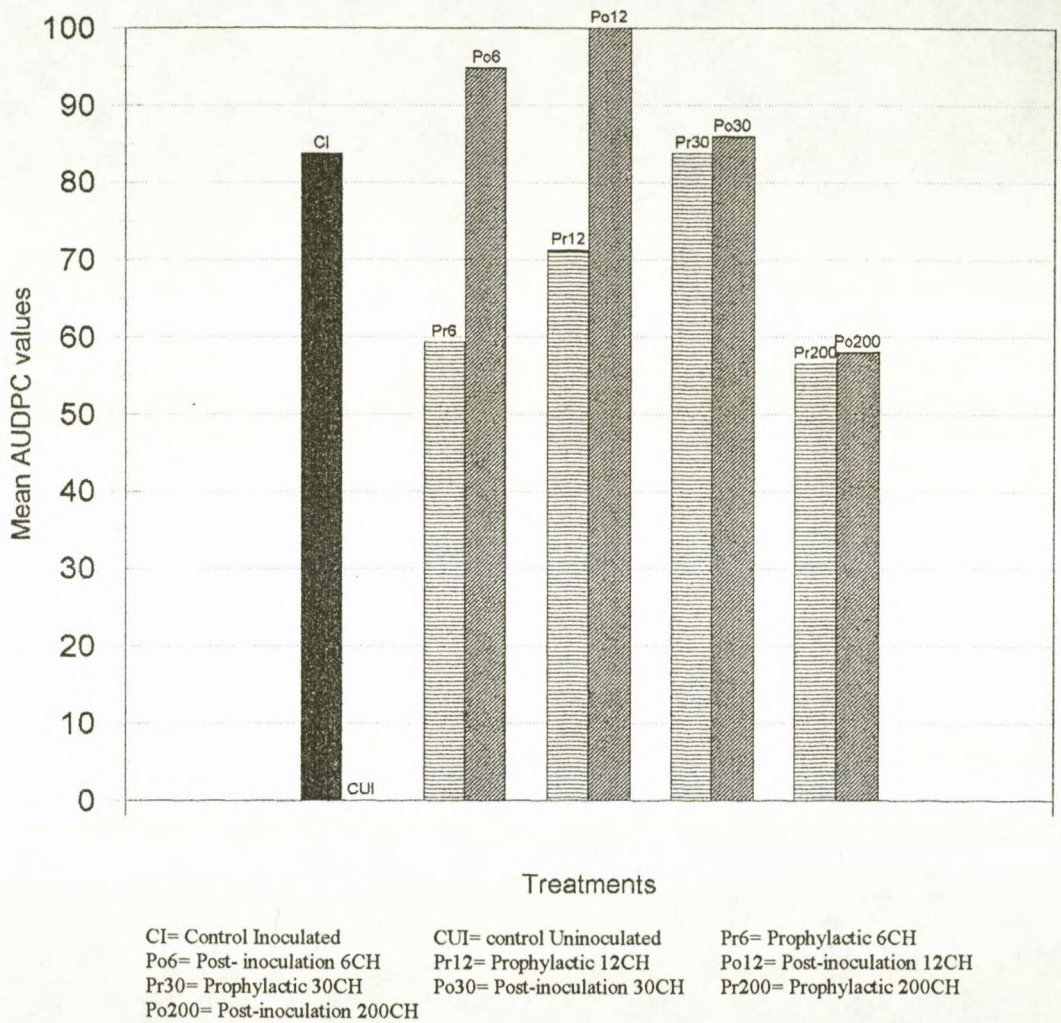
Statsgraphics was used to process the data.

CHAPTER FOUR

RESULTS

Data was obtained by the "foliar disease rating" of the inner eight seedlings of each tray. The seedlings were rated weekly for six weeks. The first rating was one of "no infection" due to an insufficient time allowed for disease development. This rating was discarded, and only data from the following five ratings were used. All the plants except the uninoculated control showed signs of disease.

The AUDPC (Area Under Disease Progress Curve) values for the data were calculated. (See Appendix C.) The averages of the AUDPC values are graphically represented in Fig 1.



CI= Control Inoculated
CUI= control Uninoculated
Pr6= Prophylactic 6CH
Po6= Post- inoculation 6CH
Pr12= Prophylactic 12CH
Po12= Post-inoculation 12CH
Pr30= Prophylactic 30CH
Po30= Post-inoculation 30CH
Pr200= Prophylactic 200CH
Po200= Post-inoculation 200CH

FIG 1: ***Mean AUDPC values of pre and post TMV inoculated tomato seedlings treated with different potencies of TM Viricum (95% confidence for mean).***

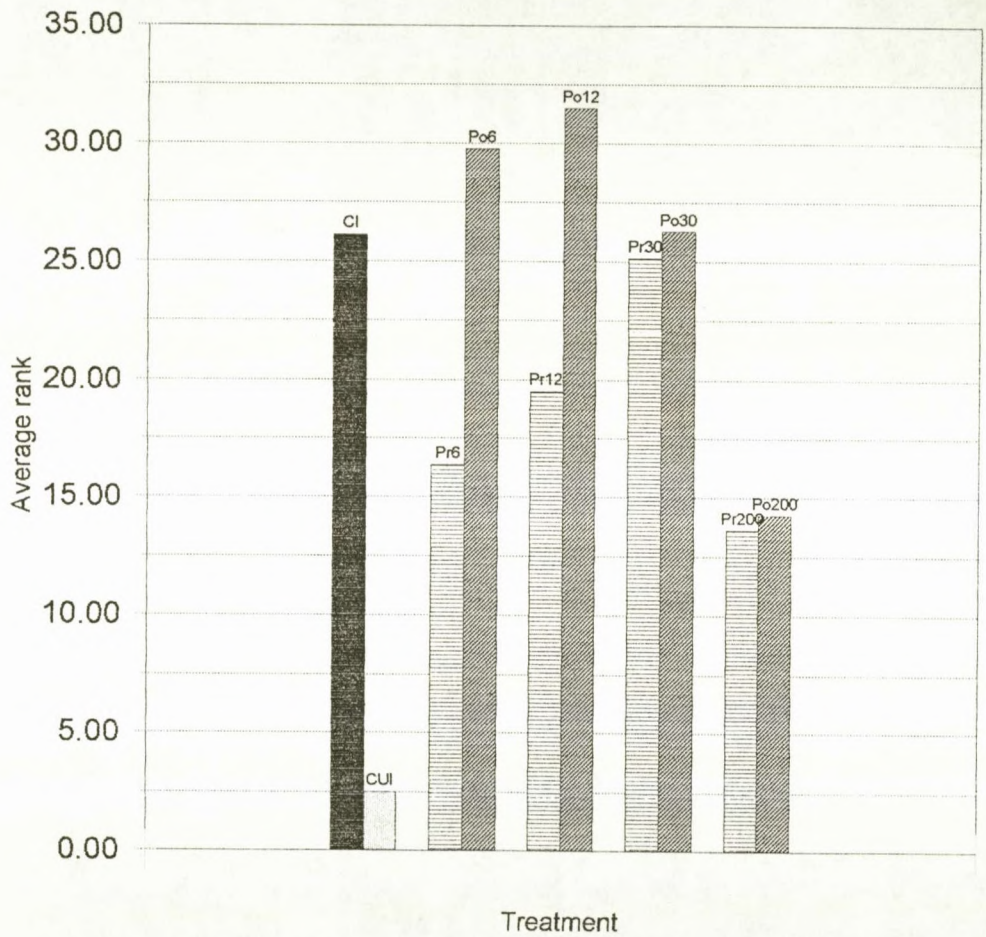
The ANOVA for the AUDPC data shows significance, at the 95% level of confidence. However, the coefficient of variation (CV%) is greater than 20%, which suggests that the ANOVA method of analysis is not suitable for analysing this data (see Table 1).

TABLE 1: ANOVA *analysis for AUDPC values of pre and post TMV inoculated tomato seedlings treated with different potencies of TM Viricum.*

Source of variation	Sum of Squares	d.f.	Mean Square	F-ratio	Sig. Level
Main Effects					
DATA.Treat	30138.337	9	3348.7041	6.598	0.001
DATA.Rep	3309.284	3	1103.0946	2.174	0.1143
Residual	13702.378	27	507.4955		
Total (corrected)	47149.999	39			

CV% = 32.5%

Kruskal-Wallis non-parametric analysis was chosen as the most effective method of analysing the data of this trial. Many horticultural data sets are not normally distributed and are therefore analysed better by a non-parametric means. Analysis produced the following graph (Fig 2), with every treatment differing significantly from each other. (See also Appendix D)



Test statistic = 21.13 Significance level = 0.012

CI= Control Inoculated
CUI= control Uninoculated
Pr6= Prophylactic 6CH
Po6= Post- inoculation 6CH
Pr12= Prophylactic 12CH
Po12= Post-inoculation 12CH
Pr30= Prophylactic 30CH
Po30= Post-inoculation 30CH
Pr200= Prophylactic 200CH
Po200= Post-inoculation 200CH

FIG 2: ***Kruskal-Wallis analysis of AUDPC values of pre and post TMV inoculated tomato seedlings treated with different potencies of TM Viricum.***

ANOVA of the dry weights of the plants showed non- significant results at the 95% level of confidence (See Table 2).

TABLE 2: *ANOVA for dry weight (in grams) of pre- and post- TMV inoculated tomato seedlings treated with TM Viricum*

Source of Variation	Sum of Squares	d.f.	Mean Square	F-ratio	Sig. Level
Main Effects					
Data.Treat-ment	0.1611788	9	0.0179088	0.560	0.8171
Data. Rep	0.1461812	3	0.0487271	1.524	0.2309
Residual	0.8633636	27	0.0319764		
Total (corrected)	1.1707236	39			

CV% = 28.45%

CHAPTER FIVE
DISCUSSION

From the results, it can be seen that the treatment after inoculation in the 30CH, 6CH and 12 CH of TM Viricum was on the whole worse than not treating the plants with anything. (i.e. worse than the inoculated control).

This effect was also found by Brammer (1994) in her homoeopathic research on Downy mildew on cabbages. She found that the plants treated with the lower potencies (i.e. 5CH, 9CH, and 15CH) produced more disease than in the control.

Homoeopathy therefore does have an effect on phytopathology, but in these lower potencies, given after inoculation, there appears to be a stimulation of the disease.

This apparent stimulation could be due to the homoeopathic phenomenon of an "aggravation". Vithoulkas (1986) states that "...a truly curative response will be preceded by some degree of aggravation of symptoms." Over a longer period of time there might have been a relative improvement in the disease , once the aggravation had worn off.

The lower homoeopathic potencies also tend to have a shorter duration of action, and are generally repeated frequently (Gaier,1991). Therefore the effectiveness of the single dose of the remedy given may not have provided the effect required for the plant to overcome the disease.

All the potencies used prophylactically produced significantly better results than the inoculated control, with the highest potency (200CH) producing the best results.

This suggests that the homoeopathic potencies may have an immunisation type effect on the plant, along the same lines as using an attenuated microbial culture as prophylaxis against the illness associated with that same micro-organism. In a study on 18 640 Brazilian children, Ullman (1991) showed that a single dose of a homoeopathic preparation of *Neisseria meningitidis* given prophylactically produced significantly fewer cases of meningitis than other children in the same community.

Vithoulkas (1980) states that during a virulent epidemic....(in humans) the higher potencies can be convincingly demonstrated as more effective, as

was found in this study with the 200CH working significantly better than the other potencies.

In keeping with Khurana's (1971) findings, the prophylactic treatment is more effective than curative treatment.

In Homoeopathic practice, in an "acute" illness, the homoeopathic microdoses are often repeated frequently, to keep up with the pace of the disease. Perhaps the TM Viricum would have had a stronger prophylactic and curative effect, had the doses been repeated.

The dry weights do not correlate with the visual ratings (see Appendix C). The dry weight gives an indication of the yield of the plant. Further experimentation, especially in the field, will give a better indication as to whether TM Viricum will reduce the visible symptoms of the virus and increase the yield of the plants.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

The most effective way of utilising the homoeopathic microdose TM Viricum appears to be as a prophylactic. The most effective potency is the 200CH. A combination of both prophylactic and curative treatments would probably be the most useful approach in the field.

Before the homoeopathic microdose could be used to a large extent, further trials would have to be conducted in the greenhouse as well as in the field.

The greenhouse trials could explore the effect of giving more frequent applications of the microdose as a curative or combination treatment eg: a comparison between 1, 5 and 10 applications etc. The effect of the treatment could also be studied over a longer period of time. This would allow one to determine whether the plants did undergo an aggravation from the treatment.

Homoeopathic potencies do not stop at the 200thCH. The even higher potencies (such as 1M, 10M and CM) may be able to produce even better results and eventually show a curative response.

Field trials would determine the use of TM Viricum in an agricultural setting. The impact of variable climatic conditions and other pathologies may change the manner in which the microdose works. Field trials would also indicate the how easy the microdose would be to use as a form of treatment on a large scale.

Another important further study would be to examine the effect of TM Viruicum on related and unrelated plant viruses. This would be a more homoeopathic approach as opposed to an isopathic one.

Ullman (1991) states, "the implications of homoeopathic research suggests that we live in a world not of dwindling but increasing resources, if we can only learn to apply them in an optimal manner. The implications of homoeopathic medicine are truly significant and cry out for more research and replication of past research. Considering how much potential value resides in the field of homoeopathy, it would be a crime not to investigate it. Homoeopathy is a gold mine waiting for prospectors."

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APPENDICES

APPENDIX A: EXAMPLES OF YIELD REDUCTION CAUSED BY VARIOUS PLANT DISEASES (Walkey, 1991:10).

CROP	VIRUS	YIELD REDUCTION(%)
Beans	Bean yellow mosaic	33
Cabbage	Turnip mosaic	36
Cassava	Cassava mosaic	24-75
Lettuce	Lettuce mosaic	56
Pepper	Various	9-67
Potato	Potato leaf roll	65-92
Maize	Maize streak	25-60
Wheat	Barley yellow dwarf	9-29
Apple	Various	9-67
Pear	Ring pattern	35
Raspberry	Raspberry mosaic	50
Strawberry	Various	14-38
Sweet cherry	Prunus ringspot	70
Tobacco	Tobacco etch Tobacco mosaic	5-16 3-18

APPENDIX B: LAYOUT OF THE SEEDLING TRAYS AS GENERATED BY COMPUTER.

POSITION	TREATMENT
1	Pre 30CH
2	Pre 6CH
3	Post 30CH
4	Post 6CH
5	Post 12CH
6	Pre 200CH
7	Pre 12CH
8	Post 200CH
9	Control inoculated
10	Control un-inoculated
11	Post 200Ch
12	Pre 6CH
13	Pre 200CH
14	Pre 30CH
15	Control un-inoculated
16	Post 6CH
17	Post 12CH
18	Control inoculated
19	Pre 12CH
20	Post 30CH
21	Control un-inoculated
22	Pre 200CH
23	Control inoculated
24	Post 12CH

25	Post 6CH
26	Post 30CH
27	Post 200CH
28	Pre 12CH
29	Pre 6CH
30	Pre 30CH
31	Post 200CH
32	Pre 30CH
33	Post 6CH
34	Post 30CH
35	Pre 6CH
36	Pre 12CH
37	Control un- inoculated
38	Control inoculated
39	Post 12CH
40	Pre 200CH

Pre= Prophylactic treatment

Post= Post-innoculation treatment.

APPENDIX C: TABLE OF RESULTS INCLUDING AUDPC VALUES AND DRY WEIGHT (in grams) OF PRE AND POST TMV INOCULATED TOMATO SEEDLINGS TREATED WITH DIFFERENT POTENCIES OF TM VIRICUM.

Treat-ment	Rep	Dry weight (g)	Week 1	Week 2	Week 3	Week 4	Week 5	AUDPC
CI	1	0.48	2.375	2.625	3.25	4.5	5	98.44
	2	0.693	2.25	2.5	3.75	5	5.125	104.56
	3	0.8	2.375	2.5	4.5	4.75	5	108.06
	4	0.4286	0.5	0.375	1.125	1	1.25	23.63
CUI	1	0.506	0	0	0	0	0	0
	2	0.607	0	0	0	0	0	0
	3	0.91	0	0	0	0	0	0
	4	0.463	0	0	0	0	0	0
Pre6	1	0.529	0.75	1.625	2.75	3.625	3.5	70.88
	2	0.426	0.5	1	2.125	3.25	3.75	59.5
	3	1.23	1.5	3	2	1.75	3.75	65.63
	4	0.477	0.25	2.25	0.875	1.25	2.75	41.13
Pre12	1	0.729	1	1.5	1.125	3	3.25	54.25
	2	0.467	1.375	3.75	4	4.5	3.5	102.81
	3	0.682	1	2.25	3.25	4.25	5.5	91
	4	0.4	1	1.5	1.25	1	2	36.75
Pre30	1	0.674	0.5	1.375	1.5	1.5	2.25	40.25
	2	0.771	1.875	2.375	3.5	4.75	6.75	104.56
	3	0.758	3	4	4.25	4	5.25	114.63
	4	0.685	1.375	1.875	3.25	2.75	4.5	75.69
Pre200	1	0.62	0.25	1.625	1.75	3	4	59.5

	2	0.68	1.75	1.625	2	3.25	3.75	62.13
	3	0.553	1.125	1.75	1.75	1.75	2.75	52.5
	4	0.784	0.875	1.75	1.75	2	2.75	52.06
Post6	1	0.48	2.25	2.75	2.75	4.5	5.75	93.19
	2	0.823	0.875	2.75	4.25	4.125	7.25	111.125
	3	0.526	1.625	2	3.375	3.75	5.5	86.19
	4	0.811	0.5	2.75	2.25	4.5	4.75	88.81
Post12	1	0.46	1	0.5	1.5	4.5	4.75	63.88
	2	0.815	3.75	1.75	4	4.625	4.5	91.88
	3	0.755	3	2.5	4.75	5.75	6.5	126.88
	4	0.802	3	3.25	4.75	4.75	6	120.75
Post30	1	0.455	2.25	3.125	4.5	5.75	5.75	124.25
	2	0.486	1.75	2.5	2.25	3.25	3.65	76.56
	3	0.655	0.5	1.875	2.25	4.25	4.75	81.38
	4	0.585	1.25	1.375	1.875	3	4.5	61.25
Post200	1	0.46	0.5	1.625	1.625	2.75	3.5	58.23
	2	0.647	1	2.125	2.5	3.25	3.5	69.16
	3	0.385	0.75	1.125	1.5	1.75	3.25	45.5
	4	0.64		1.375	2.875	2	3.5	58.63

CI= Control Inoculated
Po6= Post- inoculation 6CH
Pr30= Prophylactic 30CH
Po200= Post-inoculation 200CH

CUI= control Uninoculated
Pr12= Prophylactic 12CH
Po30= Post-inoculation 30CH

Pr6= Prophylactic 6CH
Po12= Post-inoculation 12CH
Pr200= Prophylactic 200CH

APPENDIX D: TABLE OF KRUSKAL-WALLIS ANALYSIS (small letters denote significant difference) OF AUDPC VALUES OF PRE AND POST TMV INOCULATED TOMATO SEEDLINGS TREATED WITH DIFFERENT POTENCIES OF TM VIRICUM

TREATMENT	AVERAGE RANK		RATING
Un- inoculated control	26.125	g	7
Inoculated control	2.500	a	1
Prophylaxis 6CH	16.375	d	4
Prophylaxis 12CH	19.500	e	5
Prophylaxis 30CH	25.137	f	6
Prophylaxis 200CH	13.625	b	2
Post-inoc 6CH	29.750	i	9
Post-inoc 12CH	31.500	j	10
Post- inoc 30CH	26.250	h	8
Post- inoc 200CH	14.250	c	3