Scope for controling Dieback in the Jarrah Forest with phosphorous acid

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May-October 1991

INTRODUCTION

Western Australia's unique wildflowers, and the wildlife that depend on them for there habitat and nutrition, are facing one of the greatest threats to their existence. A group of fungi called *Phytophthora*, belonging to the Oomycetes (water moulds), is the major cause of this threat. The disease is known as Dieback (26).

The *Phytophthora* species were probably introduced into Western Australia around 1900. The association of *Phytophthora* infection and death of vegetation was not known. In mid 1960's *P. cinnamomi* was identified by Dr.F.Podger, as the cause of dieback in the Jarrah Forest (19).

The aim of this project is, with the use of a bioassay, to form a better understanding of the effect and duration of phosphorous acid in the control of *Phytophthora* species infecting native vegetation of southwestern Australia. The indicator plant, Bull banksia (*Banksia grandis*), used in this trial is very susceptible to infection by *Phytophthora cinnamomi* (26).

The project consists of two parts. The first part will deal with samples from forest trials and the second part will deal with the in vitro testing of samples with various concentrations of phosphorous acid. The effect of the different phosphorous acid treatments will be assessed.

To monitor the effect of phosphorous acid in forest trials, the plants were destructively harvested in the past. Excised roots have been used (23;24), but they are difficult to obtain and are fragile. This makes sampling laborious.

A bioassay is needed whereby only a part of the plant needs to be sampled. The options for a bioassay were assessed by a literature review (15;24;28;29;30). Preliminary trials were used to try out the options which led to the decision to compare excised roots and twigs. This is the base for experiment one. The other options like stem samples (28;29), vertical samples in flasks (15;30) were discontinued because of contamination problems. The effect of the height at which the twig is taken in a plant, is dealt with in experiment two. Experiment three deals with the different concentrations used for injecting trunks. Finally in experiment four the duration of a treatment is examined.

The second part of this project is based on the analysis of the growth of *Phytophthora* and *Armillaria* on petri dishes, containing phosphorous acid. The pathogens tested were *P. cinnamomi*, *P. citricola*, *P. megasperma var. megasperma* and A. *luteobubalina*. The following concentrations assessed on the petri dishes were 0%, 0.25%, 0.5%, 1%, 2.5%, 5%, and 10% volume/volume (v/v) phosphorous acid.

The bioassay and the information gathered will be valuable in the foliar spraying program. Foliar spraying has a great potential as it is less laborious and larger areas can be treated more cheaply by the use of aeroplanes.

LITERATURE REVIEW

In Western Australia seven *Phytophthora* species are found.They are all soilborne (26;27). These fungi are not native to Australia, therefore the plants have not developed a resistance to them.

Around 1900 the *Phytophthora* species were probably introduced into Western Australia, being extended as open spots of dead vegetation. For the next 40 years the association of *Phytophthora* infection and death of vegetation was not known. In mid 1960's *P. cinnamomi* was identified by Dr.F.Podger, as the cause of dieback in the Jarrah Forest (19). The other fungi which were identified are *P. citricola*, *P. cryptogea*, *P. drechsleri*, *P. megasperma var. megasperma*, *P. megasperma var. sojae* and *P. nicotianae* (26;27).

Over at least 1000 plant species of known hosts, from different taxonomically diverse families are threatened by *P. cinnamomi* (32). The destruction of banksia woodlands and Bassendean Dunes (Spearwood Dunes) by *Phytophthora* is outlined by Shearer and Hill (22). Dieback spread from small dead patches to an estimated 228,000 ha of crown land in 1977. Wildflowers of banksia, pea and heath families are commonly killed, causing an irreversible decline in the diversity of infected areas. Many plant species occur in restricted areas (22;27).

In a diseased woodland, for example, the number of species in a 64-square meter quadrant decreased from 56 to 41 species (22). In 1989 government and industry spent at least AUS$. 3.5 million dollars on dieback disease detection, mapping, prevention and research (27). The disease is spread by man, root to root contact, soil particles and soil moisture (water). The climatic conditions are ideal for the fungi.

The other *Phytophthora* are also a concern, killing valuable species. *P. citricola* is the most widespread , after *P. cinnamomi*, mainly killing individual plants in an area bordered by Kalbarri, in the north, Boyagin Rock in the east, and along the south coast to Cape Arid. *P. megasperma var. megasperma* kills banksia communities in seasonally water-logged areas on the northern sand-plains and on the south coast.

Measures to combat the disease are sanitation, quarantine, disease mapping by remote sense photography, genetic engineering and the search for resistance.

Chemotherapy is an important control option. Phosphorous acid is one of the most promising fungicides. It is cheap, non toxic to animals and humans and it is biodegradable.

Phosphorous acid penetrates all parts of the plant, even roots far deep into the soil. This fungicide has a double action; it attacks the fungus, and at the same time it boosts the plants' natural defences. It is currently being used to protect the rare and endangered feather leaf banksia from infection (27).

Phosphorous acid is also active against *Armillaria luteobubalina* (14).

Phosphorous acid slows the growth, inhibits sporulation, induces the release of 'stress metabolites' and interferes with the recognition by the pathogen of the host.
The complex mode of action provides an effective and durable control at low application rates (10;13;26;27).

The effect of phosphorous acid has been monitored in the United States of America on several *Phytophthora* species (3;4;11;18;20) and in Western Australia over the last three years.

MATERIALS AND METHODS

Forest trials

In a growth comparison experiment the independent variables where:

- incubation method
- plant part used (roots and/or twigs)
- assessment time (4, 8 and 12 days after inoculation)
- neutralized phosphorous acid used

The dependent variable was the growth of *P. cinnamomi* in *Banksia grandis* plant material.

Each treatment was replicated five times.

All plant material was randomly sampled from *Banksia grandis* plants, used in field experiments with phosphorous acid around Dwellingup.

The sites of the experiment were classified as a Havel St type (26). The soil can be classified as a laterite soil.

The brand of the phosphorous acid used is called 'FOSJET 200' from UIM Agro chemicals. The active constituent of the stock solution is 200 g/l phosphorous(phosphonic) acid.

It is presented as mono-di-potassium phosphite, buffered between a pH of 5.7 - 6.0. It is referred to as neutralized phosphorous (phosphonic) acid.

The plants used in experiment one and two were injected with 10% phosphorous acid.

Incubation method used in the forest trials

The incubation method was first tried out in a preliminary trial resulting in a method used consistently for all the forest experiments. The preliminary experiment was based on a literature review (15;24;28;29;30). The treatment consisted of stem, root and twig material in either a flask, a corm or a tray. The flask method (15;30) consisted of vertical twigs and root samples and the corm method (28;29) was based on stem samples. The tray method (24) was found to be the most practical to use. The incubation temperature was set at 25 degrees Celsius. The temperature was controlled with the aid of a data logger and did not show deviations.

The selected samples were 30 cm long, due to the size of the tray. The diameter of the samples was between 5 and 10 mm for the practical reasons of cutting and storing in the trays. The roots were rinsed and then dried. Twigs were defoliated.

The sample is excised on the side that is nearest to the stem. A 3 mm diameter plug was collected on the margin of a 5-7 day old colony of the SC72 isolate of *P. cinnamomi* growing on cornmeal agar (CMA). The SC72 isolate was chosen because it was used in previous experiments and is known to be virulent. Contaminations can easily be located on a CMA plate.

After inoculation the cutting point was marked with a piece of black masking tape. The edges were wrapped in aluminium foil to prevent drying out of the sample, labelled and put horizontally into a tray and covered with moistened vermiculite. Then the trays, as a whole, were wrapped in aluminium foil to prevent drying out. Seeing that some samples still dried out, a plastic bag was pulled over them and sealed with Sellotape (exp 3; exp 4).The plastic bags prevented drying out of the trays. The trays were then incubated at 25 degrees Celsius, under dark conditions.

Plating out of the samples used in forest trials

At first a P5 selective medium was used, but due to heavy contamination of unwanted fungi and bacteria, the medium was changed to a variation of P10 and half strength potato dextrose agar (PDA) medium (see appendix, page 103 and 104). Of the forest trials only experiment one was on a selective P5 agar medium.
For the other field experiments the P10/PDA medium was used. PDA was used because it gives a compact growth of *P. cinnamomi*.

After 4, 8, and 12 days the samples corresponding with that day where plated out on a half strength PDA/P10 medium. The petri dishes (plates) have a diameter of 140 mm. Each plate contained 50 ml of medium.

A strip was cut from each sample in such a manner that one started at the opposite end of the inoculation mark, cutting in a straight horizontal line towards the inoculation. The agar mark was used as a zero-point. The knife blade was then sterilised by dipping it in a 100% ethanol solution and then flaming it. Starting again at the opposite end of the inoculation, the strip was cut into 5 mm pieces. In between cutting the blade was sterilised in a flame after dipping it in a 100% ethanol solution. The pieces were put on a half strength PDA/P10 dish in a clockwise spiral pattern. The pincer was flamed after dipping it in ethanol before placing the next piece on the dish.

The dishes were then sealed with 'gladwrap' and incubated in darkness at 25 degrees Celsius. After 3 days the plates where examined. *P. cinnamomi* grew out of the infected pieces of stripe into the medium. The pieces were checked under a microscope at an enlargement of forty times.

The pattern of recovery was used to determine the length of root or twig colonized by the pathogen. By adding up the length of the individual pieces, within the recovery pattern a length of growth was determined. The data were then submitted to a regression analysis.

All of the data used where analysed by a statistical software (computer) package called SYSTAT, version 5,0; 1990.
The functions of the lines where obtained via a computer software package specially designed for regression analysis, called RR Graphics.

Concentration tests

The independent variables are :

- isolates of *P. cinnamomi*, *P. citricola*, *P. megasperma var. megasperma* and *Armillaria luteobubalina*.
- assessment time
- media
- neutralized phosphorous acid concentration.

The dependent variable is the growth of *P. cinnamomi* on a petri dish.

For the first concentration experiment a plug with a diameter of 3 mm was taken from a CMA dish (diameter: 8 cm) containing a *P. cinnamomi* (SC72) culture that was 5 days old. The plugs were selected at the edge of a pure colony.

The inoculation was put onto a P5 dish, with a diameter of 140 mm and contained 50 ml of medium.

The fungus was allowed to grow out for 3 days and then checked under the microscope for abnormalities. A 20 ml of solution was taken from a stock concentration of phosphorous acid, using a pipet and the entire surface of the plate and the fungus were covered with the solution. The concentrations used were 0%, 2.5%, 5% and 10% (v/v) phosphorous acid. This day was marked as day zero. On Monday, Wednesday and Friday the dishes where assessed for a fortnight.

The plugs were then put onto CMA dishes with a diameter of 8 cm to see if the fungus was still alive. Growth was assessed by measuring the radius of the colony. The radius was measured 6 times, equally spread over the colony. The average was then taken of the 6 measurements and noted as the growth of the fungus on that plate on that day. Each treatment was replicated 5 times.

For experiment 2, 3 and 4 the following phosphorous acid concentrations have been applied: 0.25%, 0.5%, 1%, 2.5%, 5% and 10 The values were chosen because they were used in foliar spray- and trunk injection trials throughout the state.

The brand of the phosphorous acid used is the same as used with the forest trials ('FOSJET 200' from UIM Agro chemicals; see page 7 for further information).

Another change to the concentration experiment was that the phosphorous acid was put into the media before autoclaving and the pH adjusted with KOH stock solution. The pH was adjusted to a value between 6.2 and 6.4. This is according to the California trials (4;11). Also there was a change in medium used, which will be dealt with later.

The aim of the second experiment was to assess the effect of phosphorous acid on *Armillaria luteobubalina*. Forest trials indicated a positive response (B.L. Shearer, personal communication). A malt extract agar (MA) is used, as this is common practice (B.L. Shearer, personal communication). Isolate DA102 was used because of its virulent character.

The method of inoculation, assessing and analysing was as previously mentioned. The assessment time was prolonged due to delayed growth pattern. An experiment whereby rhizomorphs were used, failed to give results due to contamination problems.

A third experiment compared between *P. cinnamomi*, *P. citricola* and *P. megasperma var. megasperma*.

The medium was a half strength potato dextrose (PDA) (19.5 g/l PDA; 7.5 g/l BA). The phosphorous acid was added before autoclaving and the pH adjusted between 6.2 and 6.4 (4;11). The inoculation was done in a laminar air-flow, using 5 day old cultures grown on CMA plates with a diameter of 8 cm. All the petri dishes were checked under a microscope for abnormalities. For *P. cinnamomi* the SC72 isolate was used. A 1450 isolate of *P. citricola* was selected. This isolate is being used in experiments at ALCOA mining company and at the Research Centre. There is not much known about *P. citricola* isolates (Vickery, personal communication). This one seems to be virulent, based on experience.

No research has been done on *P. megasperma*, concerning isolates. Funding for research programs for *P. citricola* and *P. megasperma* is currently on its way. The isolate for *P. megasperma var. megasperma* has been selected from *Banksia grandis*, growing north.

The method of inoculation and assessment of experiment 3 is the same as for experiment 1 of the concentration trials.

For the fourth experiment a half strength PDA/P10 medium was used. This was done due to heavy contamination in experiment 3. The set-up is exactly the same as the procedure used in experiment 3. The amount of plates was doubled for all, but the control. This was done to achieve a greater accuracy and to check half of the plates as they developed, while the other half was reinoculated. The reinoculation was done to see if the fungicide is fungistatic.

All of data used were analysed, in the same manner as for the forest trials. (see page 9).

RESULTS

Summary of the obtained functions and their standard deviation as calculated by RR Graphics for each experiment.

DESCRIPTION	FUNCTION OBTAINED / STAND. DEVIATION
Forest trials	
1A Twigs,10% phos.acid	$Y = (3.6 \pm 1.3)X - (6.8 \pm 9.4)$ / 25.0
1B Roots,10% phos.acid	$Y = (1.1 \pm 0.2)X - (1.2 \pm 1.6)$ / 43.9
1C Twigs, 0% phos.acid	$Y = (6.7 \pm 1.1)X - (9.8 \pm 8.4)$ / 22.5
1D Roots, 0% phos.acid	$Y = (13.8 \pm 26)X - (23.0 \pm 20)$ / 53.9
2A Low, 0% phos.acid	$Y = (7.5 \pm 1.4)X - (5.0 \pm 10)$ / 27.4
2B Mid., 0% phos.acid	$Y = (9.5 \pm 1.1)X - (6.1 \pm 7.9)$ / 21.1
2C High, 0% phos.acid	$Y = (9.4 \pm 0.8)X - (6.3 \pm 6.1)$ / 16.2
2D Low, 10% phos.acid	$Y = (2.9 \pm O.8)X - (5.8 \pm 5.8)$ / 15.6
2E Mid., 10% phos.acid	$Y = (2.9 \pm 1.3)X - (5.0 \pm 10)$ / 26.8
2F High, 10% phos.acid	$Y = (3.7 \pm 0.6)X - (3.8 \pm 4.0)$ / 10.6
3A Tree, 0% phos.acid	$Y = (9.4 \pm 1.4)X - (7.0 \pm 11)$ / 28.7
3B Tree, 1% phos.acid	$Y = (6.1 \pm 1.1)X - (1.5 \pm 7.2)$ / 19.0
3C Tree, 2% phos.acid	$Y = (6.0 \pm 1.9)X - (3.0 \pm 15)$ / 39.0
3D Tree, 5% phos.acid	$Y = (3.9 \pm 1.1)X - (0.3 \pm 8.5)$ / 22.8
3E Tree, 10% phos.acid	$Y = (4.2 \pm 0.7)X - (2.0 \pm 5.6)$ / 14.9
4A Duration,0%phos.acid	$Y = (5.9 \pm 1.0)X^2 - (0.3 \pm 7.6)$ / 23.9
4B Dura, 5%,recently	$Y = (5.5 \pm 0.8)X^2 - (4.3 \pm 6.1)$ / 19.2
4C Dura, 5%,3 years ago	$Y = (5.5 \pm 0.7)X^2 - (3.5 \pm 5.9)$ / 18.5
4D Dura,10%,recently	$Y = (3.5 \pm 1.0)X^2 - (5.9 \pm 7.3)$ / 22.9
4E Dura,10%,2 years ago	$Y = (4.0 \pm 1.0)X^2 - (8.2 \pm 8.2)$ / 26.0
4F Dura,10%,3 years ago	$Y = (3.9 \pm 0.7)X^2 - (3.8 \pm 5.1)$ / 16.1
Concentration trials	
7A Armillaria, control	$Y = (4.4 \pm 0.1)X - (1.6 \pm 0.6)$ / 1.7
7B Arm.,0.25% phos.acid	$Y = (5.4 \pm 0.8)X^2 - (4.2 \pm 2.1)$ / 9.7
7C Arm.,0.5% phos.acid	$Y = (5.0 \pm 0.7)X^2 - (1.1 \pm 1.9)$ / 8.7
7D Arm., 1% phos. acid	$Y = (1.8 \pm 0.1)X^2 - (1.2 \pm 4.2)$ / 2.0
7E Arm.,2.5% phos.acid	$Y = (7.5 \pm 1.0)X^2 - (5.1 \pm 3.6)$ / 1.8
7F Arm., 5% phos. acid	$Y = (7.3 \pm 0.5)X^2 - (3.0 \pm 1.9)$ / 9.4

Of the above functions figures (corresponding with aboved numbering) have been plotted. Attention is paid to them in the following pages.

Forest trials

Experiment 1: Comparison between twig samples and root samples

The measurements of the four treatments of phosphorous acid concentration form the basis for a multiple regression analysis. The variation was determined with the computer package RR Graphics based on a 95% confidence interval. The results are presented in the summary and in the appendix, tables 1 - 4 (pages 29 and 30) and figures 1A - 1E(pages 32, 34,36 and 38). The analysis of variance (ANOVA) table 1 shows a significant difference between phosphorous acid treatments and the controls ($p = 0.007$, page 29). For the 3 measurement days, which were transversally analysed, day 4 and 12 were significantly different. Day 8 had too many missing values. (pages 29 and 30).

The diagram shows that *P. cinnamomi* grows more slowly in twigs than in the roots. The roots were more contaminated, suggesting that the infection causing the contimination is present on the plant before processing. There is a slower growth of *P. cinnamomi* in untreated roots initially. Contamination could have caused the retarded growth.

The levels of antibiotics in the selective P5 medium were half of that recommended. This was the case for day 4 only. The fact that day 8, twigs with phosphorous acid, gave no response, is not clear. Contamination might have suppressed *P. cinnamomi*. There is a significantly slower growth of *P. cinnamomi* in phosphorous trials than in untreated roots and twigs. The growth curves have a strong linear character. The experiment justifies the use of twigs in future experiments. Results of experiment 1 recommended the use of a more powerful selective media.

Experiment 2: The influence of plant height on the bioassay used in phosphorous acid trunk injections

The data collected in this experiment is presented in the appendix. The results of the regression analysis is presented in a ANOVA table, table 5 (page 40). Diagrams and functions have been produced in the summary and in the appendix (figures 2A -2G; pages 43, 45, 47, 49, 51, 53 and 54).

The ANOVA table shows a significant difference between the various phosphorous treatments ($p = 0.000$).
The transversal analysis of the 3 measurement days were also significant. The ANOVA table also indicates that there is no significant difference between the height at which the twig samples were selected in the canopy.
There is hardly any difference in growth response between the highest layer and the middle layer of the untreated plant samples. The lowest layer shows a retarded growth.

For the series treated with 10% phosphorous acid the growth is less vigorous as the untreated series. Compared with the untreated series, the middle- and lowest layer hardly differ. The highest layer shows a stronger growth performance of *P. cinnamomi*. The greatest variation was in the middle layer for the treated twigs. The lowest layer had the greatest variation in the untreated series.
The graphs might suggest that the fungus has a preference but this is not confirmed in the ANOVA analysis ($p = 0.723$).

Experiment 2 concludes that there is no difference between twigs sampled from different heights within the tree canopy as to response or sampling for the phosphorous acid bioassay.

Experiment 3: The comparison of different concentrations of phosphorous acid, injected at the same time

The data are presented in the summary and in the figures 3A -3F of the appendix (pages 58, 60, 62, 64 and 66). The results of the regression analysis are presented in ANOVA table 9. With RR Graphics diagrams of each concentration were plotted.
A 95% confidence interval was included. Figure 3F contains an overall review of the concentrations used. (see page 67)

Taking the growth as the dependent variable, it can be concluded that the phosphorous acid treatment is not significant ($p = 0.065$). Results of the transversal analysis of each measurement day also were not significant. Reason for this could be the large variation and missing values.

The distribution of the orginal measurement points indicate that a 90% confidence interval would be more appropriate.
A 'goodness of fit', performed by RR Graphics, shows there is hardly any diference between 1% and 2% concentrations. This also counts for the 5% and 10% concentrations.

Experiment 4: The duration of phosphorous acid within a tree

Twigs were sampled from trees that had been injected with phosphorous acid 0, 2 and 3 years ago.

The data of experiment 4 are presented in the summary and in figures 4a - 4G in the appendix (pages 71, 73, 75, 77, 79 and 81). The results of the regression analysis are given in ANOVA table 13 (page 68).The overall review is presented in figure 4G (page 82). A plot diagram for the 5% (figure 5, page 83) and for 10% (figure 6, page 84) solution is presented in the appendix.

The ANOVA table 13 (page 68) shows that the phosphorous acid treatments are not significantly different ($p = 0.658$). This also applied for the transversal analysis of the three measurement days.

The data were transformed from a linear to an exponential function with the aid of RR Graphics. This improves the data slightly, but it results in a better goodness of fit.

The plot diagram shows a tendency that the 5% phosphorous acid treatment has no effect after three years. The variation of the 5% phosphorous acid treatments was less than the variation of other treatments. The 10% phosphorous acid treatment retarded the growth of *P. cinnamomi*. The variation was the largest in the last measurement day, suggesting that contamination might have influenced the scoring of the growth of the fungus.
The data indicate that a 90% confidence interval would be more appropriate.

At the last sample time growth of *P. cinnamomi* in twigs for phosphorous acid trees was considerably less than expected. The second year treatment of the 10% series gave a stronger growth response than the control in the first segment of the curve. At 'day 12' the growth response was significantly below the control. For the 5% there is no sign of stabilisation of growth response.

Concentration trials

Experiment 1: The effect of phosphorous acid on *Phytophthora cinnamomi* (isolate SC72)

Only the control grew out. The fungus was completely inhibited at 2.5%, 5% and 10% phosphorous acid. Due to contamination the trial was stopped after a fortnight. Reinoculation on PDA plates of the plugs used during the experiment gave no clear result due to contamination.

Experiment 2: The effect of phosphorous acid on *Armillaria luteobubalina*

The data are presented in the summary and in the figures 7A - 7G in the appendix (pages 86, 89, 92, 95, 98 and 102). Only the 10% phosphorous acid treatment did not grow out during the experiment. The other concentration shows that after a period of delay *Armillaria luteobubalina* started growing out. The difference in growth performance is such that the fungus will still be significantly delayed, aiding host defence mechanisms in controlling the fungus. Reinnoculation of plugs taken from the 10% phosphorous acid petri plates showed a regrowth.
The control shows a strong linear relationship. Goodness of fit, by RR Graphics, indicated that a transformation to exponential functions was significant for the treated series. A reason for this change in growth behaviour could be that it takes a while for the chemical to influence the pathogen.

Using the rhizomorf form did not give any results due to heavy contamination. A concentration of 2.5% phosphorous acid or more looks promising (figure 7G, page 102).

Experiment 3: Comparing the effect of phosphorous acid treatment on three species of *Phytophthora*.

This experiment had no results due to heavy contamination of fungi and bacteria. Unaffected plates have been kept as a preliminary to give indications for the next experiment when a powerful selective media will be used.

Experiment 4: Comparing the effect of phosphorous acid treatment on three species of *Phytophthora* on a selective medium.

Phytophthora citricola grew the fastest. *P. megasperma var. megasperma* is a slow grower. Only the controls grew out of all three *Phytophthora* species. Reinoculation of the plugs on 'P10 based medium' plates shows a regrowth for the 0.25, 0.5, 1.0% (v/v) phosphorous acid for *P. cinnamomi* and a regrowth of 0.25 and 0.5% (v/v) phosphorous acid series for *P. citricola*. For both the 0.25% concentration gave a regrowth of 80%. The other concentrations mentioned gave 100% regrowth.

There was no regrowth to be found after the plugs of the with *P. megasperma var. megasperma* treated petri dishes had been plated out on a selective medium based on P10. Hereby is confirmed that phosphorous acid inhibits and, till a certain extent, kills the fungi.

DISCUSSION

Although the samples gave a great variation in growth response, it would seem reasonable to continue using the bioassay as a method of assessment. Destructive sampling results in a great loss of treated plants and is a laborious effort. Collecting root samples is difficult, due to variation in root size and the large amount of labour needed to excavate enough roots for replications (23).

The variation of the response could be, due to the condition of the (parental fungus) culture, contamination by fungi and bacteria, drying out of twig samples during the trial and the age of the collected material. The great variation affected the accuracy of the multiple regression analysis, presented in an ANOVA analysis.

Controling the responsible factors could lead to a higher significance. It should be stated that field trials usually are submitted to a greater complexity of factors than would be the case for an in vitro trial. Samples from the plants are very variable.

Contamination could be one of the causes of variation. Infections could well be on the sample before plating. Observations in experiment 1 lead this way. Surface sterilisation can be a method to further reduce the contamination hazard. A *Rhizopus* infection in the laboratory could be one of the causes. Contamination experienced during the trial was reduced. Flaming the cutting board and utilities with ethanol, spraying the room with 100% ethanol and keeping the doors and windows shut to prevent air-flow are measures used to keep the infection chance as low as possible and to prevent infection. The use of powerful selective media subsequently reduced the contamination level.

The height where the samples were taken in the tree had apparently no effect on the samples selected for the bioassay. Experiment 3 would seem to suggest that it would be sufficient with a 1% (v/v) phosphorous acid application, although a 5% (v/v) phosphorous acid application would be desirable. This due to the stronger decrease in growth of *P. cinnamomi*.

Experiment 4 however seems to indicate that the 5% (v/v) phosphorous acid treatment had lost its effect, after three years. The fact that the control gives an unexpected response can be assigned to the fact that the control was too small to cope with the great variation.

The functions obtained by RR Graphics should be interpreted with caution due to the fact that only a limited amount of data were used. There were several missing values, points beyond the 95% confidence interval and a limited amount of replications.

The functions must be quantified to justify the use, for example in modelling. The functions however help to enlarge the understanding of the relationship between *Banksia grandis*, *P. cinnamomi* and phosphorous acid.

To understand the process in the tree, concentration plate trials were introduced. The inhibition of *Phytophthora* species by phosphorous acid had been subject to research in the United States of America and in Europe. Isolates of the *Phytophthora* species occurring in Western Australia have not yet been tested. Experiments in vitro would give a clear idea about their susceptibility to phosphorous acid. The undertaken experiments proved to be successful.

P. cinnamomi, *P. citricola*, and *P. megasperma var. megasperma* are all inhibited at 0.25% (v/v) phosphorous acid. Reinoculation of the original plugs show a recovery at 0.25, 0.5 and 1.0% (v/v) phosphorous acid for *P. cinnamomi* and 0.25 and 0.5% (v/v) phosphorous acid for *P. citricola*.

Literature (10) reveals that *P. megasperma var. megasperma* is much more insensitive to phosphorous acid than *P. cinnamomi* and *P. citricola*. This was not the case for the culture obtained in Western Australia. The fungus is a slow grower and showed no regrowth after the plugs were reinoculated on 'P10 based' plates.

Most studies on the application of phosphorous acid have been focussed on avocado (*Persea indica*). In Australia it was found that an application of 20% phosphorous acid gave a total recovery after 12 months of the infection and application of 10% phosphorous acid gave a total recovery after 15 months. The dosage is related to the leaf canopy of the tree. The dose is 15 ml/m leaf canopy diameter (17). Drenching the soil and foliar spraying also gave promising results.

In South Africa it was found that a dose of 0.4 g active ingredient per meter canopy diameter of Fosetyl Al, injected twice a year gave the desired effect (6;8;9).

This in contrast to the trials run in Dwellingup, Western Australia. Here the stem or trunk diameter is used as a measurement base, because of sparse crowns. The dosage for *Banksia grandis* was 0.75 ml/cm trunk diameter using a 10% solution of phosphorous acid.

In South Africa it was found that young trees did not respond to the treatment, while the older trees do respond (5). The reason for this is yet unknown but could also apply for the banksia's growing here. After a few years a booster effect was noticed (6;7;8;9).

It has been noticed that phytotoxity or burning of the leaves occurs at lower dosis than that for avocado culture. These trees are often grown under irrigation. The lack of water availability in Jarrah Forest seems to contribute to this phenomenon of leaf burning (Fairman, personal communication).

Levels of inhibition have been established for several *Phytophthora* species. These data can be used as a guideline, but the EC50 or ED50 will have to be established for the *Phytophthora* species occurring here and for their isolates.

The successfulness of phosphorous acid is due to its ability to be transported acropetally and basipetally (3). Furthermore it is a cheap and basic compound which will not easily be overcome by the fungus defense mechanisms. There have been reports of resistance development against it by some of *Phytophthora* species (11).

There is no clear understanding over the mode of action. It was previously thought that phosphorous acid stimulated the plant's natural defence mechanisms but had no effect on its own. Recent studies have altered this line of thought. Several studies confirm the direct action of mode by phosphorous acid against the fungus (4;11;12;13;20).

'Although concentrations of phosphorous acid in the tissue never reach fungicidal to *P. cinnamomi*, partial inhibition of the pathogen probability enables plants to effectively activate other host defence mechanisms' (4). Morphological changes, changes in membrane function and in cell wall synthesis due to phosphorous acid treatment have been reported (20).

Derks and Buchenauer assessed the difference in response of sensitive or insensitive *Phytophthora* species (10). Coffey and Bower seem to agree that the characteristic response to phosphorous acid is based on formae speciales or morphological types (4). This dual mechanism is generally accepted as an explanation of the mode of action of phosphorous acid (12;13;20). Phosphorous acid has been tested with closely related substances and found to be superior (7;17;20).

Comparing what is known and what is found in this trial, a larger scale of dilutes must be examined. Because in the trials excised plant material was used, the natural host defence mechanisms could not be monitored and results relied on the direct inhibitory action of the chemical. Chemical levels of phosphorous acid in the plant must be established. Trials over a longer period of time will reveal more information over the interaction between phosphorous acid and the pathogen in the twig. This is important due to frequently occurring missing values and the large variation of response.

Information obtained can lead to the construction of a plant map. With the aid of a model, a calculation which level of phosphorous acid is needed over time, and which original level of concentration is needed to be applied to achieve this effect, can be determined. More accurate means of determining the actual biomassa of the plant and the ratio between artificial media and plant material will have to be determined. A simulation model will finally combine the parts and will be a vital part in the foliar and drenching programs. Especially the appliance of aeroplane spraying would be welcome, but this is still a long way ahead in the future. In the USA modelling has already been undertaken with avocado (18).

In young seedlings of avocado the astonishing phenomena has been found that they don't respond to phosphorous acid. It is not yet known if this is also the case for Banksia or Jarrah (*Eucalyptus marginata*). A tendency that there is a difference in response between young and old plant material has been noticed but is not yet quantified.

The fact that *Armillaria luteobubalina* is inhibited by phosphorous acid is especially surprising. It seems to be a genetical base. A.*luteobubalina* and *Phytophthora* are unusual in that for both pathogens the vegetative stage is 2n (diploid). (B.L.Shearer, personal communication).
A partial inhibition was found, showing regrowth of all the concentrations but 10% (v/v) phosphorous acid plates.
After a latent period the fungi started to grow out but were less vigourously than the control plates. The chemical has a fungistatic effect on *Armillaria luteobubalina*. A correlation between the rhizomorf form and the plain form must be made. Efforts in this experiment failed due to contamination of the plates.

A procedure as for the *Phytophthora* approach can be used for further studies on *Armillaria* and phosphorous acid.

SUMMARY

Phytophthora species, especially *P. cinnamomi* are of great concern in Western Australia, where they are responsible for the Dieback of unique vegetation. *Armillaria luteobubalina* is also a widespread primary pathogen killing large areas of vegetation. *Phytophthora* and *Armillaria* have a wide range of susceptible hosts.

Western Australia has a unique flora characterized by its diversity and high degree of endimism among its species. Often species are restricted in their occurrence. Fauna depends on this flora for its habitat. Special nutritive relationships occur between flora and fauna species. These relationships are under threat at the moment because of the disappearance of restricted species, due to fungi.

Phosphorous acid is a promising fungicide against *Phytophthora* and *Armillaria*. It has a broad mode of action, making it complex for the pathogen to intervene. The chemical is non-toxic to animals and humans and is biodegradable. It can be applied efficiently at low rates.

The aim of this project is to examine the use of phosphorous acid to control the mentioned pathogens. Previously plants were destructively sampled. Forest trials, using *Banksia grandis* as indicator plant, have been set-up to assess the use of a bioassay for the sampling of trials. It was found that twigs can be used for sampling. The twigs can be randomly selected from the canopy of plants.

The growth of *P. cinnamomi* in treated and untreated plants with phosphorous acid has been used as a means to assess the trial. The dosages used were 0%, 1%, 2%, 5% and 10% (v/v), based on experimental trials, trunk injected. The duration of phosphorous acid in the plant of the various phosphorous acid concentrations has been assesed. The trial showed that a 2% concentration sufficiently reduced the growth of *P. cinnamomi*. After three years only the 10% concentration decreased the growth of *P. cinnamomi* sufficiently.

The second part of this project is based on the analysis of the growth of *Phytophthora* and *Armillaria* on petri dishes, containing phosphorous acid. The pathogens tested were *P. cinnamomi*, *P. citricola*, *P. megasperma var. megasperma* and A. *luteobubalina*. The following concentrations assessed on the petri dishes were 0%, 0.25%, 0.5%, 1%, 2.5%, 5% and 10% (v/v) phosphorous acid.

A. luteobubalina can be sufficiently inhibited at a minimum of 2.5% concentration. The trial showed that the chemical was fungistatic for *A. luteobubalina*. The *Phytophthora* isolates were totally inhibited in their growth by phosphorous acid. Phosphorous acid inhibits P. *cinnamomi* and *P. citricola* fungistatically at 0.25%, 0.5% and 1% concentration. For *P. megasperma var. megasperma* the concentrations were 0.25% and 0.5% phosphorous acid.

ACKNOWLEDGEMENT

I would like to thank dr. B.L. Shearer for his guidance and professor J.C. Zadoks for his support for this project. I am grateful to the Department of Conservation and Land Management (CALM) for giving me an opportunity of doing research in the problem of Dieback. I have experienced a warm support from all colleagues and the technical staff in Dwellingup. Especially the discussions with Richard Fairman and Libby Vickery enhanced my understanding of the practical aspects of the experiments with phosphorous acid and the taxation of the *Phytophthora* species. Finally I like to thank everyone who assisted me.

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APPENDIX

Forest trials

Experiment 1. Comparison between roots and twigs.

Experiment 2. Height comparison within a tree (canopy).

Experiment 3. The comparison of different concentrations of phosphorous acid, injected at the same time.

Experiment 4. The duration of phosphorous acid within a tree.

Concentration trials

Experiment 2. The effect of phosphorous acid on *Armillaria luteobubalina*.

Media used

Forest trial

Experiment 1. Comparison between root and twigs

11 CASES DELETED DUE TO MISSING DATA.

DEP VAR: GROWTH N: 49 MULTIPLE R: 0.395 SQUARED MULTIPLE R: 0.156

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
PHOS	31706.184	1	31706.184	7.878	0.007
PLANT	2267.045	1	2267.045	0.563	0.457
PHOS*PLANT	725.908	1	725.908	0.180	0.673
ERROR	181097.932	45	4024.398		

TABLE 1 Overall analysis

11 CASES DELETED DUE TO MISSING DATA.

DEP VAR: GROWTH N: 9 MULTIPLE R: 0.543 SQUARED MULTIPLE R: 0.295

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
PHOS	816.588	1	816.588	1.108	0.341
PLANT	257.294	1	257.294	0.349	0.580
REPLICA	49.260	1	49.260	0.067	0.806
ERROR	3686.407	5	737.281		

TABLE 2 Day 4

plant: root and twig samples used
(plant material)
phos: phoshorous treatement

Forest trial

Experiment 1. Comparison between roots and twigs

DEP VAR: GROWTH N: 20 MULTIPLE R: 0.498 SQUARED MULTIPLE R: 0.248

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
PHOS	966.050	1	966.050	5.146	0.037
PLANT	2.450	1	2.450	0.013	0.910
REPLICA	22.500	1	22.500	0.120	0.734
ERROR	3003.550	16	187.722		

TABLE 4 Day 12

plant: root and twig samples used
(plant material)
phos: phoshorous treatement

Experiment 1 Twigs, 10% phos. acid

Function obtained:
Y = +(3.6 +- 1.3)%(X)
    -(6.8 +- 9.4)%(1)

Analysis of Variance

Sum of Squares	Value	Degr.Freedom	Variance
Total	1.8558E+04	18	
Due to regression	8.5968E+03	2	4.2984E+03
Residual	9.9612E+03	16	6.2257E+02

If the model is assumed to be correct, the estimated
standard deviation of Y is 2.4951E+01 (absolute)

The 95% confidence values show the limits between which you can expect
the value of Yreg if you repeat all 18 observations and use the
same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 6.800E+00	- 2.666E+01	1.306E+01
2	0.000E+00	0.000E+00	- 6.800E+00	- 2.666E+01	1.306E+01
3	0.000E+00	0.000E+00	- 6.800E+00	- 2.666E+01	1.306E+01
4	0.000E+00	0.000E+00	- 6.800E+00	- 2.666E+01	1.306E+01
5	0.000E+00	0.000E+00	- 6.800E+00	- 2.666E+01	1.306E+01
6	4.000E+00	0.000E+00	7.600E+00	- 5.744E+00	2.094E+01
7	4.000E+00	1.000E+01	7.600E+00	- 5.744E+00	2.094E+01
8	4.000E+00	0.000E+00	7.600E+00	- 5.744E+00	2.094E+01
9	4.000E+00	1.000E+01	7.600E+00	- 5.744E+00	2.094E+01
10	4.000E+00	0.000E+00	7.600E+00	- 5.744E+00	2.094E+01
11	8.000E+00	0.000E+00	2.200E+01	8.188E+00	3.581E+01
12	8.000E+00	0.000E+00	2.200E+01	8.188E+00	3.581E+01
13	8.000E+00	0.000E+00	2.200E+01	8.188E+00	3.581E+01
14	1.200E+01	4.700E+01	3.640E+01	1.561E+01	5.719E+01
15	1.200E+01	8.000E+00	3.640E+01	1.561E+01	5.719E+01
16	1.200E+01	5.500E+01	3.640E+01	1.561E+01	5.719E+01
17	1.200E+01	1.140E+02	3.640E+01	1.561E+01	5.719E+01
18	1.200E+01	8.000E+00	3.640E+01	1.561E+01	5.719E+01

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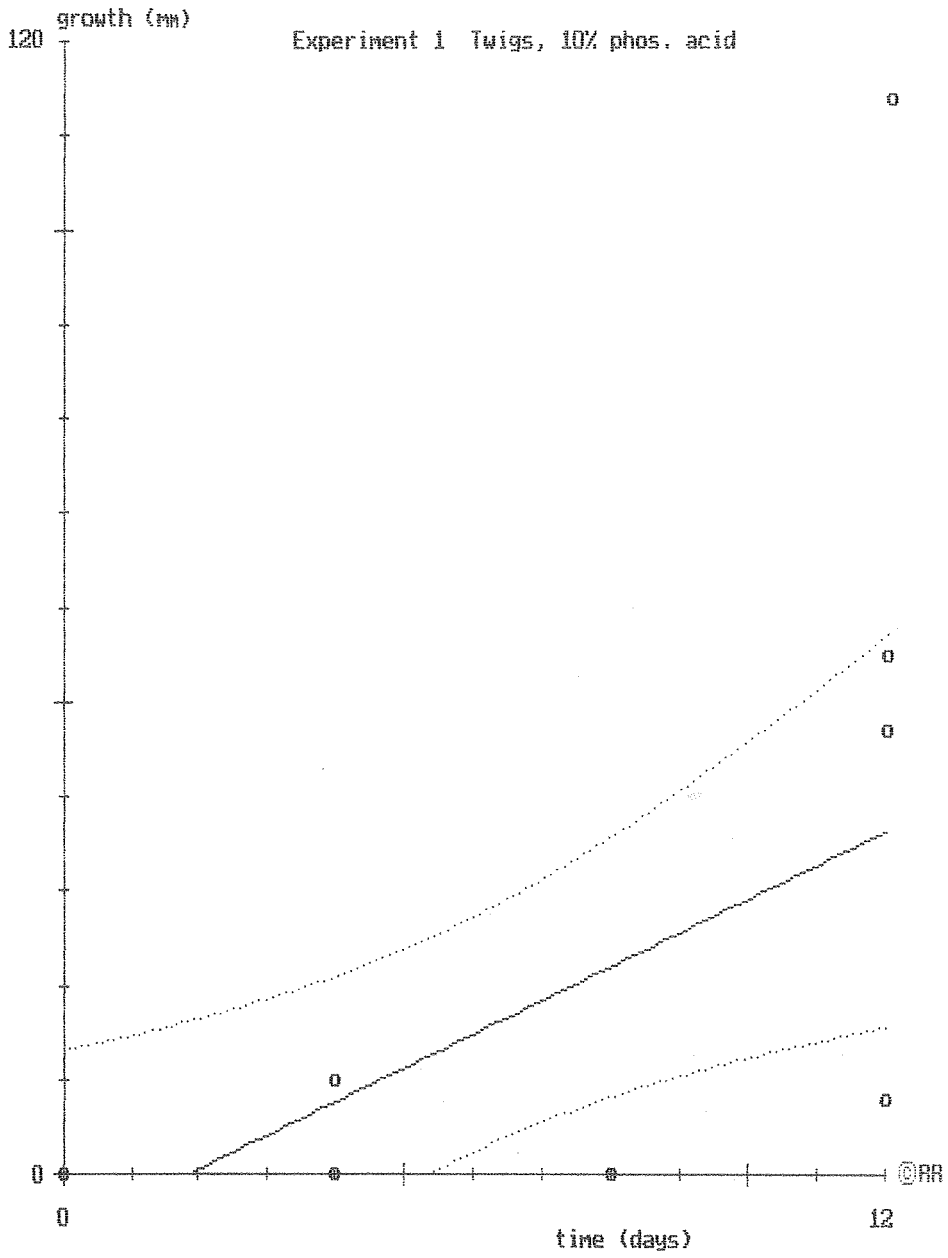

o original points
..... 95% confidence interval

Figure 1A

Experiment 1 Roots, 10% phos. acid

Function obtained:
Y = +(1.08 +- 0.21)%E+01%(X)
    -(1.2 +- 1.6)%E+01%(1)

Analysis of Variance

Sum of Squares	Value	Degr.Freedom	Variance
Total	1.3627E+05	20	
Due to regression	1.0145E+05	2	5.0724E+04
Residual	3.4821E+04	18	1.9345E+03

If the model is assumed to be correct, the estimated standard deviation of Y is 4.3983E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 20 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 1.201E+01	- 4.507E+01	2.106E+01
2	0.000E+00	0.000E+00	- 1.201E+01	- 4.507E+01	2.106E+01
3	0.000E+00	0.000E+00	- 1.201E+01	- 4.507E+01	2.106E+01
4	0.000E+00	0.000E+00	- 1.201E+01	- 4.507E+01	2.106E+01
5	0.000E+00	0.000E+00	- 1.201E+01	- 4.507E+01	2.106E+01
6	0.000E+00	0.000E+00	- 1.201E+01	- 4.507E+01	2.106E+01
7	4.000E+00	1.900E+01	3.117E+01	9.010E+00	5.333E+01
8	4.000E+00	2.500E+01	3.117E+01	9.010E+00	5.333E+01
9	4.000E+00	3.400E+01	3.117E+01	9.010E+00	5.333E+01
10	4.000E+00	4.200E+01	3.117E+01	9.010E+00	5.333E+01
11	8.000E+00	0.000E+00	7.435E+01	5.148E+01	9.721E+01
12	8.000E+00	0.000E+00	7.435E+01	5.148E+01	9.721E+01
13	8.000E+00	0.000E+00	7.435E+01	5.148E+01	9.721E+01
14	8.000E+00	7.700E+01	7.435E+01	5.148E+01	9.721E+01
15	8.000E+00	8.800E+01	7.435E+01	5.148E+01	9.721E+01
16	1.200E+01	6.600E+01	1.175E+02	8.305E+01	1.520E+02
17	1.200E+01	1.350E+02	1.175E+02	8.305E+01	1.520E+02
18	1.200E+01	1.460E+02	1.175E+02	8.305E+01	1.520E+02
19	1.200E+01	1.540E+02	1.175E+02	8.305E+01	1.520E+02
20	1.200E+01	2.260E+02	1.175E+02	8.305E+01	1.520E+02

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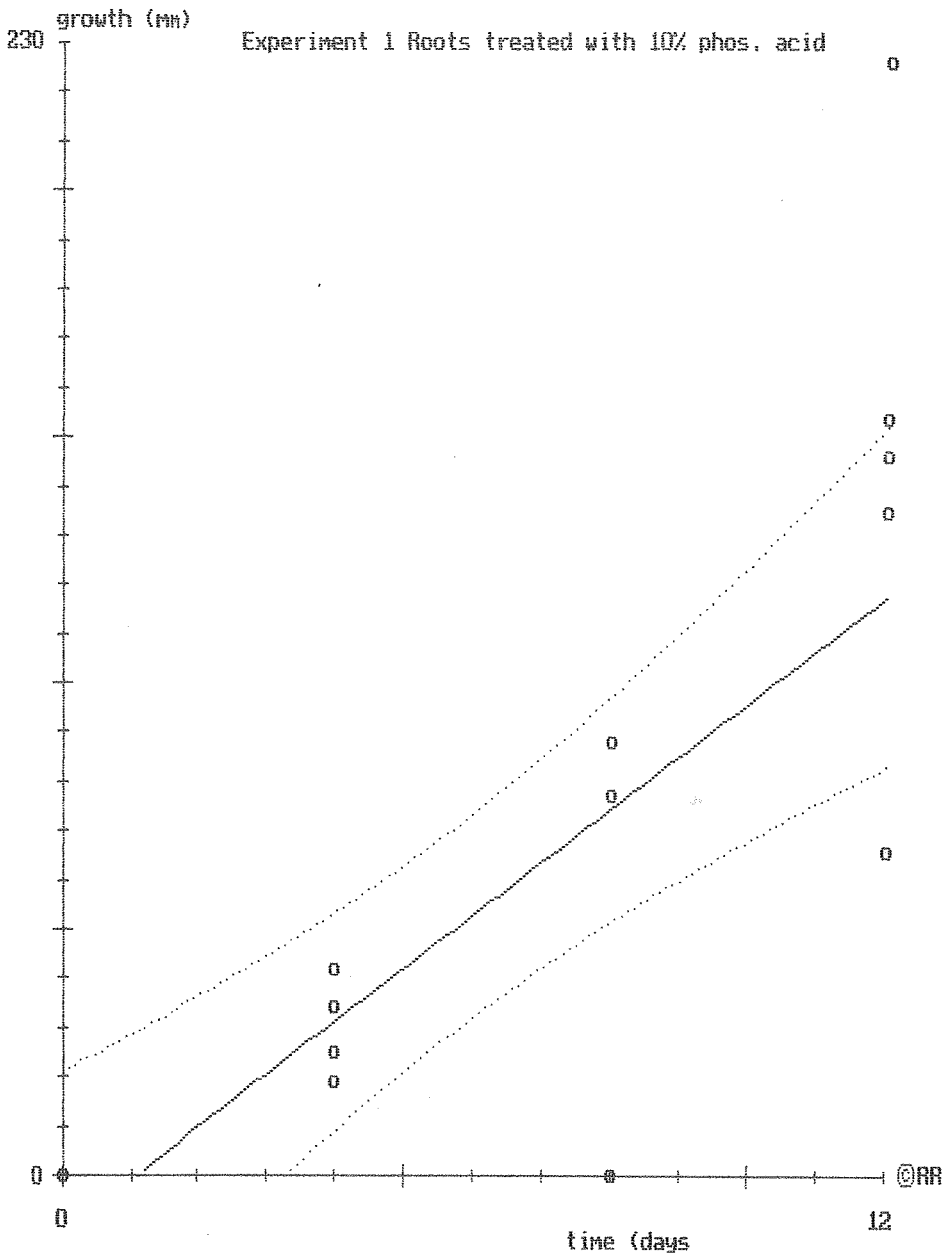

o original points
..... 95% confidence interval

Figure 1B

Experiment 1 Twigs, 0% phos. acid

Function obtained:
Y = +(6.7 +- 1.1)*(X)
    -(9.8 +- 8.4)*(1)

Analysis of Variance

Sum of Squares	Value	Degr.Freedom	Variance
Total	4.5532E+04	20	
Due to regression	3.6439E+04	2	1.8220E+04
Residual	9.0928E+03	18	5.0516E+02

If the model is assumed to be correct, the estimated standard deviation of Y is 2.2476E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 20 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 9.800E+00	- 2.747E+01	7.868E+00
2	0.000E+00	0.000E+00	- 9.800E+00	- 2.747E+01	7.868E+00
3	0.000E+00	0.000E+00	- 9.800E+00	- 2.747E+01	7.868E+00
4	0.000E+00	0.000E+00	- 9.800E+00	- 2.747E+01	7.868E+00
5	0.000E+00	0.000E+00	- 9.800E+00	- 2.747E+01	7.868E+00
6	4.000E+00	0.000E+00	1.700E+01	5.433E+00	2.857E+01
7	4.000E+00	0.000E+00	1.700E+01	5.433E+00	2.857E+01
8	4.000E+00	8.000E+00	1.700E+01	5.433E+00	2.857E+01
9	4.000E+00	9.000E+00	1.700E+01	5.433E+00	2.857E+01
10	4.000E+00	3.000E+01	1.700E+01	5.433E+00	2.857E+01
11	8.000E+00	0.000E+00	4.380E+01	3.223E+01	5.537E+01
12	8.000E+00	0.000E+00	4.380E+01	3.223E+01	5.537E+01
13	8.000E+00	3.600E+01	4.380E+01	3.223E+01	5.537E+01
14	8.000E+00	4.900E+01	4.380E+01	3.223E+01	5.537E+01
15	8.000E+00	6.300E+01	4.380E+01	3.223E+01	5.537E+01
16	1.200E+01	6.400E+01	7.060E+01	5.293E+01	8.827E+01
17	1.200E+01	6.800E+01	7.060E+01	5.293E+01	8.827E+01
18	1.200E+01	7.400E+01	7.060E+01	5.293E+01	8.827E+01
19	1.200E+01	7.900E+01	7.060E+01	5.293E+01	8.827E+01
20	1.200E+01	1.280E+02	7.060E+01	5.293E+01	8.827E+01

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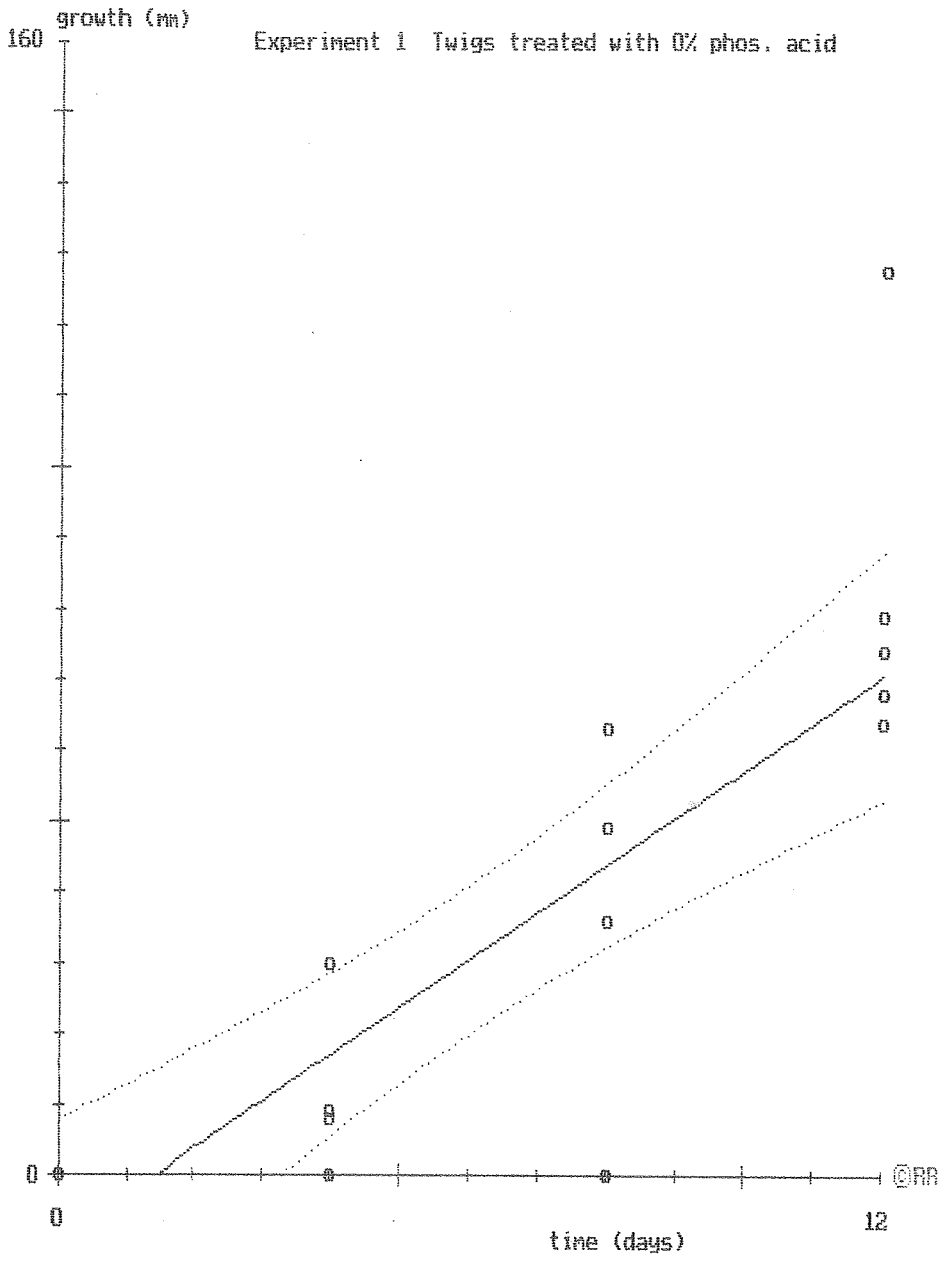


o original points
..... 95% confidence interval

Figure 1C

Experiment 1 Roots, 0% phos. acid

Function obtained:
Y = +(1.38 +- 0.26)%E+01%(X)
    -(2.3 +- 2.0)%E+01%(1)

Analysis of Variance

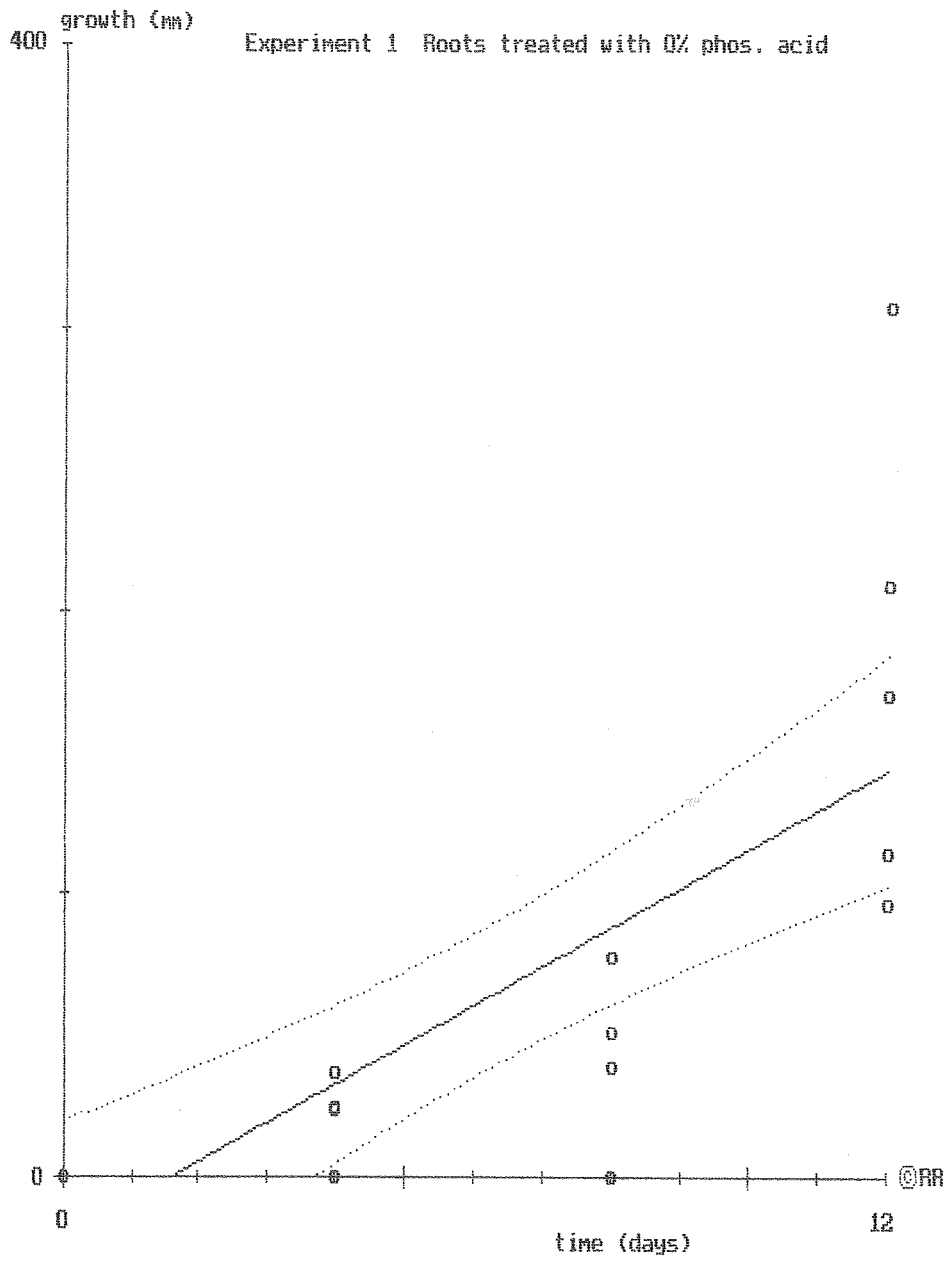
Sum of Squares	Value	Degr.Freedom	Variance
Total	2.1481E+05	20	
Due to regression	1.6257E+05	2	8.1287E+04
Residual	5.2241E+04	18	2.9023E+03

If the model is assumed to be correct, the estimated
standard deviation of Y is 5.3873E+01 (absolute)

The 95% confidence values show the limits between which you can expect
the value of Yreg if you repeat all 20 observations and use the
same type and order of equation to obtain Yreg at X

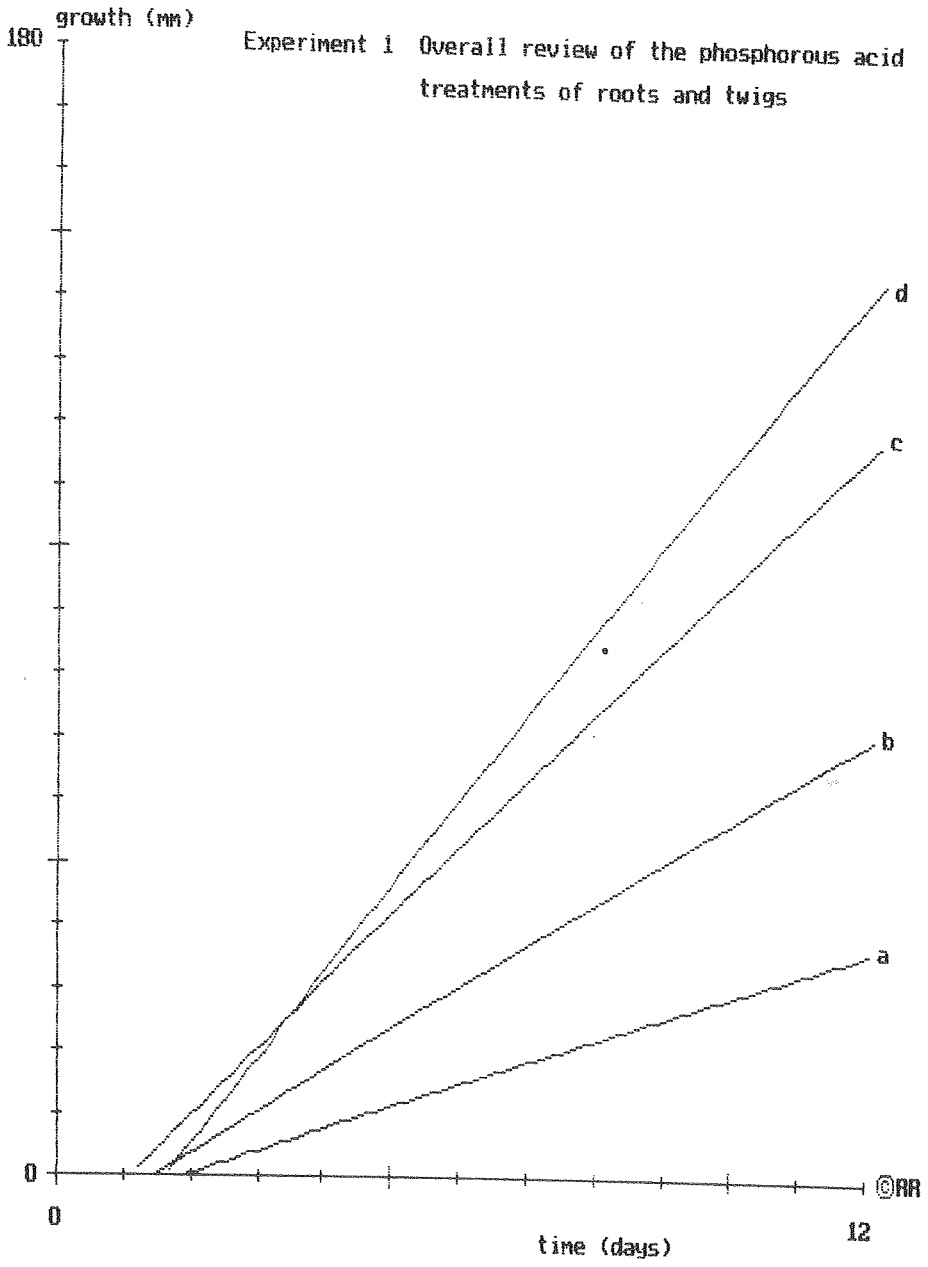
Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 2.266E+01	- 6.488E+01	1.956E+01
2	0.000E+00	0.000E+00	- 2.266E+01	- 6.488E+01	1.956E+01
3	0.000E+00	0.000E+00	- 2.266E+01	- 6.488E+01	1.956E+01
4	0.000E+00	0.000E+00	- 2.266E+01	- 6.488E+01	1.956E+01
5	0.000E+00	0.000E+00	- 2.266E+01	- 6.488E+01	1.956E+01
6	4.000E+00	0.000E+00	3.273E+01	4.729E+00	6.074E+01
7	4.000E+00	0.000E+00	3.273E+01	4.729E+00	6.074E+01
8	4.000E+00	2.400E+01	3.273E+01	4.729E+00	6.074E+01
9	4.000E+00	2.500E+01	3.273E+01	4.729E+00	6.074E+01
10	4.000E+00	3.700E+01	3.273E+01	4.729E+00	6.074E+01
11	8.000E+00	0.000E+00	8.813E+01	6.098E+01	1.153E+02
12	8.000E+00	3.900E+01	8.813E+01	6.098E+01	1.153E+02
13	8.000E+00	5.100E+01	8.813E+01	6.098E+01	1.153E+02
14	8.000E+00	7.800E+01	8.813E+01	6.098E+01	1.153E+02
15	1.200E+01	1.140E+02	1.435E+02	1.030E+02	1.840E+02
16	1.200E+01	9.600E+01	1.435E+02	1.030E+02	1.840E+02
17	1.200E+01	1.140E+02	1.435E+02	1.030E+02	1.840E+02
18	1.200E+01	1.700E+02	1.435E+02	1.030E+02	1.840E+02
19	1.200E+01	2.090E+02	1.435E+02	1.030E+02	1.840E+02
20	1.200E+01	3.070E+02	1.435E+02	1.030E+02	1.840E+02

-RR-



o original points
..... 95% confidence interval

Figure 1D



a : twig samples selected from plants treated with 10% phosphorous acid

b : root samples selected from plants treated with 10% phosphorous acid

c : twig samples selected from plants treated with water (control)

d : root samples selected from plants treated with water (control)

Figure 1E

Experiment 2. Height comparison within a tree (canopy)

DEP VAR: GROWTH N: 78 MULTIPLE R: 0.473 SQUARED MULTIPLE R: 0.223

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
PHOS	26169.951	1	26169.951	18.710	0.000
HEIGHT	912.440	2	456.220	0.326	0.723
PHOS*HEIGHT	892.176	2	446.088	0.319	0.728
ERROR	100709.036	72	1398.737		

WARNING: CASE 12 IS AN OUTLIER (STUDENTIZED RESIDUAL = 2.810)

DURBIN-WATSON D STATISTIC 1.074
FIRST ORDER AUTOCORRELATION .451

RESIDUALS HAVE BEEN SAVED

TABLE 5 Overall analysis

6 CASES DELETED DUE TO MISSING DATA.

DEP VAR: GROWTH N: 24 MULTIPLE R: 0.638 SQUARED MULTIPLE R: 0.407

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
HEIGHT	1177.788	2	588.894	0.813	0.458
PHOS	7367.313	1	7367.313	10.171	0.005
REPLICA	136.872	1	136.872	0.189	0.669
ERROR	13762.530	19	724.344		

TABLE 6 Day 4

Experiment 2. Height comparison within a tree (canopy)

DEP VAR: GROWTH N: 30 MULTIPLE R: 0.795 SQUARED MULTIPLE R: 0.632

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
HEIGHT	90.067	2	45.033	0.772	0.474
PHOS	2201.633	1	2201.633	37.741	0.000
REPLICA	11.267	1	11.267	0.193	0.664
HEIGHT*PHOS *REPLICA	2.673	2	1.336	0.023	0.977
ERROR	1341.727	23	58.336		

DURBIN-WATSON D STATISTIC 2.462
FIRST ORDER AUTOCORRELATION -.287

RESIDUALS HAVE BEEN SAVED

TABLE 7 Day 8

6 CASES DELETED DUE TO MISSING DATA.

DEP VAR: GROWTH N: 24 MULTIPLE R: 0.677 SQUARED MULTIPLE R: 0.459

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
HEIGHT	2628.857	2	1314.428	1.426	0.265
PHOS	9577.935	1	9577.935	10.389	0.004
REPLICA	311.951	1	311.951	0.338	0.568
ERROR	17516.376	19	921.915		

TABLE 8 Day 12

Exp 2 Tree crown (low), 0% phos. acid

Function obtained:
Y = +(7.5 +- 1.4)*(X)
    -(0.5 +- 1.0)*E+01*(1)

Analysis of Variance

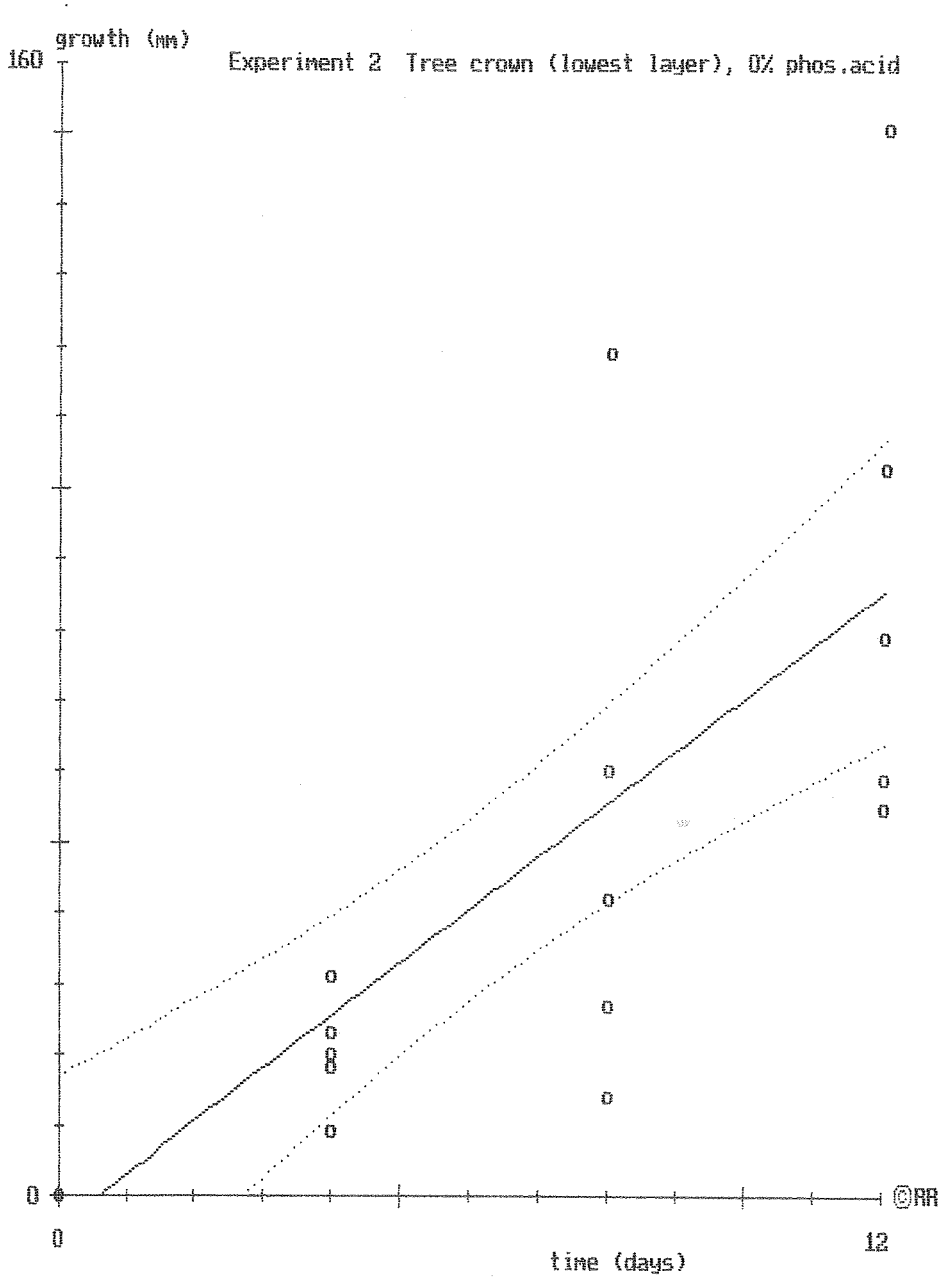
Sum of Squares	Value	Degr.Freedom	Variance
Total	6.8902E+04	20	
Due to regression	5.5365E+04	2	2.7683E+04
Residual	1.3537E+04	18	7.5205E+02

If the model is assumed to be correct, the estimated standard deviation of Y is 2.7424E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 20 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 4.560E+00	- 2.612E+01	1.700E+01
2	0.000E+00	0.000E+00	- 4.560E+00	- 2.612E+01	1.700E+01
3	0.000E+00	0.000E+00	- 4.560E+00	- 2.612E+01	1.700E+01
4	0.000E+00	0.000E+00	- 4.560E+00	- 2.612E+01	1.700E+01
5	0.000E+00	0.000E+00	- 4.560E+00	- 2.612E+01	1.700E+01
6	4.000E+00	9.000E+00	2.548E+01	1.137E+01	3.959E+01
7	4.000E+00	1.800E+01	2.548E+01	1.137E+01	3.959E+01
8	4.000E+00	2.000E+01	2.548E+01	1.137E+01	3.959E+01
9	4.000E+00	2.300E+01	2.548E+01	1.137E+01	3.959E+01
10	4.000E+00	3.100E+01	2.548E+01	1.137E+01	3.959E+01
11	8.000E+00	1.400E+01	5.552E+01	4.141E+01	6.963E+01
12	8.000E+00	2.700E+01	5.552E+01	4.141E+01	6.963E+01
13	8.000E+00	4.200E+01	5.552E+01	4.141E+01	6.963E+01
14	8.000E+00	6.000E+01	5.552E+01	4.141E+01	6.963E+01
15	8.000E+00	1.190E+02	5.552E+01	4.141E+01	6.963E+01
16	1.200E+01	5.500E+01	8.556E+01	6.400E+01	1.071E+02
17	1.200E+01	5.900E+01	8.556E+01	6.400E+01	1.071E+02
18	1.200E+01	7.900E+01	8.556E+01	6.400E+01	1.071E+02
19	1.200E+01	1.030E+02	8.556E+01	6.400E+01	1.071E+02
20	1.200E+01	1.510E+02	8.556E+01	6.400E+01	1.071E+02

-RR-



o original points
..... 95% confidence interval

Figure 2A

Exp 2 Tree crown (mid.), 0% phos.acid

Function obtained:
Y = +(9.5 +- 1.1)*(X)
    -(6.1 +- 7.9)*(1)

Analysis of Variance

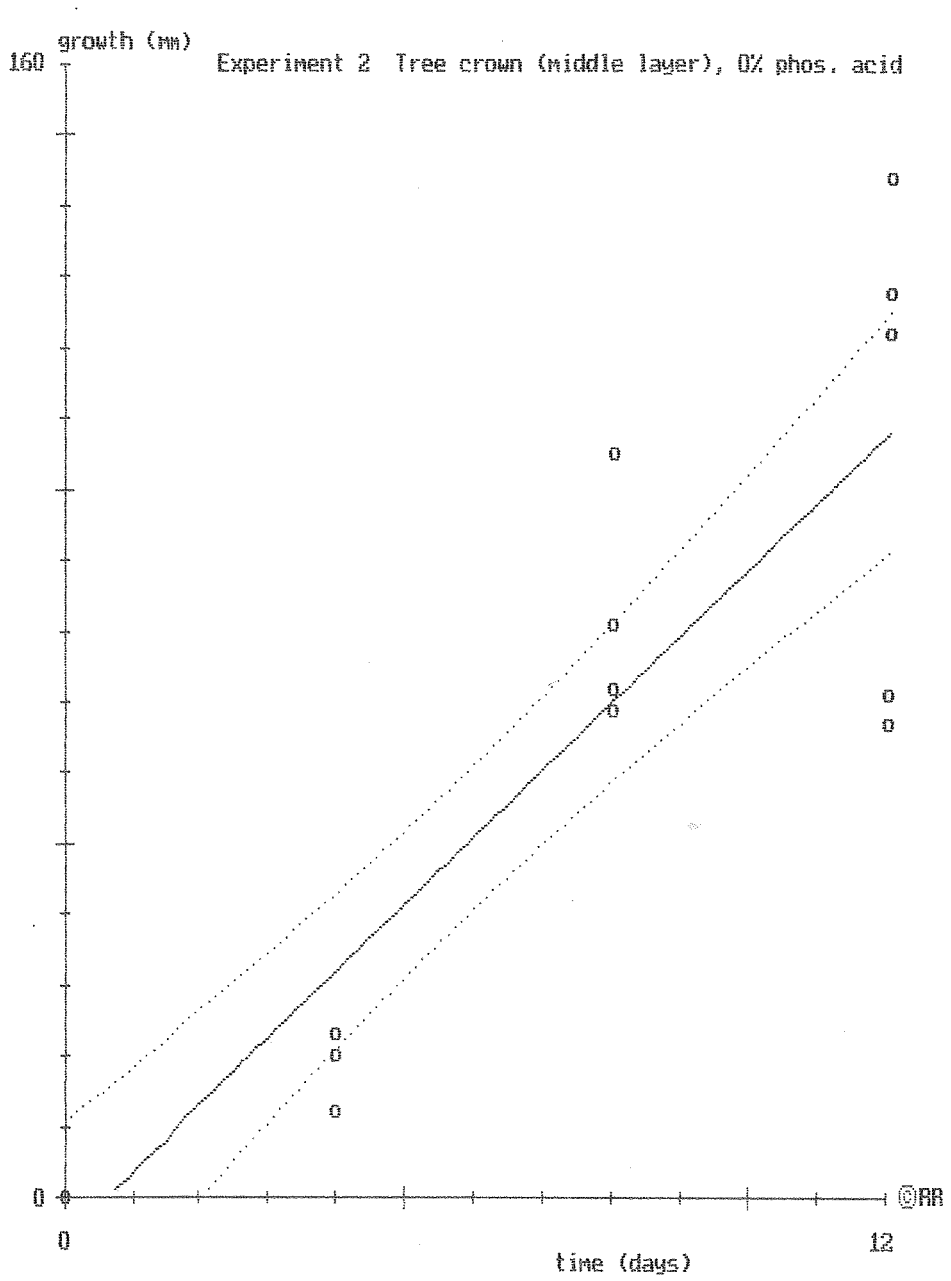
Sum of Squares	Value	Degr.Freedom	Variance
Total	9.0811E+04	19	
Due to regression	8.3232E+04	2	4.1616E+04
Residual	7.5789E+03	17	4.4582E+02

If the model is assumed to be correct, the estimated standard deviation of Y is 2.1114E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 19 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 6.140E+00	- 2.283E+01	1.055E+01
2	0.000E+00	0.000E+00	- 6.140E+00	- 2.283E+01	1.055E+01
3	0.000E+00	0.000E+00	- 6.140E+00	- 2.283E+01	1.055E+01
4	0.000E+00	0.000E+00	- 6.140E+00	- 2.283E+01	1.055E+01
5	0.000E+00	0.000E+00	- 6.140E+00	- 2.283E+01	1.055E+01
6	4.000E+00	1.200E+01	3.192E+01	2.085E+01	4.298E+01
7	4.000E+00	1.200E+01	3.192E+01	2.085E+01	4.298E+01
8	4.000E+00	2.000E+01	3.192E+01	2.085E+01	4.298E+01
9	4.000E+00	2.300E+01	3.192E+01	2.085E+01	4.298E+01
10	4.000E+00	2.300E+01	3.192E+01	2.085E+01	4.298E+01
11	8.000E+00	6.900E+01	6.998E+01	5.872E+01	8.123E+01
12	8.000E+00	7.200E+01	6.998E+01	5.872E+01	8.123E+01
13	8.000E+00	8.100E+01	6.998E+01	5.872E+01	8.123E+01
14	8.000E+00	1.050E+02	6.998E+01	5.872E+01	8.123E+01
15	1.200E+01	6.700E+01	1.080E+02	9.097E+01	1.251E+02
16	1.200E+01	7.100E+01	1.080E+02	9.097E+01	1.251E+02
17	1.200E+01	1.220E+02	1.080E+02	9.097E+01	1.251E+02
18	1.200E+01	1.280E+02	1.080E+02	9.097E+01	1.251E+02
19	1.200E+01	1.440E+02	1.080E+02	9.097E+01	1.251E+02

-RR-



o original points
..... 95% confidence interval

Figure 2B

Exp 2 Tree crown (high), 0% phos.acid

Function obtained:
Y = +(9.37 +- 0.81)*(X)
    -(6.3 +- 6.1)*(1)

Analysis of Variance

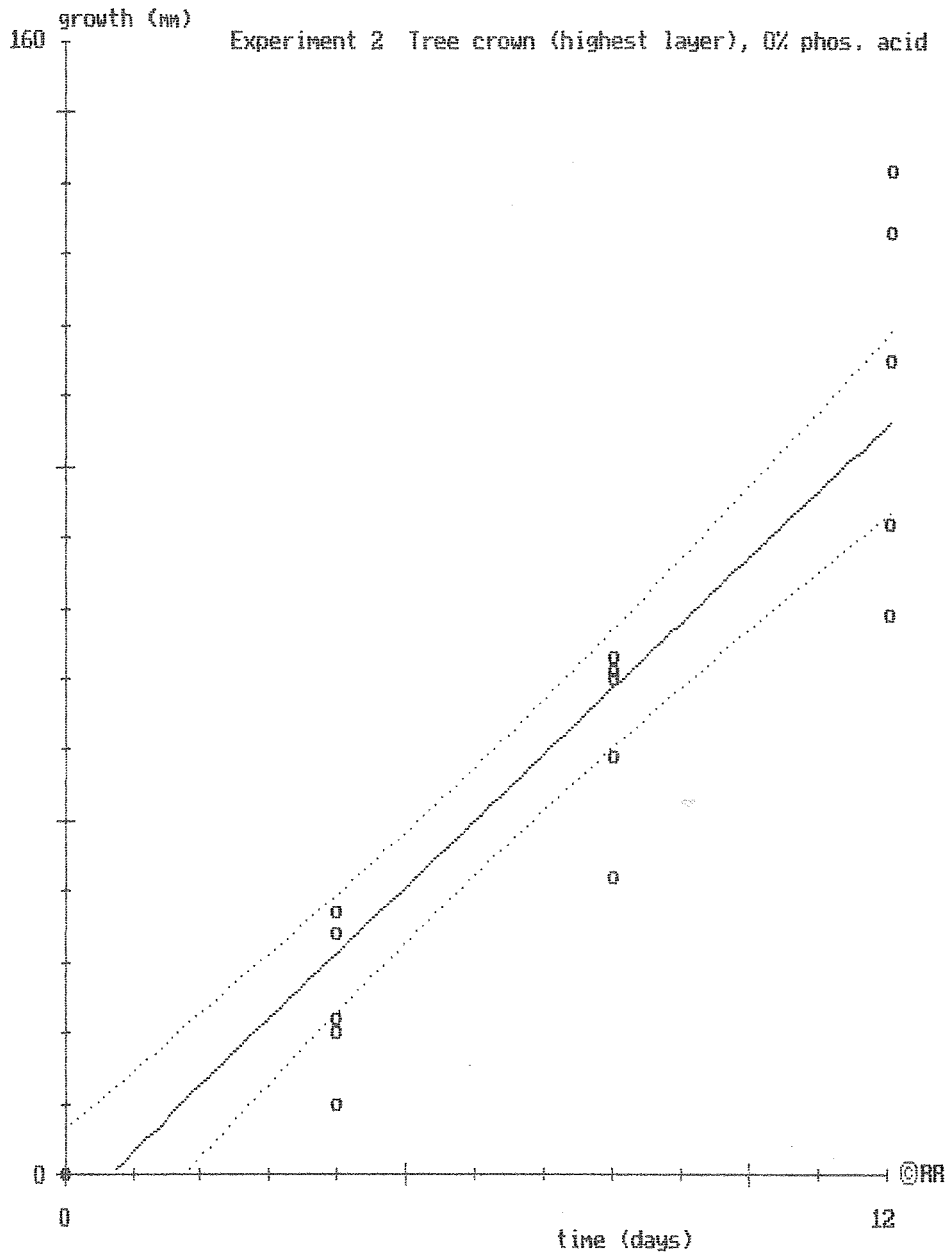
Sum of Squares	Value	Degr.Freedom	Variance
Total	8.9807E+04	20	
Due to regression	8.5056E+04	2	4.2528E+04
Residual	4.7507E+03	18	2.6393E+02

If the model is assumed to be correct, the estimated standard deviation of Y is 1.6246E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 20 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 6.300E+00	- 1.907E+01	6.471E+00
2	0.000E+00	0.000E+00	- 6.300E+00	- 1.907E+01	6.471E+00
3	0.000E+00	0.000E+00	- 6.300E+00	- 1.907E+01	6.471E+00
4	0.000E+00	0.000E+00	- 6.300E+00	- 1.907E+01	6.471E+00
5	0.000E+00	0.000E+00	- 6.300E+00	- 1.907E+01	6.471E+00
6	4.000E+00	1.000E+01	3.120E+01	2.284E+01	3.956E+01
7	4.000E+00	2.000E+01	3.120E+01	2.284E+01	3.956E+01
8	4.000E+00	2.200E+01	3.120E+01	2.284E+01	3.956E+01
9	4.000E+00	3.400E+01	3.120E+01	2.284E+01	3.956E+01
10	4.000E+00	3.700E+01	3.120E+01	2.284E+01	3.956E+01
11	8.000E+00	4.200E+01	6.870E+01	6.034E+01	7.706E+01
12	8.000E+00	5.900E+01	6.870E+01	6.034E+01	7.706E+01
13	8.000E+00	7.000E+01	6.870E+01	6.034E+01	7.706E+01
14	8.000E+00	7.100E+01	6.870E+01	6.034E+01	7.706E+01
15	8.000E+00	7.300E+01	6.870E+01	6.034E+01	7.706E+01
16	1.200E+01	7.900E+01	1.062E+02	9.343E+01	1.190E+02
17	1.200E+01	9.200E+01	1.062E+02	9.343E+01	1.190E+02
18	1.200E+01	1.150E+02	1.062E+02	9.343E+01	1.190E+02
19	1.200E+01	1.330E+02	1.062E+02	9.343E+01	1.190E+02
20	1.200E+01	1.420E+02	1.062E+02	9.343E+01	1.190E+02

-RR-



o original points
..... 95% confidence interval

Figure 2C

Exp 2 Tree crown (low), 10% phos. acid

Function obtained:
Y = +(2.91 +- 0.78)*(X)
    -(5.8 +- 5.8)*(1)

Analysis of Variance

Sum of Squares	Value	Degr.Freedom	Variance
Total	1.0496E+04	20	
Due to regression	6.1005E+03	2	3.0503E+03
Residual	4.3953E+03	18	2.4419E+02

If the model is assumed to be correct, the estimated standard deviation of Y is 1.5626E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 20 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 5.774E+00	- 1.806E+01	6.510E+00
2	0.000E+00	0.000E+00	- 5.774E+00	- 1.806E+01	6.510E+00
3	0.000E+00	0.000E+00	- 5.774E+00	- 1.806E+01	6.510E+00
4	0.000E+00	0.000E+00	- 5.774E+00	- 1.806E+01	6.510E+00
5	0.000E+00	0.000E+00	- 5.774E+00	- 1.806E+01	6.510E+00
6	4.000E+00	0.000E+00	5.852E+00	- 2.190E+00	1.389E+01
7	4.000E+00	0.000E+00	5.852E+00	- 2.190E+00	1.389E+01
8	4.000E+00	0.000E+00	5.852E+00	- 2.190E+00	1.389E+01
9	4.000E+00	0.000E+00	5.852E+00	- 2.190E+00	1.389E+01
10	4.000E+00	1.500E+01	5.852E+00	- 2.190E+00	1.389E+01
11	8.000E+00	0.000E+00	1.748E+01	9.436E+00	2.552E+01
12	8.000E+00	0.000E+00	1.748E+01	9.436E+00	2.552E+01
13	8.000E+00	8.000E+00	1.748E+01	9.436E+00	2.552E+01
14	8.000E+00	1.300E+01	1.748E+01	9.436E+00	2.552E+01
15	8.000E+00	8.300E+00	1.748E+01	9.436E+00	2.552E+01
16	1.200E+01	0.000E+00	2.910E+01	1.682E+01	4.139E+01
17	1.200E+01	2.200E+01	2.910E+01	1.682E+01	4.139E+01
18	1.200E+01	4.500E+01	2.910E+01	1.682E+01	4.139E+01
19	1.200E+01	5.800E+01	2.910E+01	1.682E+01	4.139E+01
20	1.200E+01	6.400E+01	2.910E+01	1.682E+01	4.139E+01

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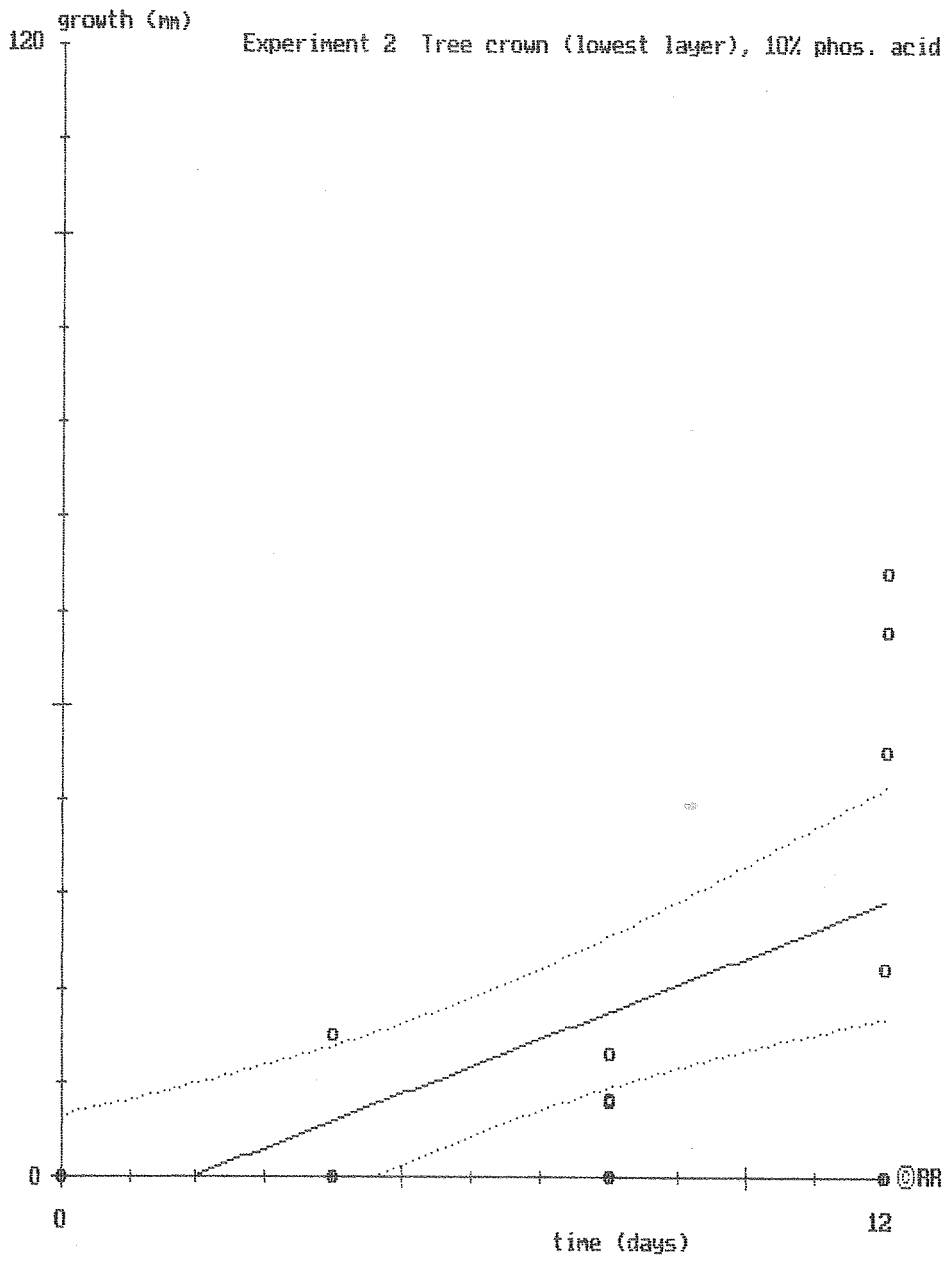


o original points
..... 95% confidence interval

Figure 2D

Exp 2 Tree crown (mid), 10% phos.acid

Function obtained:
Y = +(2.9 +- 1.3)%(X)
    -(0.5 +- 1.0)%E+01%(1)

Analysis of Variance

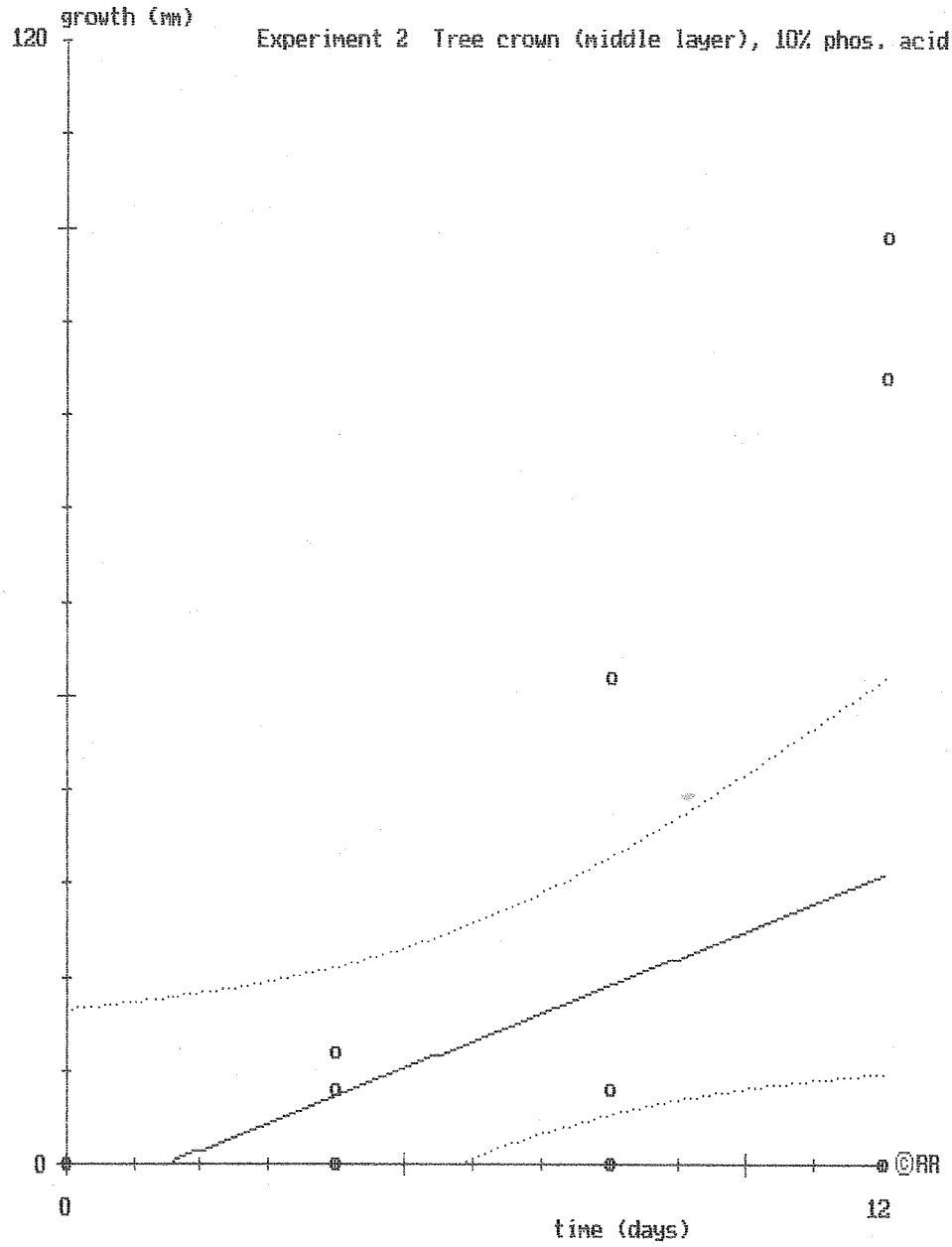
Sum of Squares	Value	Degr.Freedom	Variance
Total	1.9833E+04	20	
Due to regression	6.9277E+03	2	3.4638E+03
Residual	1.2905E+04	18	7.1696E+02

If the model is assumed to be correct, the estimated
standard deviation of Y is 2.6776E+01 (absolute)

The 95% confidence values show the limits between which you can expect
the value of Yreg if you repeat all 20 observations and use the
same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 4.520E+00	- 2.557E+01	1.653E+01
2	0.000E+00	0.000E+00	- 4.520E+00	- 2.557E+01	1.653E+01
3	0.000E+00	0.000E+00	- 4.520E+00	- 2.557E+01	1.653E+01
4	0.000E+00	0.000E+00	- 4.520E+00	- 2.557E+01	1.653E+01
5	0.000E+00	0.000E+00	- 4.520E+00	- 2.557E+01	1.653E+01
6	4.000E+00	0.000E+00	7.260E+00	- 6.520E+00	2.104E+01
7	4.000E+00	0.000E+00	7.260E+00	- 6.520E+00	2.104E+01
8	4.000E+00	0.000E+00	7.260E+00	- 6.520E+00	2.104E+01
9	4.000E+00	8.000E+00	7.260E+00	- 6.520E+00	2.104E+01
10	4.000E+00	1.200E+01	7.260E+00	- 6.520E+00	2.104E+01
11	8.000E+00	0.000E+00	1.904E+01	5.260E+00	3.282E+01
12	8.000E+00	0.000E+00	1.904E+01	5.260E+00	3.282E+01
13	8.000E+00	0.000E+00	1.904E+01	5.260E+00	3.282E+01
14	8.000E+00	8.000E+00	1.904E+01	5.260E+00	3.282E+01
15	8.000E+00	5.200E+01	1.904E+01	5.260E+00	3.282E+01
16	1.200E+01	0.000E+00	3.082E+01	9.771E+00	5.187E+01
17	1.200E+01	0.000E+00	3.082E+01	9.771E+00	5.187E+01
18	1.200E+01	0.000E+00	3.082E+01	9.771E+00	5.187E+01
19	1.200E+01	8.400E+01	3.082E+01	9.771E+00	5.187E+01
20	1.200E+01	9.900E+01	3.082E+01	9.771E+00	5.187E+01

-RR-



o original points
..... 95% confidence interval

Figure 2E

Exp 2 Tree crown (high), 10%phos.acid

Function obtained:
Y = +(3.74 +- 0.59)*(X)
    -(3.8 +- 4.0)*(1)

Analysis of Variance

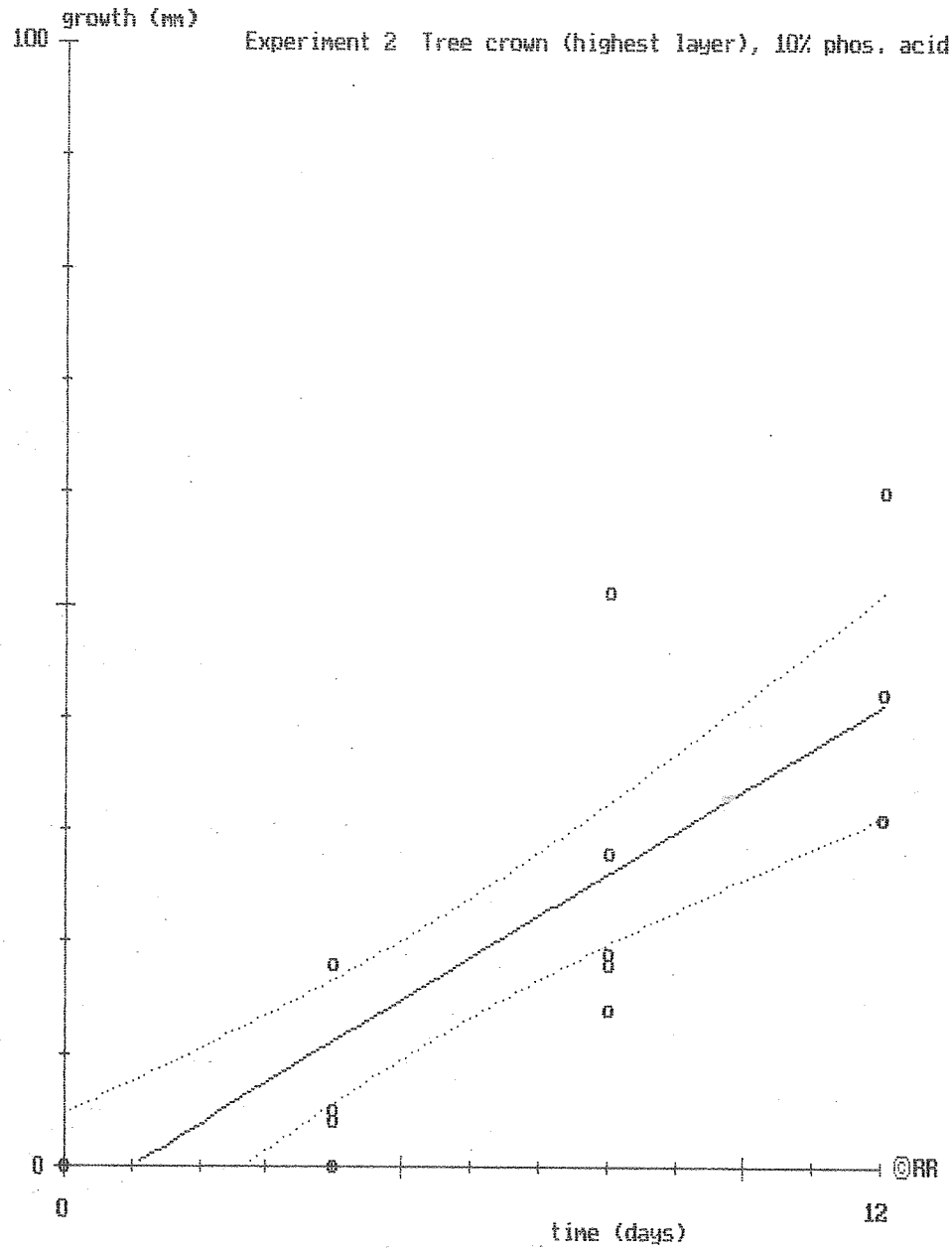
Sum of Squares	Value	Degr.Freedom	Variance
Total	1.0956E+04	18	
Due to regression	9.1522E+03	2	4.5761E+03
Residual	1.8038E+03	16	1.1273E+02

If the model is assumed to be correct, the estimated standard deviation of Y is 1.0618E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 18 observations and use the same type and order of equation to obtain Yreg at X

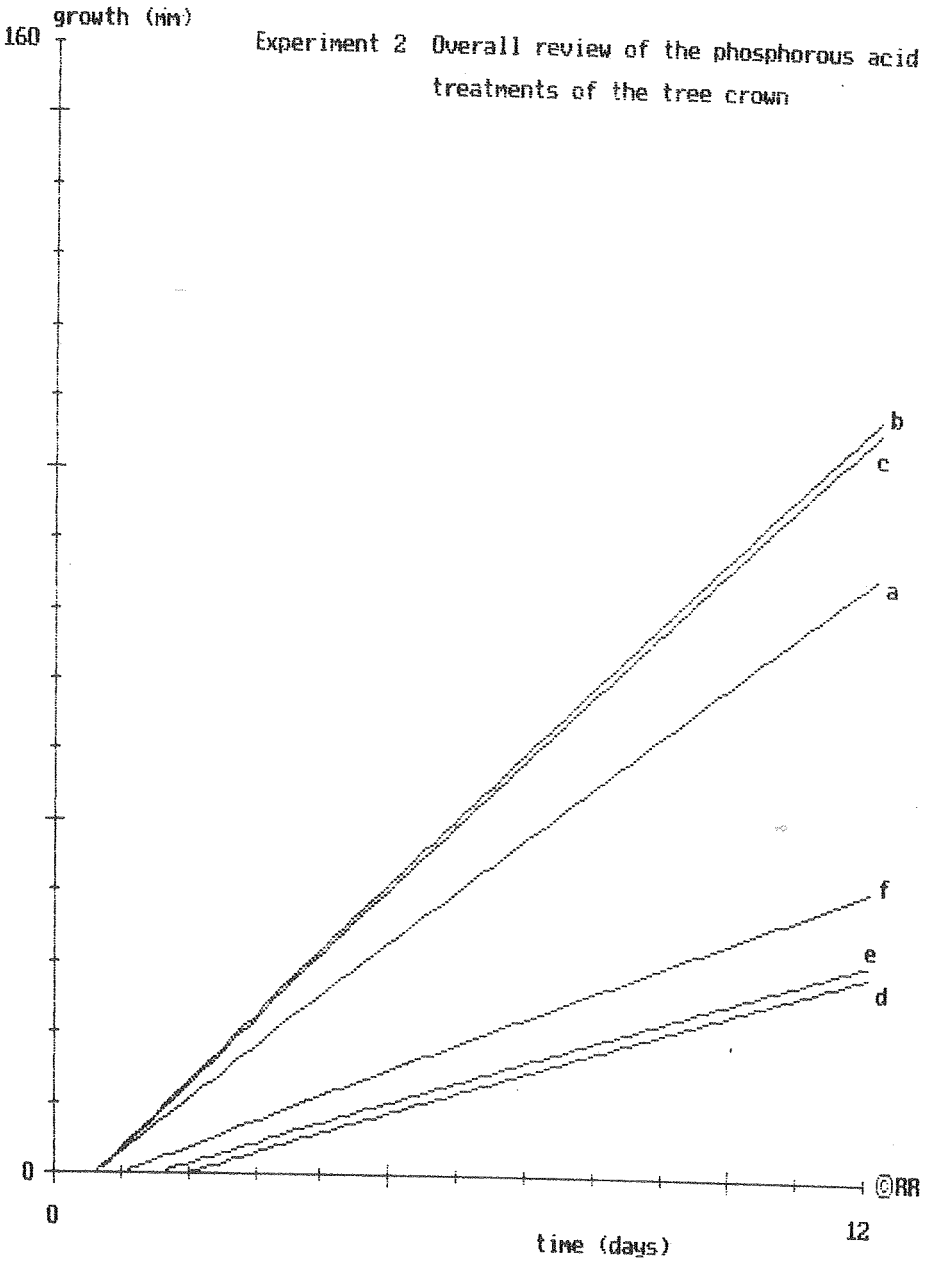
Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 3.844E+00	- 1.240E+01	4.710E+00
2	0.000E+00	0.000E+00	- 3.844E+00	- 1.240E+01	4.710E+00
3	0.000E+00	0.000E+00	- 3.844E+00	- 1.240E+01	4.710E+00
4	0.000E+00	0.000E+00	- 3.844E+00	- 1.240E+01	4.710E+00
5	0.000E+00	0.000E+00	- 3.844E+00	- 1.240E+01	4.710E+00
6	4.000E+00	0.000E+00	1.112E+01	5.558E+00	1.669E+01
7	4.000E+00	0.000E+00	1.112E+01	5.558E+00	1.669E+01
8	4.000E+00	4.000E+00	1.112E+01	5.558E+00	1.669E+01
9	4.000E+00	5.000E+00	1.112E+01	5.558E+00	1.669E+01
10	4.000E+00	1.800E+01	1.112E+01	5.558E+00	1.669E+01
11	8.000E+00	1.400E+01	2.609E+01	1.981E+01	3.237E+01
12	8.000E+00	1.800E+01	2.609E+01	1.981E+01	3.237E+01
13	8.000E+00	1.900E+01	2.609E+01	1.981E+01	3.237E+01
14	8.000E+00	2.800E+01	2.609E+01	1.981E+01	3.237E+01
15	8.000E+00	5.100E+01	2.609E+01	1.981E+01	3.237E+01
16	1.200E+01	3.100E+01	4.106E+01	3.113E+01	5.098E+01
17	1.200E+01	4.200E+01	4.106E+01	3.113E+01	5.098E+01
18	1.200E+01	6.000E+01	4.106E+01	3.113E+01	5.098E+01

RR-



o original points
..... 95% confidence interval

Figure 2F



a : twig samples selected from lowest layer of the canopy of plants treated with water (control)

b : twig samples selected from the middle layer of the canopy of plants treated with water (control)

c : twig samples selected from the highest layer of the canopy of plants treated with water (control)

d : twig samples selected from lowest layer of the canopy of plants, treated with 10% phoshorous acid

e : twig samples selected from the middle layer of the canopy of plants treated with 10% phosphorous acid.

f : twig samples selected from the highest layer of the canopy of plants treated with 10% phosphorous acid

Figure 2G

Experiment 3: The comparison of different concentrations of phosphorous acid, injected at the same time

DEP VAR: GROWTH N: 25 MULTIPLE R: 0.501 SQUARED MULTIPLE R: 0.251

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REPLICA	0.080	1	0.080	0.001	0.982
CONCENT	1008.360	4	252.140	1.590	0.218
ERROR	3013.520	19	158.606		

TABLE 10 Day 4

5 CASES DELETED DUE TO MISSING DATA.

DEP VAR: GROWTH N: 70 MULTIPLE R: 0.740 SQUARED MULTIPLE R: 0.547

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
CONCENT	8241.116	4	2060.279	2.360	0.065
DAY	43481.216	2	21740.608	24.900	0.000
CONCENT*DAY	7051.530	8	881.441	1.010	0.440
ERROR	48021.717	55	873.122		

WARNING: CASE 44 IS AN OUTLIER (STUDENTIZED RESIDUAL = 3.516)

DURBIN-WATSON D STATISTIC 2.372
FIRST ORDER AUTOCORRELATION -.198

RESIDUALS HAVE BEEN SAVED

TABLE 9 Overall analysis

Experiment 3: The comparison of different concentrations of phosphorous acid, injected at the same time

3 CASES DELETED DUE TO MISSING DATA.

DEP VAR: GROWTH N: 22 MULTIPLE R: 0.437 SQUARED MULTIPLE R: 0.191

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
CONCENT	2287.832	4	571.958	0.767	0.562
REPLICA	442.864	1	442.864	0.594	0.452
ERROR	11928.986	16	745.562		

TABLE 11 Day 8

3 CASES DELETED DUE TO MISSING DATA.

DEP VAR: GROWTH N: 23 MULTIPLE R: 0.519 SQUARED MULTIPLE R: 0.269

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REPLICA	30.857	1	30.857	0.016	0.901
CONCENT	11985.559	4	2996.390	1.562	0.230
ERROR	32605.410	17	1917.965		

TABLE 12 Day 12

Experiment 3 Trees, 0% phos. acid

Function obtained:
Y = +(9.4 +- 1.4)*(X)
    -(0.7 +- 1.1)*E+01*(1)

Analysis of Variance

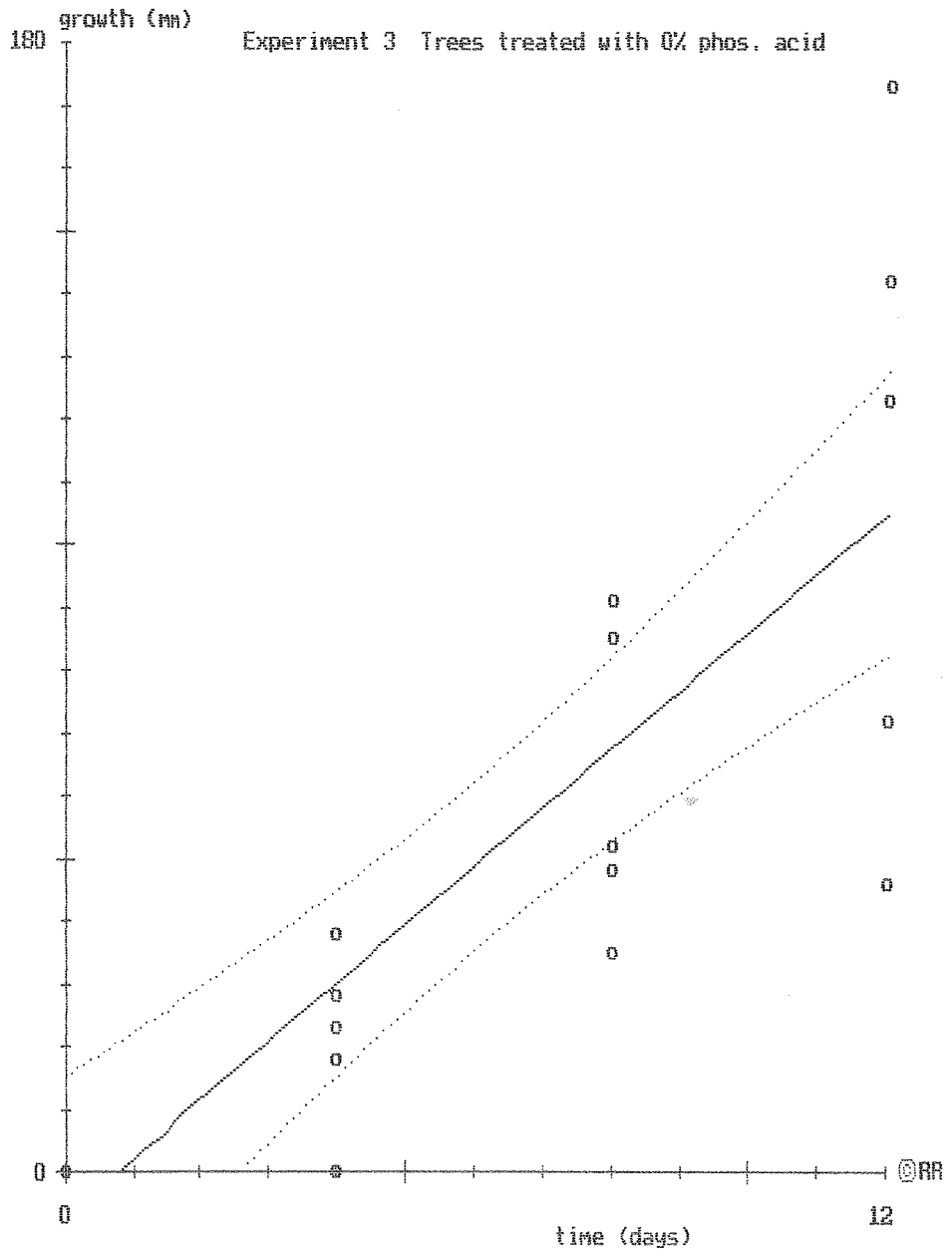
Sum of Squares	Value	Degr.Freedom	Variance
Total	9.7342E+04	20	
Due to regression	8.2478E+04	2	4.1239E+04
Residual	1.4864E+04	18	8.2580E+02

If the model is assumed to be correct, the estimated standard deviation of Y is 2.8737E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 20 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 7.460E+00	- 3.005E+01	1.513E+01
2	0.000E+00	0.000E+00	- 7.460E+00	- 3.005E+01	1.513E+01
3	0.000E+00	0.000E+00	- 7.460E+00	- 3.005E+01	1.513E+01
4	0.000E+00	0.000E+00	- 7.460E+00	- 3.005E+01	1.513E+01
5	0.000E+00	0.000E+00	- 7.460E+00	- 3.005E+01	1.513E+01
6	4.000E+00	3.800E+01	2.998E+01	1.519E+01	4.477E+01
7	4.000E+00	2.300E+01	2.998E+01	1.519E+01	4.477E+01
8	4.000E+00	1.800E+01	2.998E+01	1.519E+01	4.477E+01
9	4.000E+00	2.800E+01	2.998E+01	1.519E+01	4.477E+01
10	4.000E+00	0.000E+00	2.998E+01	1.519E+01	4.477E+01
11	8.000E+00	9.100E+01	6.742E+01	5.263E+01	8.221E+01
12	8.000E+00	5.200E+01	6.742E+01	5.263E+01	8.221E+01
13	8.000E+00	4.800E+01	6.742E+01	5.263E+01	8.221E+01
14	8.000E+00	8.500E+01	6.742E+01	5.263E+01	8.221E+01
15	8.000E+00	3.500E+01	6.742E+01	5.263E+01	8.221E+01
16	1.200E+01	1.230E+02	1.049E+02	8.227E+01	1.275E+02
17	1.200E+01	7.200E+01	1.049E+02	8.227E+01	1.275E+02
18	1.200E+01	1.420E+02	1.049E+02	8.227E+01	1.275E+02
19	1.200E+01	1.730E+02	1.049E+02	8.227E+01	1.275E+02
20	1.200E+01	4.600E+01	1.049E+02	8.227E+01	1.275E+02

-RR-



o original points
..... 95% confidence interval

Figure 3A

Experiment 3 Trees, 1% phos. acid

Function obtained:
Y = +(6.1 +- 1.1)*(X)
    -(1.5 +- 7.2)*(1)

Analysis of Variance

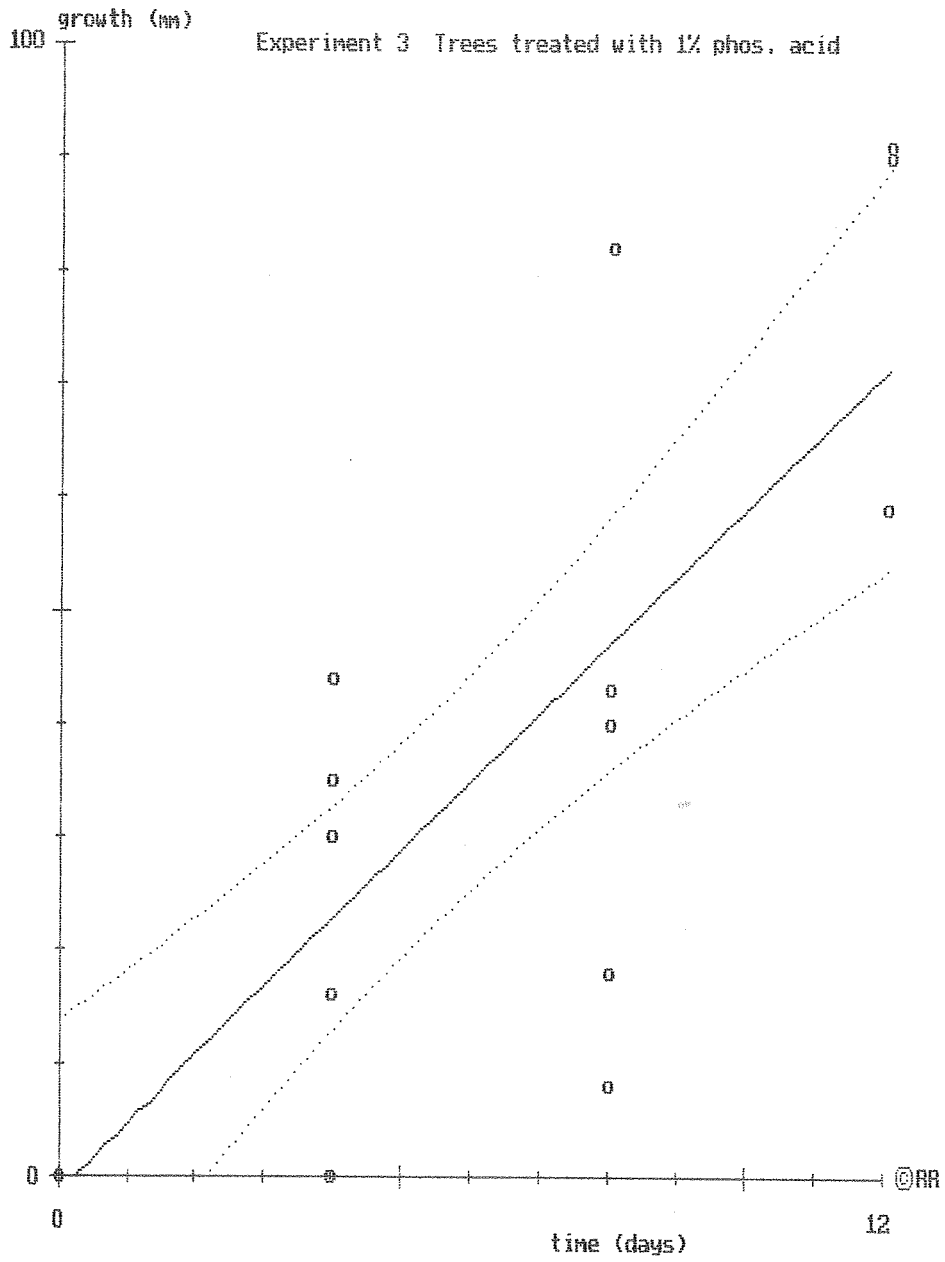
Sum of Squares	Value	Degr.Freedom	Variance
Total	3.4740E+04	18	
Due to regression	2.8968E+04	2	1.4484E+04
Residual	5.7722E+03	16	3.6076E+02

If the model is assumed to be correct, the estimated
standard deviation of Y is 1.8994E+01 (absolute)

The 95% confidence values show the limits between which you can expect
the value of Yreg if you repeat all 18 observations and use the
same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 1.489E+00	- 1.679E+01	1.381E+01
2	0.000E+00	0.000E+00	- 1.489E+00	- 1.679E+01	1.381E+01
3	0.000E+00	0.000E+00	- 1.489E+00	- 1.679E+01	1.381E+01
4	0.000E+00	0.000E+00	- 1.489E+00	- 1.679E+01	1.381E+01
5	0.000E+00	0.000E+00	- 1.489E+00	- 1.679E+01	1.381E+01
6	4.000E+00	3.500E+01	2.279E+01	1.284E+01	3.275E+01
7	4.000E+00	3.000E+01	2.279E+01	1.284E+01	3.275E+01
8	4.000E+00	0.000E+00	2.279E+01	1.284E+01	3.275E+01
9	4.000E+00	1.600E+01	2.279E+01	1.284E+01	3.275E+01
10	4.000E+00	4.400E+01	2.279E+01	1.284E+01	3.275E+01
11	8.000E+00	8.000E+00	4.708E+01	3.585E+01	5.831E+01
12	8.000E+00	4.000E+01	4.708E+01	3.585E+01	5.831E+01
13	8.000E+00	1.800E+01	4.708E+01	3.585E+01	5.831E+01
14	8.000E+00	4.300E+01	4.708E+01	3.585E+01	5.831E+01
15	8.000E+00	8.200E+01	4.708E+01	3.585E+01	5.831E+01
16	1.200E+01	9.100E+01	7.136E+01	5.361E+01	8.912E+01
17	1.200E+01	5.900E+01	7.136E+01	5.361E+01	8.912E+01
18	1.200E+01	9.000E+01	7.136E+01	5.361E+01	8.912E+01

-RR-



o original points
..... 95% confidence interval

Figure 3B

Experiment 3 Trees, 2% phos. acid

Function obtained:
Y = +(6.0 +- 1.9)*(X)
-(0.3 +- 1.5)*E+01*(1)

Analysis of Variance

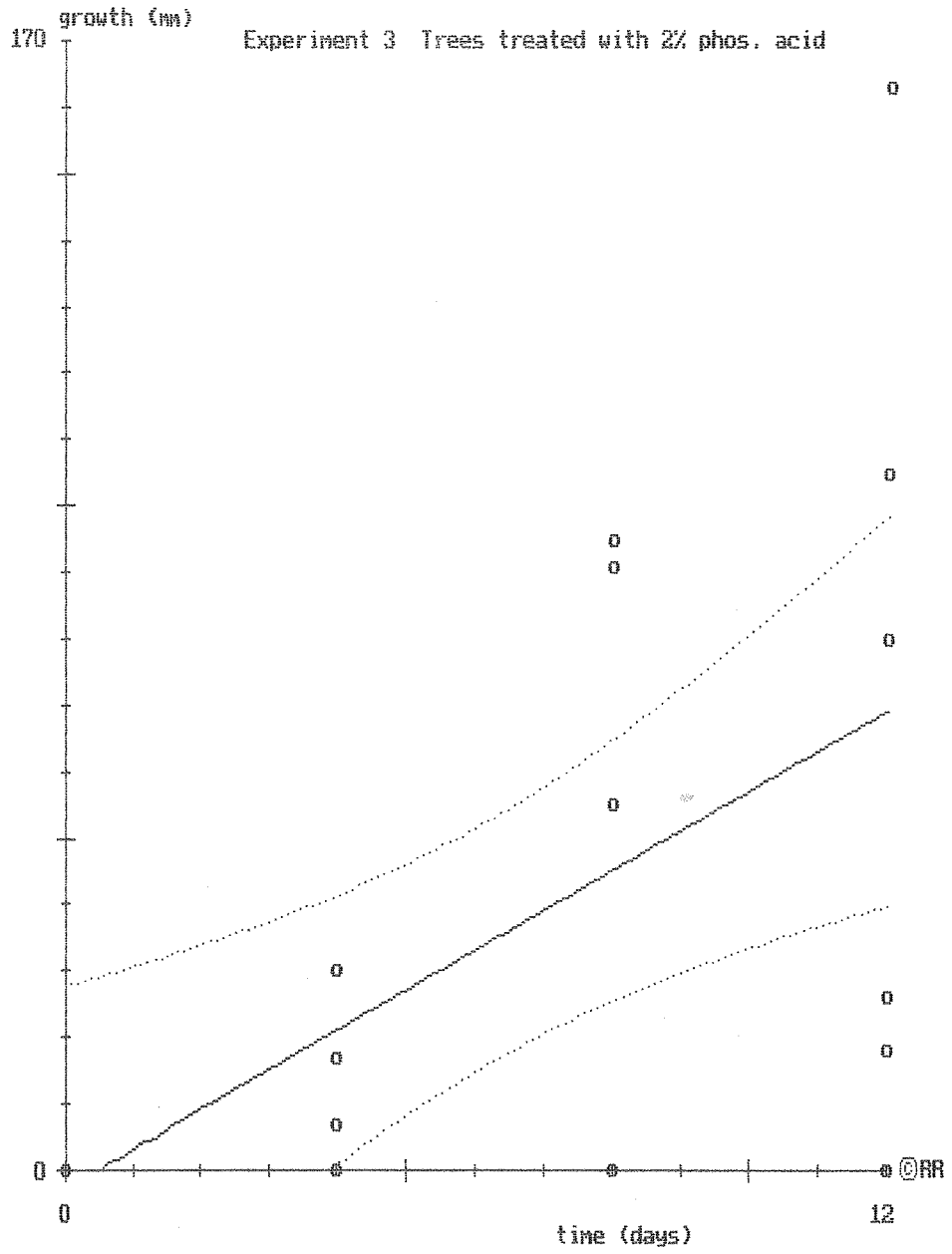
Sum of Squares	Value	Degr.Freedom	Variance
Total	6.6563E+04	20	
Due to regression	3.9138E+04	2	1.9569E+04
Residual	2.7425E+04	18	1.5236E+03

If the model is assumed to be correct, the estimated standard deviation of Y is 3.9033E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 20 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 2.870E+00	- 3.346E+01	2.772E+01
2	0.000E+00	0.000E+00	- 2.870E+00	- 3.346E+01	2.772E+01
3	0.000E+00	0.000E+00	- 2.870E+00	- 3.346E+01	2.772E+01
4	0.000E+00	0.000E+00	- 2.870E+00	- 3.346E+01	2.772E+01
5	0.000E+00	0.000E+00	- 2.870E+00	- 3.346E+01	2.772E+01
6	4.000E+00	0.000E+00	2.114E+01	8.514E-01	4.143E+01
7	4.000E+00	7.000E+00	2.114E+01	8.514E-01	4.143E+01
8	4.000E+00	0.000E+00	2.114E+01	8.514E-01	4.143E+01
9	4.000E+00	3.000E+01	2.114E+01	8.514E-01	4.143E+01
10	4.000E+00	1.700E+01	2.114E+01	8.514E-01	4.143E+01
11	1.200E+01	0.000E+00	6.917E+01	3.983E+01	9.851E+01
12	8.000E+00	9.100E+01	4.516E+01	2.549E+01	6.482E+01
13	8.000E+00	0.000E+00	4.516E+01	2.549E+01	6.482E+01
14	8.000E+00	9.500E+01	4.516E+01	2.549E+01	6.482E+01
15	8.000E+00	5.500E+01	4.516E+01	2.549E+01	6.482E+01
16	1.200E+01	1.800E+01	6.917E+01	3.983E+01	9.851E+01
17	1.200E+01	1.050E+02	6.917E+01	3.983E+01	9.851E+01
18	1.200E+01	8.000E+01	6.917E+01	3.983E+01	9.851E+01
19	1.200E+01	1.630E+02	6.917E+01	3.983E+01	9.851E+01
20	1.200E+01	2.600E+01	6.917E+01	3.983E+01	9.851E+01

-RR-



o original points
..... 95% confidence interval

Figure 3C

Experiment 3 Trees, 5% phos. acid

Function obtained:
Y = +(3.9 +- 1.1)*(X)
    -(0.3 +- 8.5)*(1)

Analysis of Variance

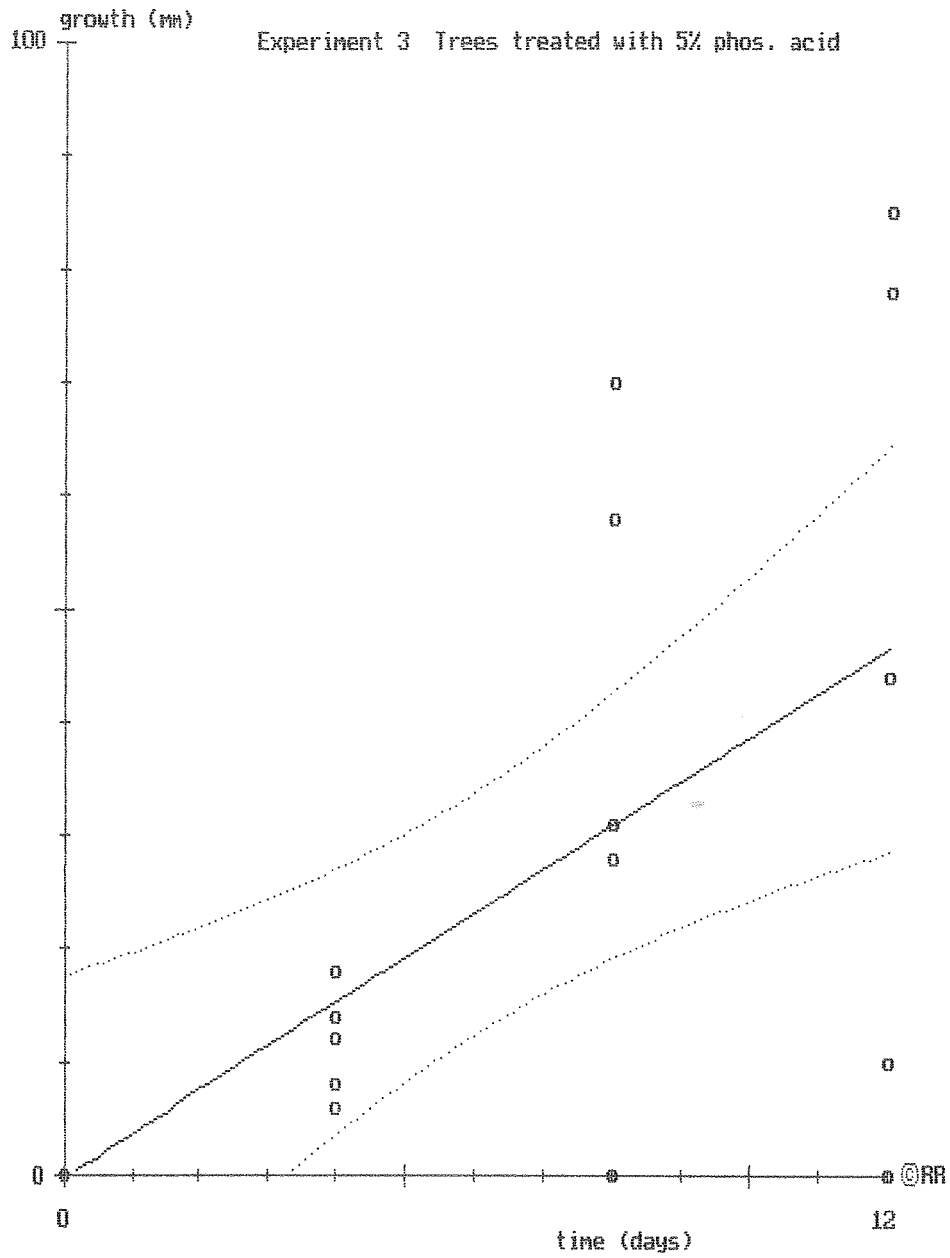
Sum of Squares	Value	Degr.Freedom	Variance
Total	2.6118E+04	20	
Due to regression	1.6756E+04	2	8.3781E+03
Residual	9.3618E+03	18	5.2010E+02

If the model is assumed to be correct, the estimated standard deviation of Y is 2.2806E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 20 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 3.000E-01	- 1.823E+01	1.763E+01
2	0.000E+00	0.000E+00	- 3.000E-01	- 1.823E+01	1.763E+01
3	0.000E+00	0.000E+00	- 3.000E-01	- 1.823E+01	1.763E+01
4	0.000E+00	0.000E+00	- 3.000E-01	- 1.823E+01	1.763E+01
5	0.000E+00	0.000E+00	- 3.000E-01	- 1.823E+01	1.763E+01
6	4.000E+00	8.000E+00	1.530E+01	3.564E+00	2.704E+01
7	4.000E+00	1.800E+01	1.530E+01	3.564E+00	2.704E+01
8	4.000E+00	1.400E+01	1.530E+01	3.564E+00	2.704E+01
9	4.000E+00	6.000E+00	1.530E+01	3.564E+00	2.704E+01
10	4.000E+00	1.200E+01	1.530E+01	3.564E+00	2.704E+01
11	8.000E+00	0.000E+00	3.090E+01	1.916E+01	4.264E+01
12	8.000E+00	2.800E+01	3.090E+01	1.916E+01	4.264E+01
13	8.000E+00	5.800E+01	3.090E+01	1.916E+01	4.264E+01
14	8.000E+00	3.100E+01	3.090E+01	1.916E+01	4.264E+01
15	8.000E+00	7.000E+01	3.090E+01	1.916E+01	4.264E+01
16	1.200E+01	0.000E+00	4.650E+01	2.857E+01	6.443E+01
17	1.200E+01	1.000E+01	4.650E+01	2.857E+01	6.443E+01
18	1.200E+01	4.400E+01	4.650E+01	2.857E+01	6.443E+01
19	1.200E+01	7.800E+01	4.650E+01	2.857E+01	6.443E+01
20	1.200E+01	8.500E+01	4.650E+01	2.857E+01	6.443E+01

-RR-



o original points
..... 95% confidence interval

Figure 3D

Experiment 3 Trees, 10% phos. acid

Function obtained:
Y = +(4.20 +- 0.74)*(X)
    -(2.0 +- 5.6)*(1)

Analysis of Variance

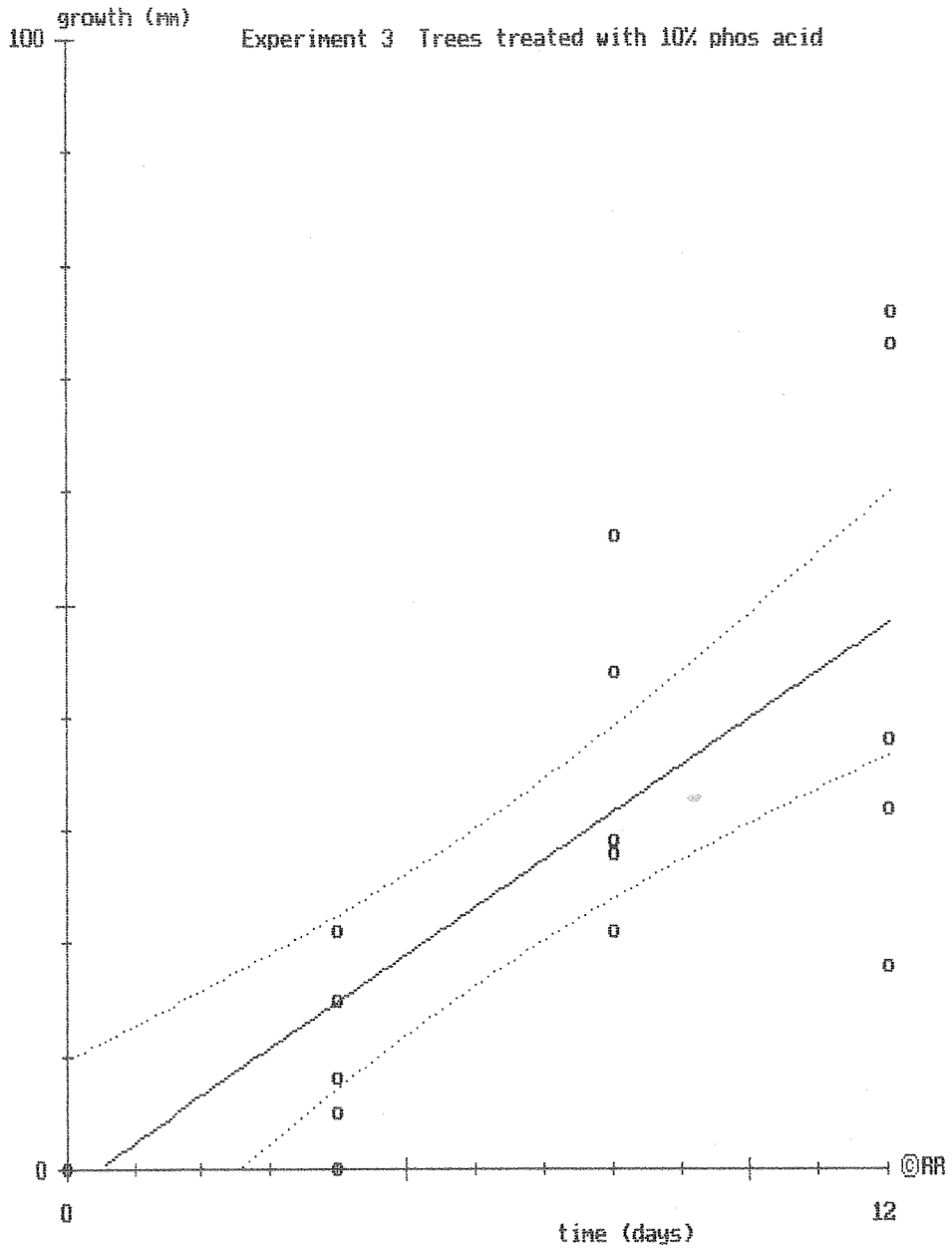
Sum of Squares	Value	Degr.Freedom	Variance
Total	2.1790E+04	20	
Due to regression	1.7821E+04	2	8.9104E+03
Residual	3.9692E+03	18	2.2051E+02

If the model is assumed to be correct, the estimated
standard deviation of Y is 1.4850E+01 (absolute)

The 95% confidence values show the limits between which you can expect
the value of Yreg if you repeat all 20 observations and use the
same type and order of equation to obtain Yreg at X

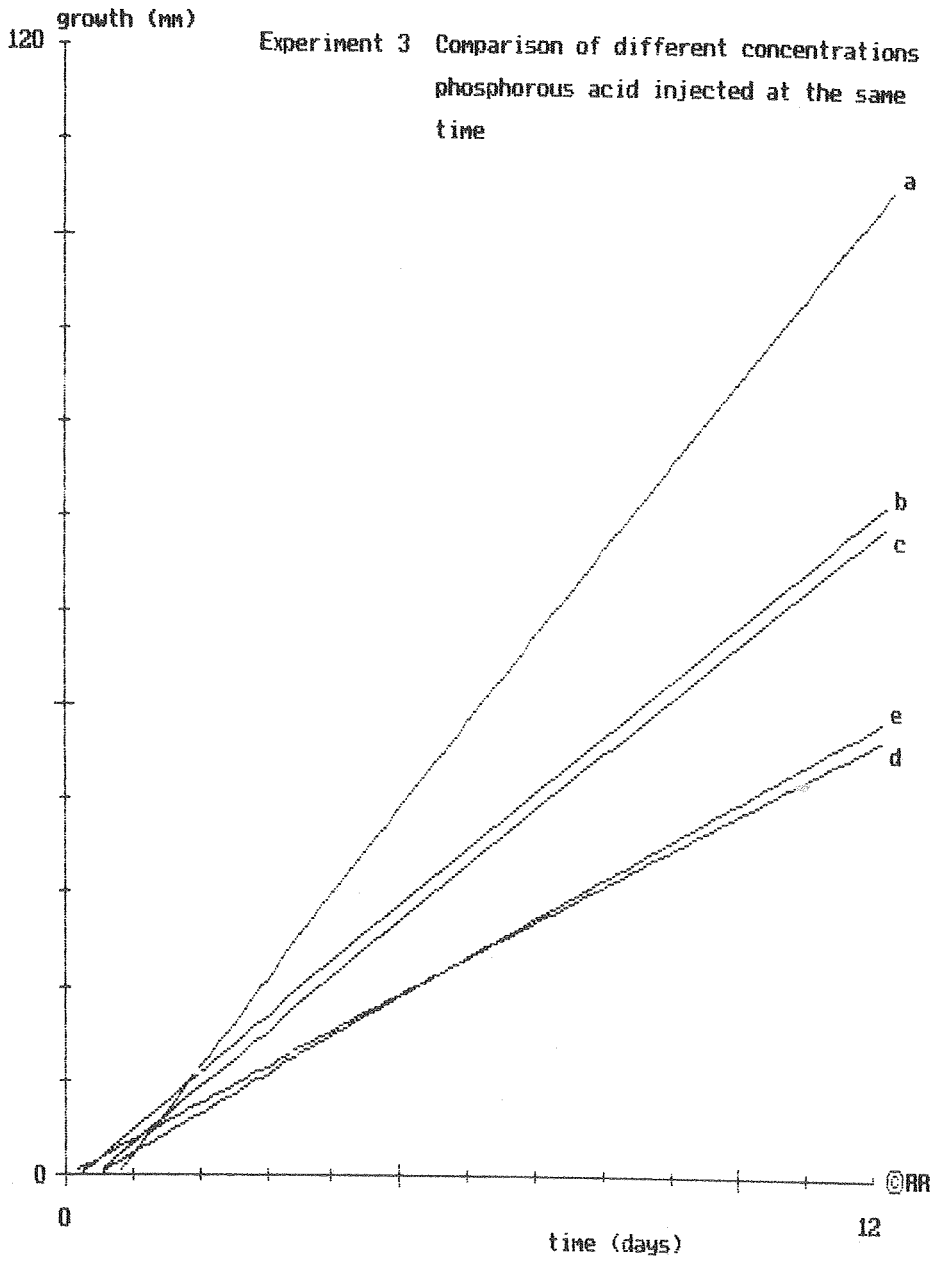
Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 2.000E+00	- 1.367E+01	9.673E+00
2	0.000E+00	0.000E+00	- 2.000E+00	- 1.367E+01	9.673E+00
3	0.000E+00	0.000E+00	- 2.000E+00	- 1.367E+01	9.673E+00
4	0.000E+00	0.000E+00	- 2.000E+00	- 1.367E+01	9.673E+00
5	0.000E+00	0.000E+00	- 2.000E+00	- 1.367E+01	9.673E+00
6	4.000E+00	0.000E+00	1.480E+01	7.158E+00	2.244E+01
7	4.000E+00	5.000E+00	1.480E+01	7.158E+00	2.244E+01
8	4.000E+00	8.000E+00	1.480E+01	7.158E+00	2.244E+01
9	4.000E+00	1.500E+01	1.480E+01	7.158E+00	2.244E+01
10	4.000E+00	2.100E+01	1.480E+01	7.158E+00	2.244E+01
11	8.000E+00	2.100E+01	3.160E+01	2.396E+01	3.924E+01
12	8.000E+00	2.800E+01	3.160E+01	2.396E+01	3.924E+01
13	8.000E+00	2.900E+01	3.160E+01	2.396E+01	3.924E+01
14	8.000E+00	4.400E+01	3.160E+01	2.396E+01	3.924E+01
15	8.000E+00	5.600E+01	3.160E+01	2.396E+01	3.924E+01
16	1.200E+01	1.800E+01	4.840E+01	3.673E+01	6.007E+01
17	1.200E+01	3.200E+01	4.840E+01	3.673E+01	6.007E+01
18	1.200E+01	3.800E+01	4.840E+01	3.673E+01	6.007E+01
19	1.200E+01	7.300E+01	4.840E+01	3.673E+01	6.007E+01
20	1.200E+01	7.600E+01	4.840E+01	3.673E+01	6.007E+01

-RR-



o original points
..... 95% confidence interval

Figure 3E



a : control samples

b : twig samples selected from plants treated with 1% phosphorous acid

c : twig samples selected from plants treated with 2% phosphorous acid

d : twig samples selected from plants treated with 5% phosphorous acid

e : twig samples selected from plants treated with 10% phoshorous acid

Figure 3F

Experiment 4: The duration of phosphorous acid within a tree

```
LEVELS ENCOUNTERED DURING PROCESSING ARE:
CONC
          1.000          2.000          3.000          4.000          5.000          6.000
DAY
          1.000          2.000          3.000

     3 CASES DELETED DUE TO MISSING DATA.


DEP VAR:  GROWTH       N:       88  MULTIPLE R: 0.752  SQUARED MULTIPLE R: 0.566

                         ANALYSIS OF VARIANCE

SOURCE          SUM-OF-SQUARES   DF  MEAN-SQUARE      F-RATIO        P

CONC                  2066.684    5      413.337        0.656    0.658
DAY                  48480.597    2    24240.299       38.482    0.000
CONC*DAY              4777.785   10      477.778        0.758    0.667

ERROR                44094.000   70      629.914

WARNING: CASE     14 IS AN OUTLIER (STUDENTIZED RESIDUAL =      -2.728)
WARNING: CASE     73 IS AN OUTLIER (STUDENTIZED RESIDUAL =       2.842)
WARNING: CASE     87 IS AN OUTLIER (STUDENTIZED RESIDUAL =       2.742)

DURBIN-WATSON D STATISTIC     1.992
FIRST ORDER AUTOCORRELATION  -.009

RESIDUALS HAVE BEEN SAVED
```

TABLE 13 Overall analysis

```
Analytical options

Utilities    Files    Data    Graph    Statistics

LEVELS ENCOUNTERED DURING PROCESSING ARE:
CONCENT
          1.000          2.000          3.000          4.000          5.000          6.000

DEP VAR:  GROWTH       N:       30  MULTIPLE R: 0.554  SQUARED MULTIPLE R: 0.307

                         ANALYSIS OF VARIANCE

SOURCE          SUM-OF-SQUARES   DF  MEAN-SQUARE      F-RATIO        P

REPLICA              [illegible]    1      [illegible]        8.218    0.009
CONCENT              [illegible]    5       20.853        0.392    0.849

ERROR                [illegible]   23       53.226
```

TABLE 14 Day 4

Experiment 4: The duration of phosphorous acid within a tree

Utilities Files Data Graph Statistics
LEVELS ENCOUNTERED DURING PROCESSING ARE:
CONCENT

1.000	2.000	3.000	4.000	5.000	6.000

1 CASES DELETED DUE TO MISSING DATA.

DEP VAR: GROWTH N: 30 MULTIPLE R: 0.392 SQUARED MULTIPLE R: 0.153

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
CONCENT	1510.533	5	302.107	0.711	0.621
REPLICA	142.584	1	142.884	0.336	0.568
ERROR	9768.266	23	424.707		

TABLE 15 Day 8

Utilities Files Data Graph Statistics
LEVELS ENCOUNTERED DURING PROCESSING ARE:
CONCENT

1.000	2.000	3.000	4.000	5.000	6.000

2 CASES DELETED DUE TO MISSING DATA.

DEP VAR: GROWTH N: 28 MULTIPLE R: 0.420 SQUARED MULTIPLE R: 0.176

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REPLICA	1641.645	1	1641.645	1.117	0.303
CONCENT	5631.251	5	1126.250	0.766	0.584
ERROR	30859.505	21	1469.500		

TABLE 16 Day 12

Exp 4 Duration of phos.acid (control)

Function obtained:
Y = +(5.92 +- 0.95)%E-01%(X%X)
    -(0.3 +- 7.6)%(1)

Analysis of Variance

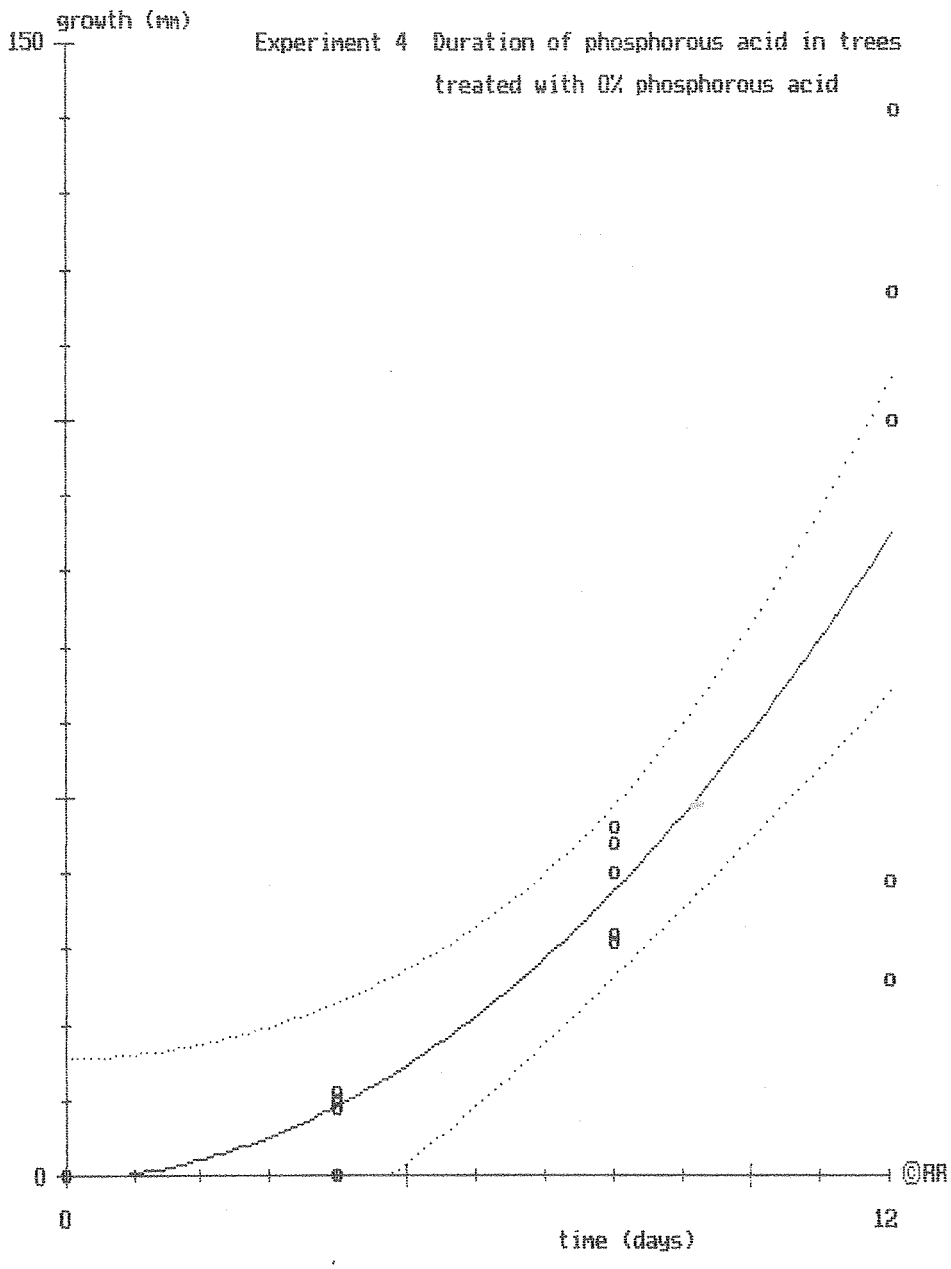
Sum of Squares	Value	Degr.Freedom	Variance
Total	5.3827E+04	20	
Due to regression	4.3561E+04	2	2.1780E+04
Residual	1.0266E+04	18	5.7034E+02

If the model is assumed to be correct, the estimated
standard deviation of Y is 2.3882E+01 (absolute)

The 95% confidence values show the limits between which you can expect
the value of Yreg if you repeat all 20 observations and use the
same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 3.000E-01	- 1.617E+01	1.557E+01
2	0.000E+00	0.000E+00	- 3.000E-01	- 1.617E+01	1.557E+01
3	0.000E+00	0.000E+00	- 3.000E-01	- 1.617E+01	1.557E+01
4	0.000E+00	0.000E+00	- 3.000E-01	- 1.617E+01	1.557E+01
5	0.000E+00	0.000E+00	- 3.000E-01	- 1.617E+01	1.557E+01
6	4.000E+00	9.000E+00	9.171E+00	- 4.616E+00	2.296E+01
7	4.000E+00	1.100E+01	9.171E+00	- 4.616E+00	2.296E+01
8	4.000E+00	1.100E+01	9.171E+00	- 4.616E+00	2.296E+01
9	4.000E+00	1.000E+01	9.171E+00	- 4.616E+00	2.296E+01
10	4.000E+00	0.000E+00	9.171E+00	- 4.616E+00	2.296E+01
11	8.000E+00	4.600E+01	3.759E+01	2.625E+01	4.892E+01
12	8.000E+00	4.400E+01	3.759E+01	2.625E+01	4.892E+01
13	8.000E+00	3.200E+01	3.759E+01	2.625E+01	4.892E+01
14	8.000E+00	3.100E+01	3.759E+01	2.625E+01	4.892E+01
15	8.000E+00	4.000E+01	3.759E+01	2.625E+01	4.892E+01
16	1.200E+01	1.000E+02	8.494E+01	6.405E+01	1.058E+02
17	1.200E+01	3.900E+01	8.494E+01	6.405E+01	1.058E+02
18	1.200E+01	2.600E+01	8.494E+01	6.405E+01	1.058E+02
19	1.200E+01	1.170E+02	8.494E+01	6.405E+01	1.058E+02
20	1.200E+01	1.410E+02	8.494E+01	6.405E+01	1.058E+02

-RR-



o original points
..... 95% confidence interval

Figure 4A

Exp 4 Trees, 5% phos. acid (recently)

Function obtained:
Y = +(5.47 +- 0.77)*E-01*(X*X)
-(4.3 +- 6.1)*(1)

Analysis of Variance

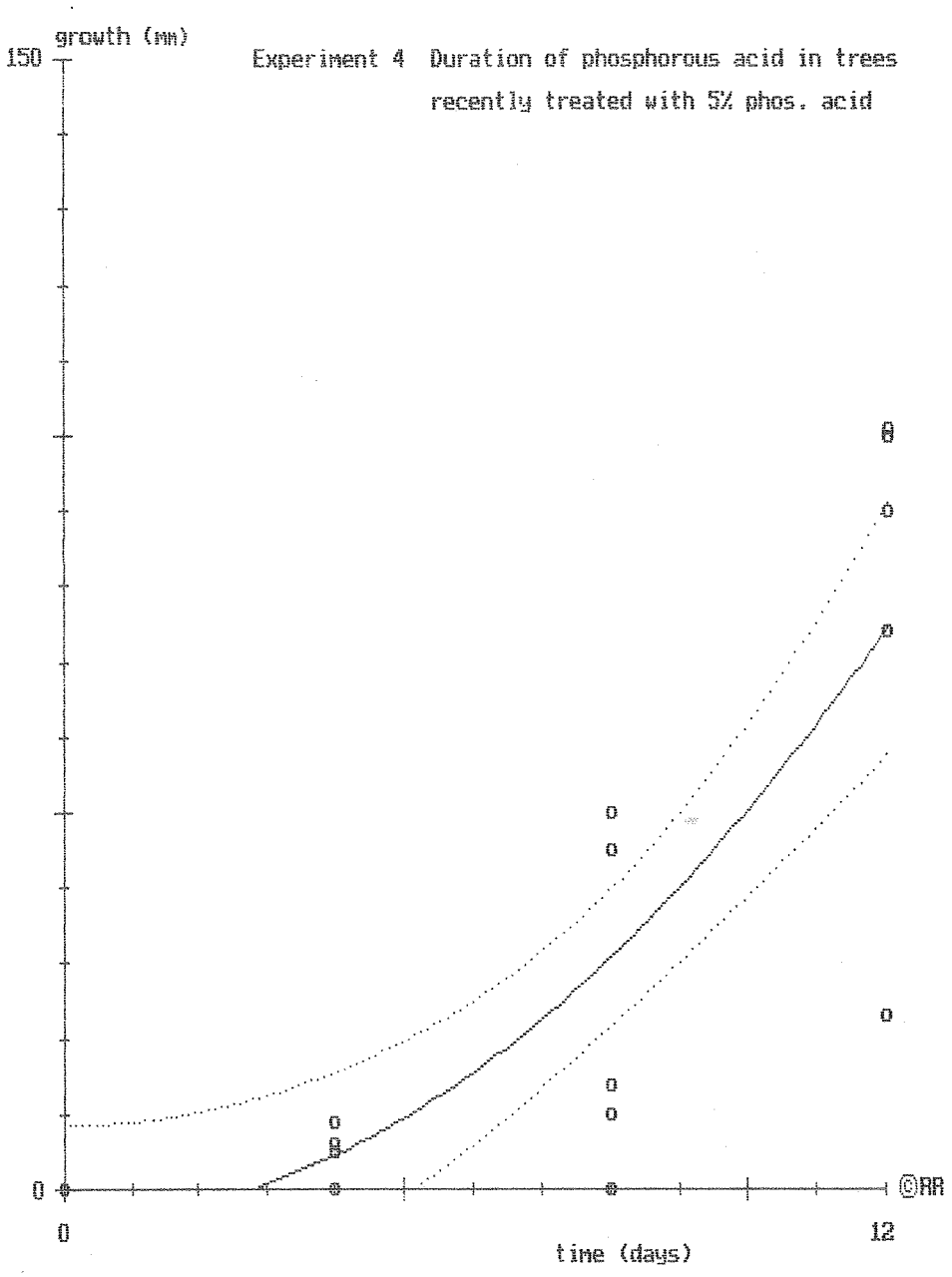
Sum of Squares	Value	Degr.Freedom	Variance
Total	3.9269E+04	20	
Due to regression	3.2640E+04	2	1.6320E+04
Residual	6.6291E+03	18	3.6828E+02

If the model is assumed to be correct, the estimated standard deviation of Y is 1.9191E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 20 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 4.271E+00	- 1.702E+01	8.479E+00
2	0.000E+00	0.000E+00	- 4.271E+00	- 1.702E+01	8.479E+00
3	0.000E+00	0.000E+00	- 4.271E+00	- 1.702E+01	8.479E+00
4	0.000E+00	0.000E+00	- 4.271E+00	- 1.702E+01	8.479E+00
5	0.000E+00	0.000E+00	- 4.271E+00	- 1.702E+01	8.479E+00
6	4.000E+00	5.000E+00	4.478E+00	- 6.602E+00	1.556E+01
7	4.000E+00	0.000E+00	4.478E+00	- 6.602E+00	1.556E+01
8	4.000E+00	9.000E+00	4.478E+00	- 6.602E+00	1.556E+01
9	4.000E+00	0.000E+00	4.478E+00	- 6.602E+00	1.556E+01
10	4.000E+00	6.000E+00	4.478E+00	- 6.602E+00	1.556E+01
11	8.000E+00	0.000E+00	3.072E+01	2.162E+01	3.983E+01
12	8.000E+00	4.500E+01	3.072E+01	2.162E+01	3.983E+01
13	8.000E+00	1.000E+01	3.072E+01	2.162E+01	3.983E+01
14	8.000E+00	5.000E+01	3.072E+01	2.162E+01	3.983E+01
15	8.000E+00	1.400E+01	3.072E+01	2.162E+01	3.983E+01
16	1.200E+01	9.000E+01	7.447E+01	5.768E+01	9.126E+01
17	1.200E+01	1.000E+02	7.447E+01	5.768E+01	9.126E+01
18	1.200E+01	1.010E+02	7.447E+01	5.768E+01	9.126E+01
19	1.200E+01	7.400E+01	7.447E+01	5.768E+01	9.126E+01
20	1.200E+01	2.300E+01	7.447E+01	5.768E+01	9.126E+01

RR-



o original points
..... 95% confidence interval

Figure 4B

Exp 4 Trees 5% phos.acid (3 years ago)

Function obtained:
Y = +(5.47 +- 0.74)*E-01*(X*X)
    +(3.5 +- 5.9)*(1)

Analysis of Variance

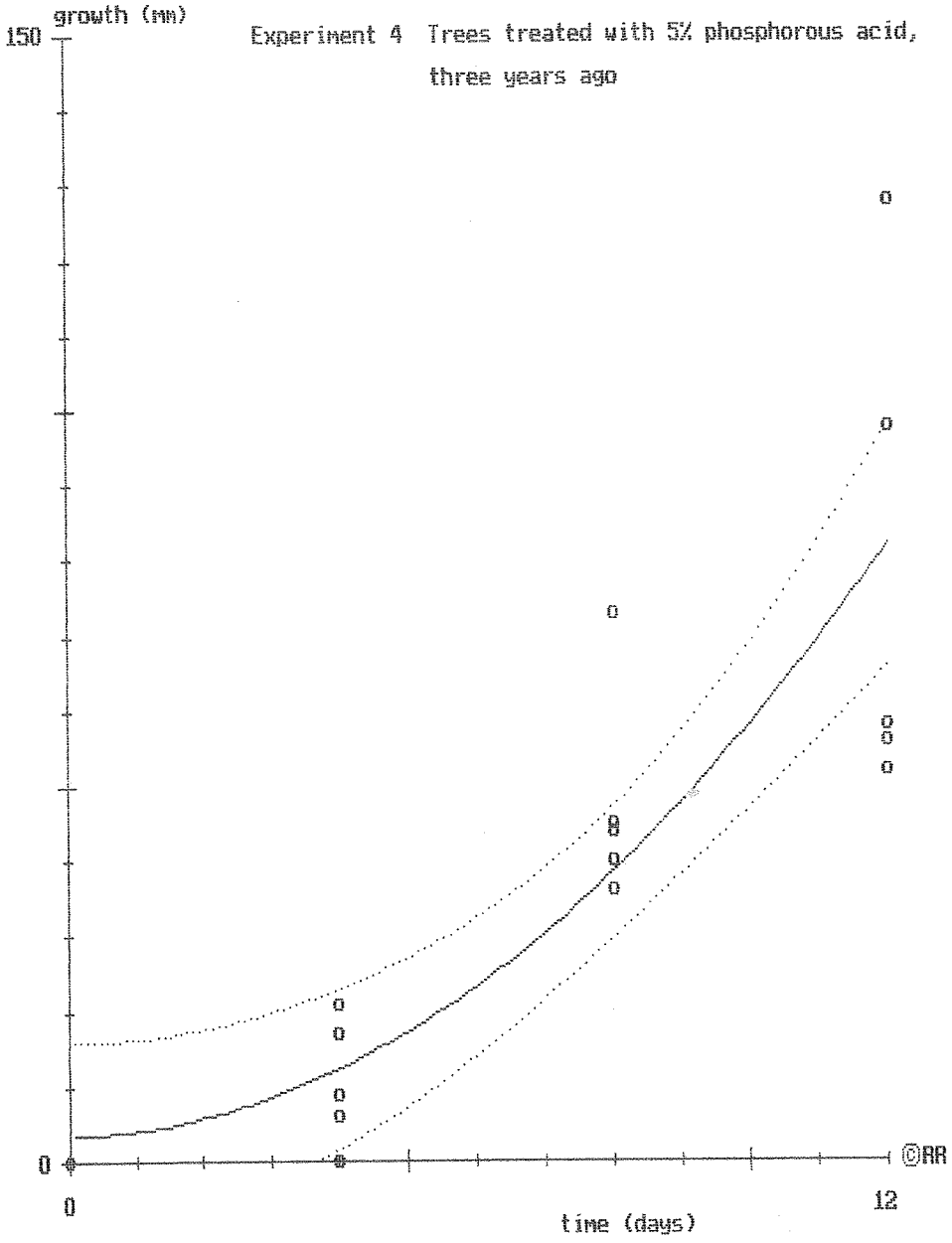
Sum of Squares	Value	Degr.Freedom	Variance
Total	4.8225E+04	20	
Due to regression	4.2060E+04	2	2.1030E+04
Residual	6.1646E+03	18	3.4248E+02

If the model is assumed to be correct, the estimated standard deviation of Y is 1.8506E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 20 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	3.543E+00	- 8.752E+00	1.584E+01
2	0.000E+00	0.000E+00	3.543E+00	- 8.752E+00	1.584E+01
3	0.000E+00	0.000E+00	3.543E+00	- 8.752E+00	1.584E+01
4	0.000E+00	0.000E+00	3.543E+00	- 8.752E+00	1.584E+01
5	0.000E+00	0.000E+00	3.543E+00	- 8.752E+00	1.584E+01
6	4.000E+00	2.100E+01	1.229E+01	1.604E+00	2.297E+01
7	4.000E+00	9.000E+00	1.229E+01	1.604E+00	2.297E+01
8	4.000E+00	1.700E+01	1.229E+01	1.604E+00	2.297E+01
9	4.000E+00	6.000E+00	1.229E+01	1.604E+00	2.297E+01
10	4.000E+00	0.000E+00	1.229E+01	1.604E+00	2.297E+01
11	8.000E+00	4.000E+01	3.852E+01	2.974E+01	4.730E+01
12	8.000E+00	4.400E+01	3.852E+01	2.974E+01	4.730E+01
13	8.000E+00	7.300E+01	3.852E+01	2.974E+01	4.730E+01
14	8.000E+00	4.500E+01	3.852E+01	2.974E+01	4.730E+01
15	8.000E+00	3.600E+01	3.852E+01	2.974E+01	4.730E+01
16	1.200E+01	9.800E+01	8.225E+01	6.605E+01	9.844E+01
17	1.200E+01	5.600E+01	8.225E+01	6.605E+01	9.844E+01
18	1.200E+01	1.280E+02	8.225E+01	6.605E+01	9.844E+01
19	1.200E+01	5.200E+01	8.225E+01	6.605E+01	9.844E+01
20	1.200E+01	5.800E+01	8.225E+01	6.605E+01	9.844E+01

-RR-



o original points
..... 95% confidence interval

Figure 4C

Exp 4 Trees, 10% phos. acid (recently)

Function obtained:
Y = +(3.52 +- 0.98)*E-01*(X*X)
    +(5.9 +- 7.3)*(1)

Analysis of Variance

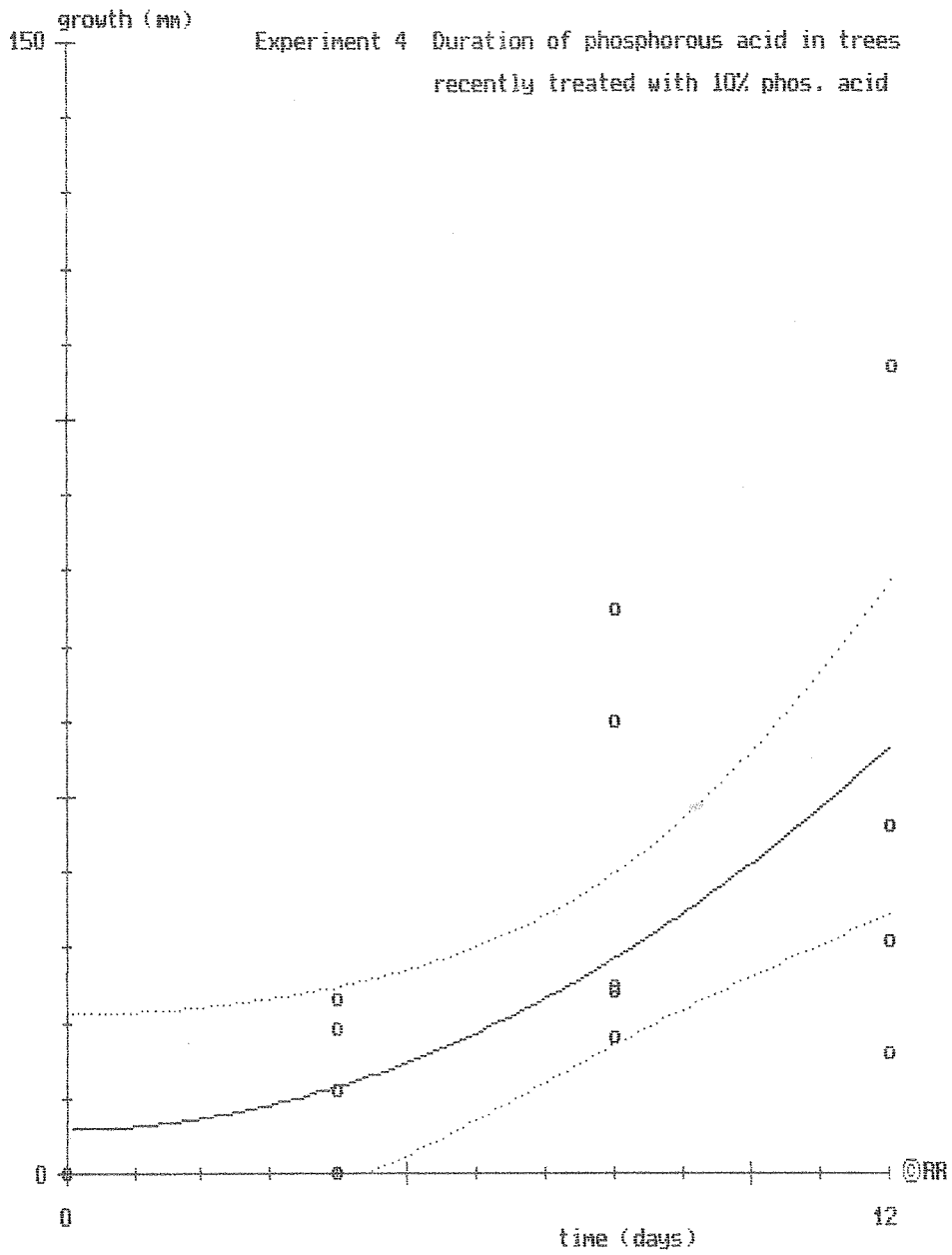
Sum of Squares	Value	Degr.Freedom	Variance
Total	2.6543E+04	19	
Due to regression	1.7654E+04	2	8.8270E+03
Residual	8.8890E+03	17	5.2288E+02

If the model is assumed to be correct, the estimated
standard deviation of Y is 2.2867E+01 (absolute)

The 95% confidence values show the limits between which you can expect
the value of Yreg if you repeat all 19 observations and use the
same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	5.870E+00	- 9.462E+00	2.120E+01
2	0.000E+00	0.000E+00	5.870E+00	- 9.462E+00	2.120E+01
3	0.000E+00	0.000E+00	5.870E+00	- 9.462E+00	2.120E+01
4	0.000E+00	0.000E+00	5.870E+00	- 9.462E+00	2.120E+01
5	0.000E+00	0.000E+00	5.870E+00	- 9.462E+00	2.120E+01
6	4.000E+00	2.300E+01	1.150E+01	- 1.761E+00	2.476E+01
7	4.000E+00	1.900E+01	1.150E+01	- 1.761E+00	2.476E+01
8	4.000E+00	0.000E+00	1.150E+01	- 1.761E+00	2.476E+01
9	4.000E+00	1.100E+01	1.150E+01	- 1.761E+00	2.476E+01
10	4.000E+00	0.000E+00	1.150E+01	- 1.761E+00	2.476E+01
11	8.000E+00	7.500E+01	2.839E+01	1.702E+01	3.976E+01
12	8.000E+00	6.000E+01	2.839E+01	1.702E+01	3.976E+01
13	8.000E+00	1.800E+01	2.839E+01	1.702E+01	3.976E+01
14	8.000E+00	2.400E+01	2.839E+01	1.702E+01	3.976E+01
15	8.000E+00	2.500E+01	2.839E+01	1.702E+01	3.976E+01
16	1.200E+01	1.070E+02	5.655E+01	3.444E+01	7.865E+01
17	1.200E+01	3.100E+01	5.655E+01	3.444E+01	7.865E+01
18	1.200E+01	4.600E+01	5.655E+01	3.444E+01	7.865E+01
19	1.200E+01	1.600E+01	5.655E+01	3.444E+01	7.865E+01

-RR-



o original points
..... 95% confidence interval

Figure 4D

Exp 4 Trees,10% phos.acid(2 years ago)

Function obtained:
Y = +(4.0 +- 1.0)%E-01%(X%X)
    +(8.2 +- 8.2)%(1)

Analysis of Variance

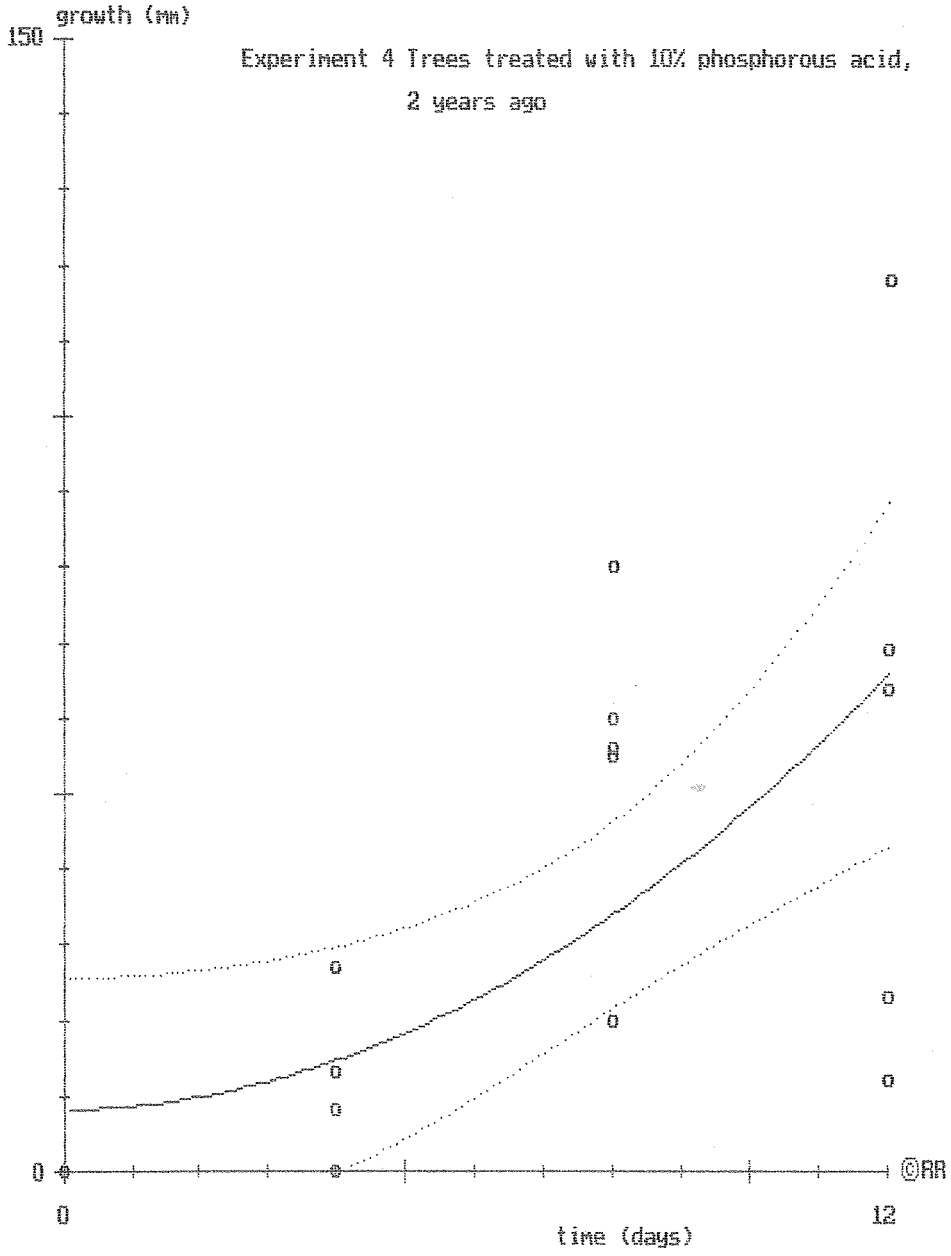
Sum of Squares	Value	Degr.Freedom	Variance
Total	4.1041E+04	20	
Due to regression	2.8830E+04	2	1.4415E+04
Residual	1.2211E+04	18	6.7839E+02

If the model is assumed to be correct, the estimated standard deviation of Y is 2.6046E+01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 20 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	8.243E+00	- 9.062E+00	2.555E+01
2	0.000E+00	0.000E+00	8.243E+00	- 9.062E+00	2.555E+01
3	0.000E+00	0.000E+00	8.243E+00	- 9.062E+00	2.555E+01
4	0.000E+00	0.000E+00	8.243E+00	- 9.062E+00	2.555E+01
5	0.000E+00	0.000E+00	8.243E+00	- 9.062E+00	2.555E+01
6	4.000E+00	8.000E+00	1.464E+01	- 3.920E-01	2.968E+01
7	4.000E+00	8.000E+00	1.464E+01	- 3.920E-01	2.968E+01
8	4.000E+00	2.700E+01	1.464E+01	- 3.920E-01	2.968E+01
9	4.000E+00	0.000E+00	1.464E+01	- 3.920E-01	2.968E+01
10	4.000E+00	1.300E+01	1.464E+01	- 3.920E-01	2.968E+01
11	8.000E+00	6.000E+01	3.385E+01	2.149E+01	4.621E+01
12	8.000E+00	2.000E+01	3.385E+01	2.149E+01	4.621E+01
13	8.000E+00	8.000E+01	3.385E+01	2.149E+01	4.621E+01
14	8.000E+00	5.600E+01	3.385E+01	2.149E+01	4.621E+01
15	8.000E+00	5.500E+01	3.385E+01	2.149E+01	4.621E+01
16	1.200E+01	2.300E+01	6.586E+01	4.307E+01	8.865E+01
17	1.200E+01	1.200E+01	6.586E+01	4.307E+01	8.865E+01
18	1.200E+01	6.900E+01	6.586E+01	4.307E+01	8.865E+01
19	1.200E+01	1.180E+02	6.586E+01	4.307E+01	8.865E+01
20	1.200E+01	6.400E+01	6.586E+01	4.307E+01	8.865E+01

-RR-



o original points
..... 95% confidence interval

Figure 4E

Exp 4 Trees,10% phos.acid(3 years ago)

Function obtained:
Y = +(3.90 +- 0.69)%E-01%(X%X)
    +(3.8 +- 5.1)%(1)

Analysis of Variance

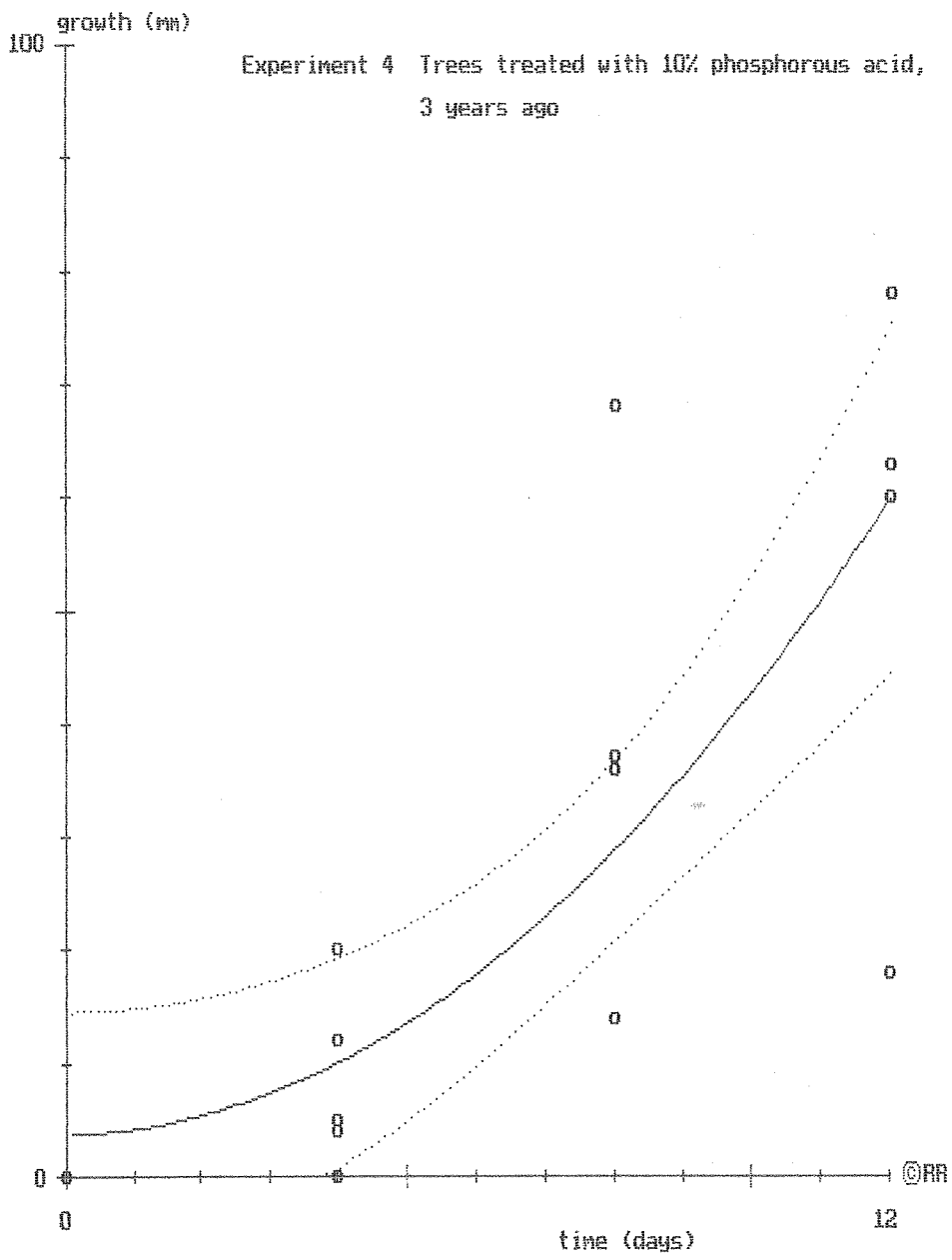
Sum of Squares	Value	Degr.Freedom	Variance
Total	2.3416E+04	19	
Due to regression	1.9037E+04	2	9.5185E+03
Residual	4.3791E+03	17	2.5759E+02

If the model is assumed to be correct, the estimated
standard deviation of Y is 1.6050E+01 (absolute)

The 95% confidence values show the limits between which you can expect
the value of Yreg if you repeat all 19 observations and use the
same type and order of equation to obtain Yreg at X

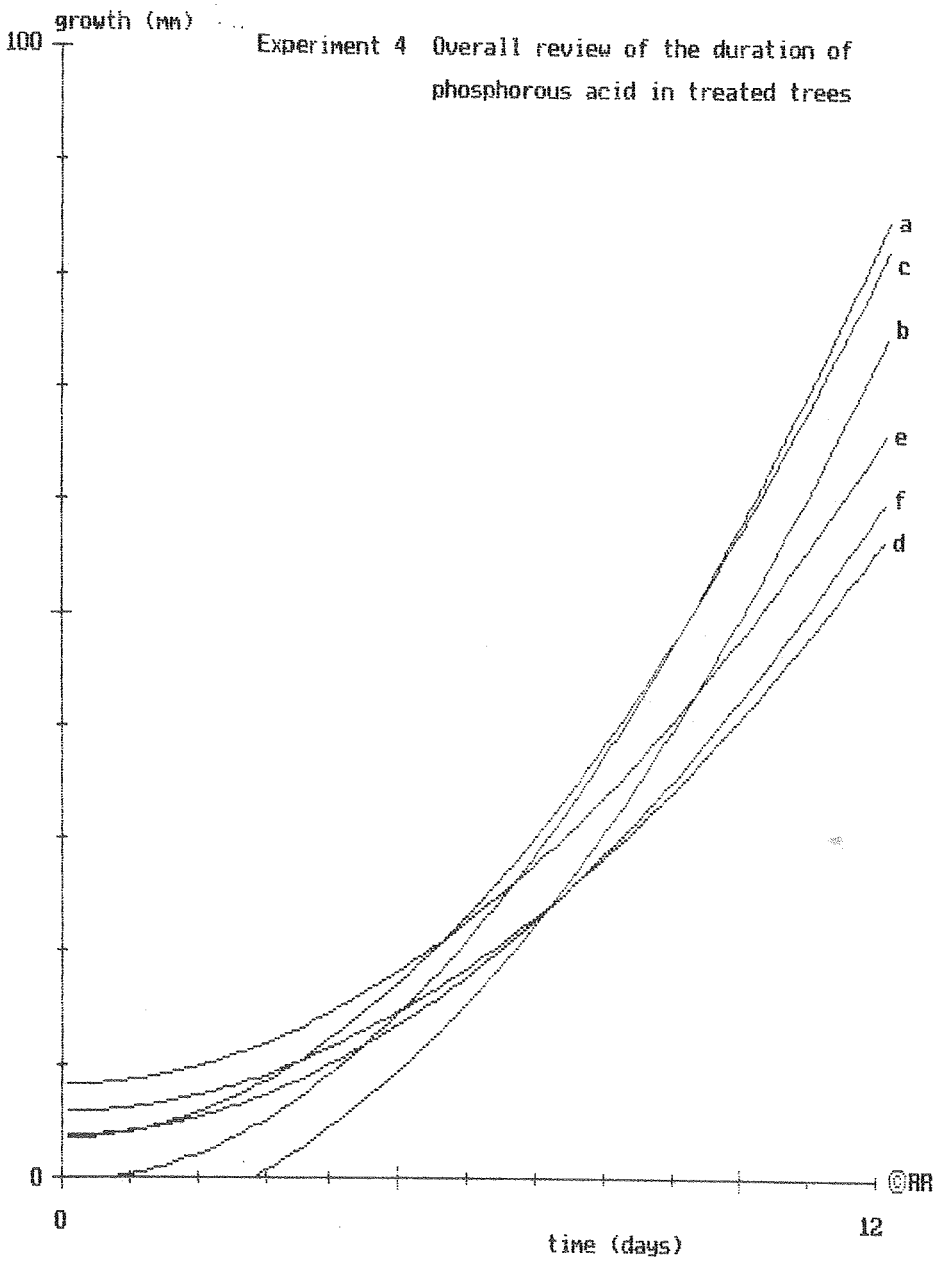
Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	3.775E+00	- 6.986E+00	1.454E+01
2	0.000E+00	0.000E+00	3.775E+00	- 6.986E+00	1.454E+01
3	0.000E+00	0.000E+00	3.775E+00	- 6.986E+00	1.454E+01
4	0.000E+00	0.000E+00	3.775E+00	- 6.986E+00	1.454E+01
5	0.000E+00	0.000E+00	3.775E+00	- 6.986E+00	1.454E+01
6	4.000E+00	4.000E+00	1.001E+01	7.010E-01	1.932E+01
7	4.000E+00	0.000E+00	1.001E+01	7.010E-01	1.932E+01
8	4.000E+00	2.000E+01	1.001E+01	7.010E-01	1.932E+01
9	4.000E+00	5.000E+00	1.001E+01	7.010E-01	1.932E+01
10	4.000E+00	1.200E+01	1.001E+01	7.010E-01	1.932E+01
11	8.000E+00	6.800E+01	2.871E+01	2.073E+01	3.669E+01
12	8.000E+00	3.700E+01	2.871E+01	2.073E+01	3.669E+01
13	8.000E+00	1.400E+01	2.871E+01	2.073E+01	3.669E+01
14	8.000E+00	3.700E+01	2.871E+01	2.073E+01	3.669E+01
15	8.000E+00	3.600E+01	2.871E+01	2.073E+01	3.669E+01
16	1.200E+01	6.300E+01	5.988E+01	4.437E+01	7.539E+01
17	1.200E+01	7.800E+01	5.988E+01	4.437E+01	7.539E+01
18	1.200E+01	1.800E+01	5.988E+01	4.437E+01	7.539E+01
19	1.200E+01	6.000E+01	5.988E+01	4.437E+01	7.539E+01

-RR-



o original points
..... 95% confidence interval

Figure 4F



a : control samples

b : twigs samples selected from plants treated in April 1991 with 5% phosphorous acid

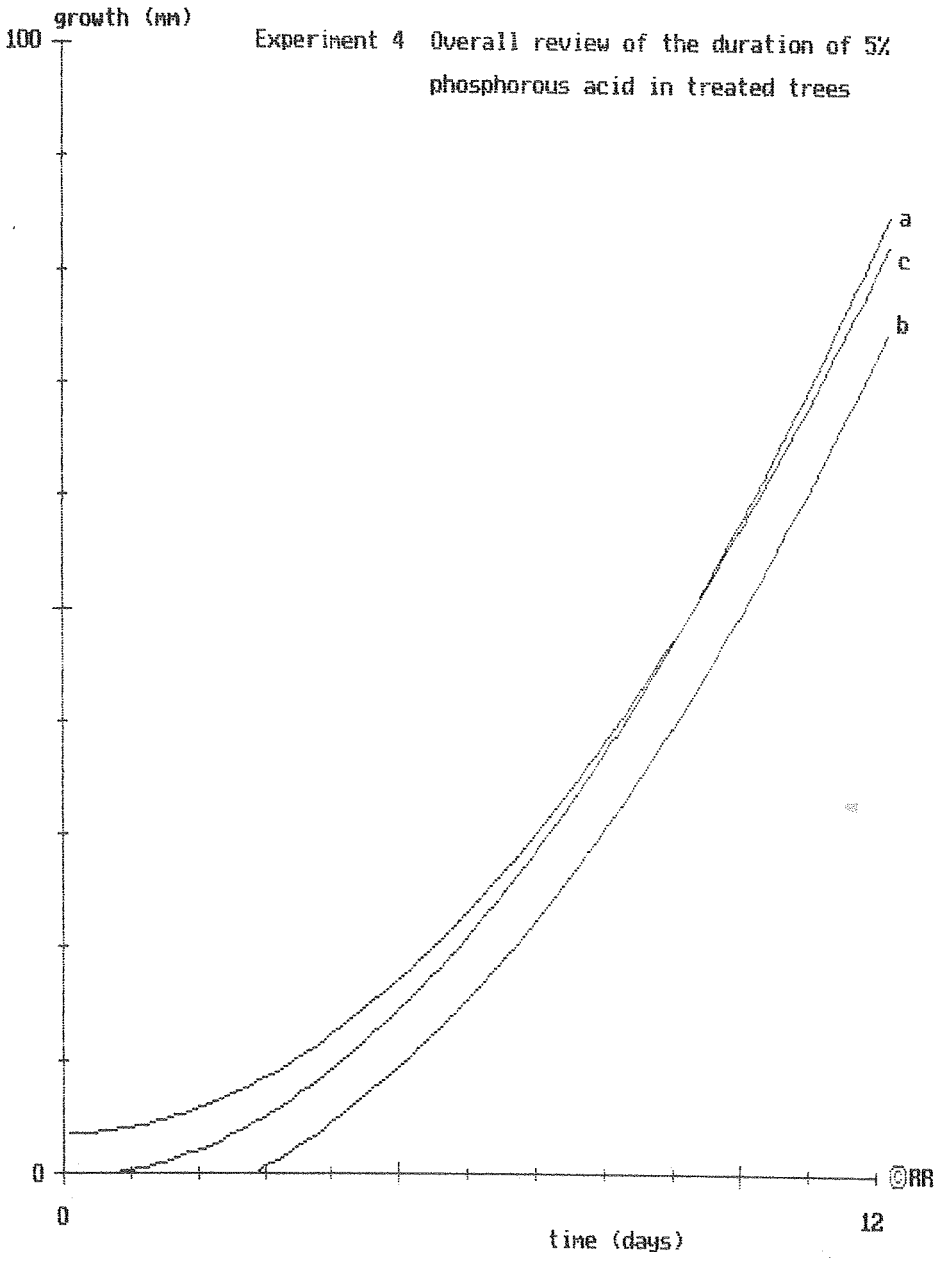
c : twig samples selected from plants treated three years ago with 10% phosphorous acid

d : twig samples selected from plants treated in April 1991 with 10% phosphorous acid

e : twig samples selected from plants treated two years ago with 10% phosphorous acid

f : twig samples selected from plants treated three years ago with 10% phosphorous acid

Figure 4G

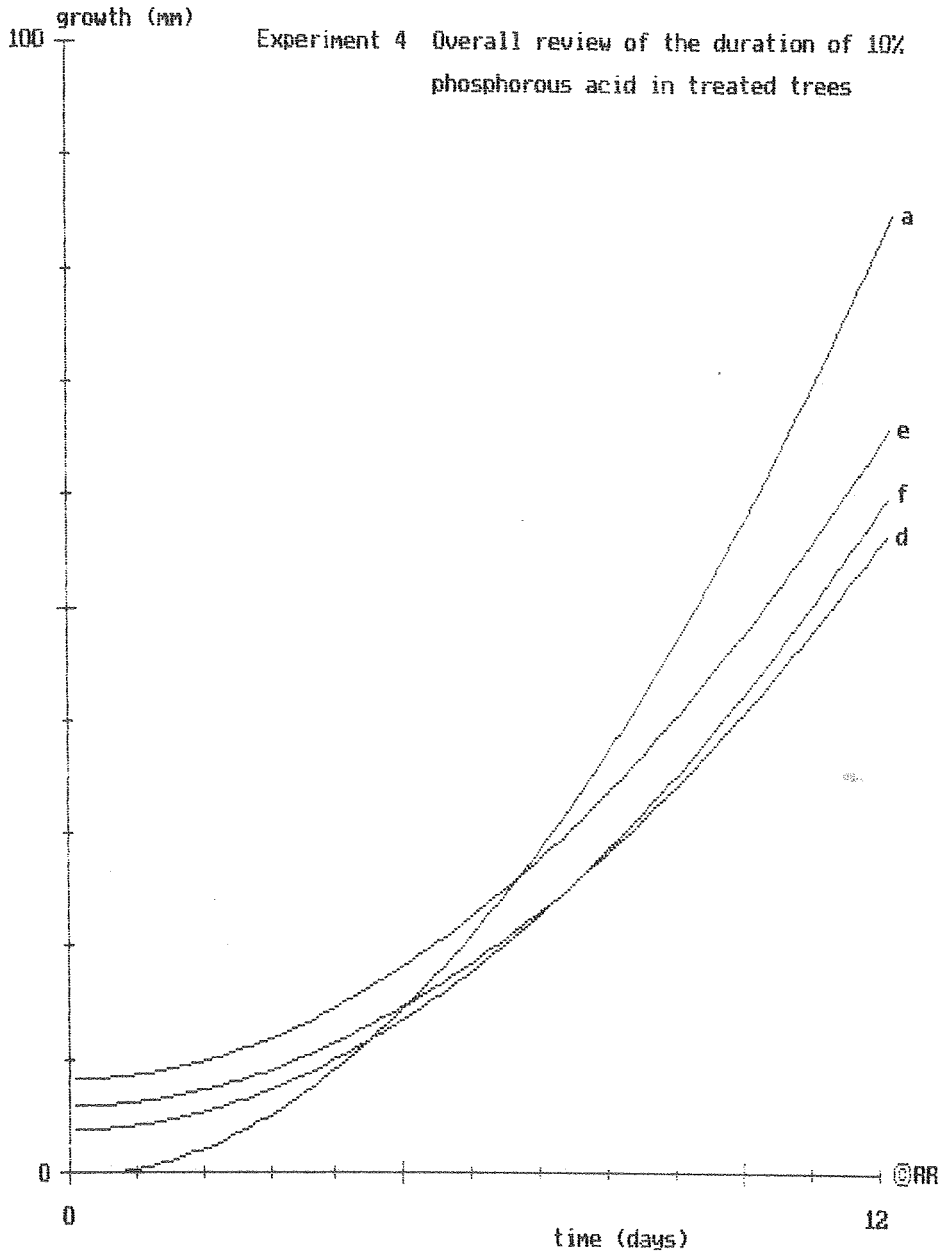


a : control samples

b : twigs samples selected from plants treated in April 1991 with 5% phosphorous acid

c : twig samples selected from plants treated three years ago with 10% phosphorous acid

Figure 5



a : control samples

d : twig samples selected from plants treated in April 1991 with 10% phosphorous acid

e : twig samples selected from plants treated two years ago with 10% phosphorous acid

f : twig samples selected from plants treated three years ago with 10% phosphorous acid

Figure 6

Armillaria, inhibition of 0% phos.acid

Function obtained:
Y = +(4.362 +- 0.062)*(X)
    -(1.57 +- 0.55)*(1)

Analysis of Variance

Sum of Squares	Value	Degr.Freedom	Variance
Total	4.3210E+04	30	
Due to regression	4.3132E+04	2	2.1566E+04
Residual	7.8271E+01	28	2.7954E+00

If the model is assumed to be correct, the estimated
standard deviation of Y is 1.6719E+00 (absolute)

The 95% confidence values show the limits between which you can expect
the value of Yreg if you repeat all 30 observations and use the
same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 1.571E+00	- 2.705E+00	- 4.370E-01
2	0.000E+00	0.000E+00	- 1.571E+00	- 2.705E+00	- 4.370E-01
3	0.000E+00	0.000E+00	- 1.571E+00	- 2.705E+00	- 4.370E-01
4	0.000E+00	0.000E+00	- 1.571E+00	- 2.705E+00	- 4.370E-01
5	0.000E+00	0.000E+00	- 1.571E+00	- 2.705E+00	- 4.370E-01
6	4.000E+00	1.400E+01	1.588E+01	1.511E+01	1.664E+01
7	4.000E+00	1.500E+01	1.588E+01	1.511E+01	1.664E+01
8	4.000E+00	1.667E+01	1.588E+01	1.511E+01	1.664E+01
9	4.000E+00	1.450E+01	1.588E+01	1.511E+01	1.664E+01
10	4.000E+00	1.233E+01	1.588E+01	1.511E+01	1.664E+01
11	6.000E+00	2.400E+01	2.460E+01	2.395E+01	2.525E+01
12	6.000E+00	2.467E+01	2.460E+01	2.395E+01	2.525E+01
13	6.000E+00	2.450E+01	2.460E+01	2.395E+01	2.525E+01
14	6.000E+00	2.400E+01	2.460E+01	2.395E+01	2.525E+01
15	6.000E+00	2.367E+01	2.460E+01	2.395E+01	2.525E+01
16	8.000E+00	3.283E+01	3.333E+01	3.270E+01	3.395E+01
17	8.000E+00	3.300E+01	3.333E+01	3.270E+01	3.395E+01
18	8.000E+00	3.383E+01	3.333E+01	3.270E+01	3.395E+01
19	8.000E+00	3.283E+01	3.333E+01	3.270E+01	3.395E+01
20	8.000E+00	3.200E+01	3.333E+01	3.270E+01	3.395E+01
21	1.200E+01	5.050E+01	5.077E+01	4.993E+01	5.162E+01
22	1.200E+01	5.000E+01	5.077E+01	4.993E+01	5.162E+01
23	1.200E+01	5.083E+01	5.077E+01	4.993E+01	5.162E+01
24	1.200E+01	5.033E+01	5.077E+01	4.993E+01	5.162E+01
25	1.200E+01	4.967E+01	5.077E+01	4.993E+01	5.162E+01
26	1.500E+01	6.767E+01	6.386E+01	6.273E+01	6.499E+01
27	1.500E+01	6.650E+01	6.386E+01	6.273E+01	6.499E+01
28	1.500E+01	6.700E+01	6.386E+01	6.273E+01	6.499E+01
29	1.500E+01	6.100E+01	6.386E+01	6.273E+01	6.499E+01
30	1.500E+01	6.300E+01	6.386E+01	6.273E+01	6.499E+01

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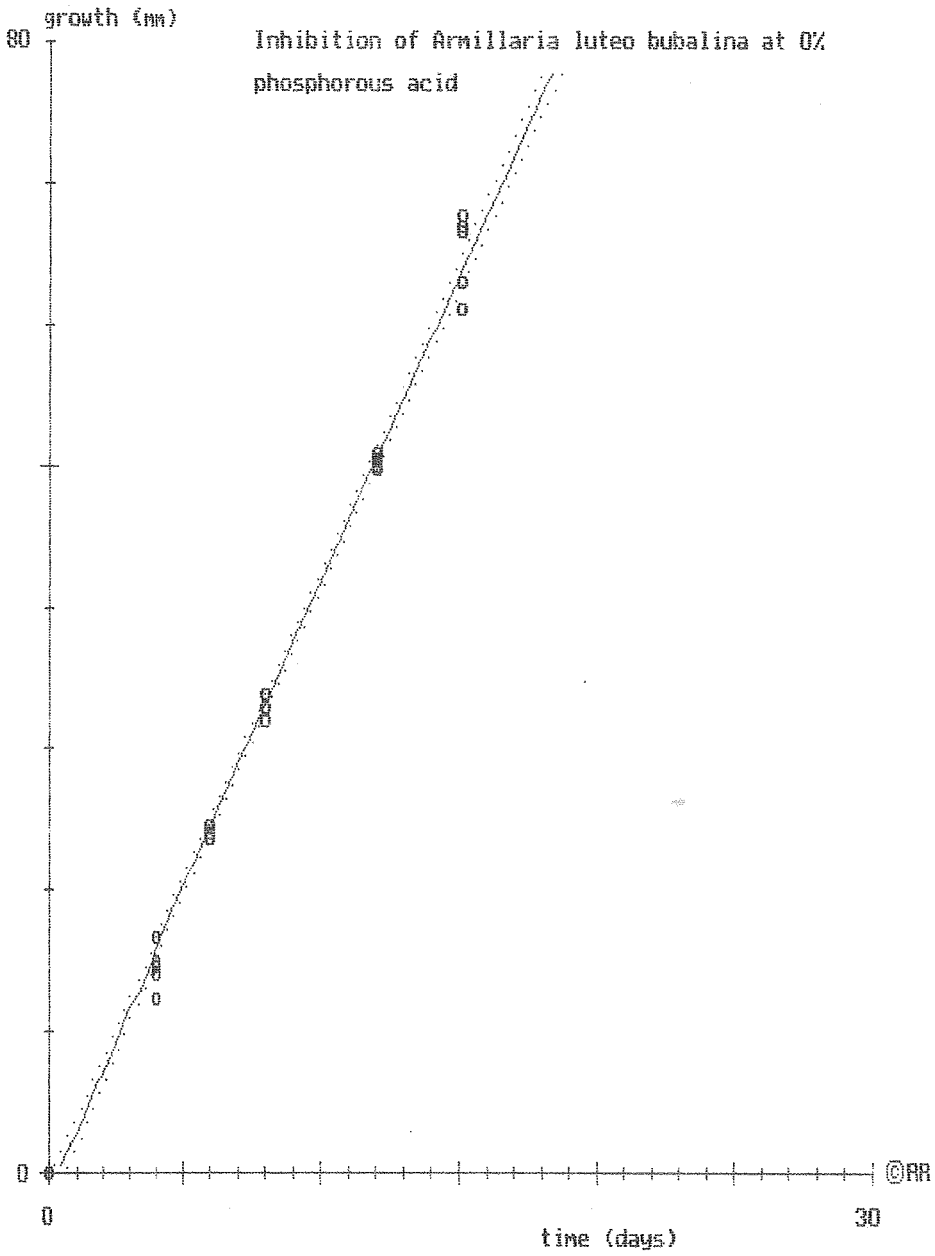


o original points
..... 95% confidence interval

Figure 7A

Armillaria, inhibition 0.25% phos.acid

Function obtained:
Y = +(5.35 +- 0.76)%E-02%(X%X)
    +(4.2 +- 2.1)%(1)

Analysis of Variance

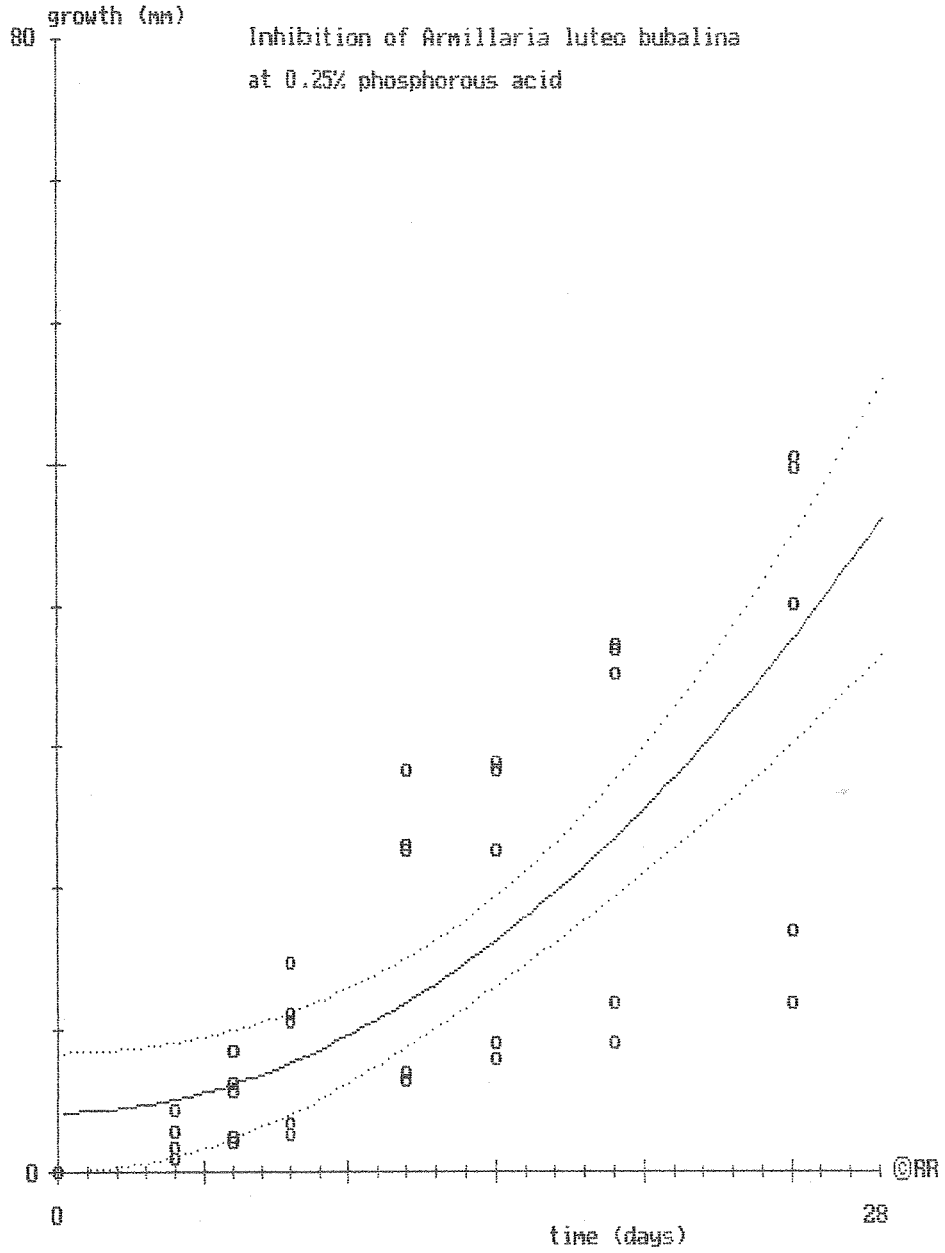
Sum of Squares	Value	Degr.Freedom	Variance
Total	1.6168E+04	40	
Due to regression	1.2606E+04	2	6.3028E+03
Residual	3.5620E+03	38	9.3737E+01

If the model is assumed to be correct, the estimated standard deviation of Y is 9.6818E+00 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 40 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	4.225E+00	3.739E-02	8.413E+00
2	0.000E+00	0.000E+00	4.225E+00	3.739E-02	8.413E+00
3	0.000E+00	0.000E+00	4.225E+00	3.739E-02	8.413E+00
4	0.000E+00	0.000E+00	4.225E+00	3.739E-02	8.413E+00
5	0.000E+00	0.000E+00	4.225E+00	3.739E-02	8.413E+00
6	4.000E+00	1.000E+00	5.081E+00	1.055E+00	9.108E+00
7	4.000E+00	2.833E+00	5.081E+00	1.055E+00	9.108E+00
8	4.000E+00	1.000E+00	5.081E+00	1.055E+00	9.108E+00
9	4.000E+00	4.333E+00	5.081E+00	1.055E+00	9.108E+00
10	4.000E+00	1.667E+00	5.081E+00	1.055E+00	9.108E+00
11	6.000E+00	2.167E+00	6.152E+00	2.313E+00	9.990E+00
12	6.000E+00	6.333E+00	6.152E+00	2.313E+00	9.990E+00
13	6.000E+00	2.500E+00	6.152E+00	2.313E+00	9.990E+00
14	6.000E+00	8.500E+00	6.152E+00	2.313E+00	9.990E+00
15	6.000E+00	5.667E+00	6.152E+00	2.313E+00	9.990E+00
16	8.000E+00	3.333E+00	7.651E+00	4.048E+00	1.125E+01
17	8.000E+00	1.050E+01	7.651E+00	4.048E+00	1.125E+01
18	8.000E+00	2.667E+00	7.651E+00	4.048E+00	1.125E+01
19	8.000E+00	1.467E+01	7.651E+00	4.048E+00	1.125E+01
20	8.000E+00	1.117E+01	7.651E+00	4.048E+00	1.125E+01
21	1.200E+01	6.500E+00	1.193E+01	8.774E+00	1.509E+01
22	1.200E+01	2.317E+01	1.193E+01	8.774E+00	1.509E+01
23	1.200E+01	7.000E+00	1.193E+01	8.774E+00	1.509E+01
24	1.200E+01	2.833E+01	1.193E+01	8.774E+00	1.509E+01
25	1.200E+01	2.267E+01	1.193E+01	8.774E+00	1.509E+01
26	1.500E+01	8.000E+00	1.627E+01	1.311E+01	1.943E+01
27	1.500E+01	2.900E+01	1.627E+01	1.311E+01	1.943E+01
28	1.500E+01	9.167E+00	1.627E+01	1.311E+01	1.943E+01
29	1.500E+01	2.833E+01	1.627E+01	1.311E+01	1.943E+01
30	1.500E+01	2.267E+01	1.627E+01	1.311E+01	1.943E+01
31	1.900E+01	3.683E+01	2.355E+01	1.943E+01	2.767E+01
32	1.900E+01	3.517E+01	2.355E+01	1.943E+01	2.767E+01
33	1.900E+01	1.183E+01	2.355E+01	1.943E+01	2.767E+01
34	1.900E+01	9.167E+00	2.355E+01	1.943E+01	2.767E+01

35	1.900E+01	3.717E+01	2.355E+01	1.943E+01	2.767E+01
36	2.500E+01	1.700E+01	3.768E+01	3.024E+01	4.511E+01
37	2.500E+01	1.200E+01	3.768E+01	3.024E+01	4.511E+01
38	2.500E+01	4.967E+01	3.768E+01	3.024E+01	4.511E+01
39	2.500E+01	5.050E+01	3.768E+01	3.024E+01	4.511E+01
40	2.500E+01	4.017E+01	3.768E+01	3.024E+01	4.511E+01



o original points
..... 95% confidence interval

Figure 7B

Amillaria, inhibition 0.5% phos.acid

Function obtained:
Y = +(4.97 +- 0.68)*E-02*(X*X)
    +(1.1 +- 1.7)*(1)

Analysis of Variance

Sum of Squares	Value	Degr.Freedom	Variance
Total	1.1153E+04	40	
Due to regression	8.2535E+03	2	4.1268E+03
Residual	2.8990E+03	38	7.6290E+01

If the model is assumed to be correct, the estimated standard deviation of Y is 8.7344E+00 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 40 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	1.124E+00	- 2.654E+00	4.901E+00
2	0.000E+00	0.000E+00	1.124E+00	- 2.654E+00	4.901E+00
3	0.000E+00	0.000E+00	1.124E+00	- 2.654E+00	4.901E+00
4	0.000E+00	0.000E+00	1.124E+00	- 2.654E+00	4.901E+00
5	0.000E+00	0.000E+00	1.124E+00	- 2.654E+00	4.901E+00
6	4.000E+00	1.670E+00	1.919E+00	- 1.714E+00	5.551E+00
7	4.000E+00	0.000E+00	1.919E+00	- 1.714E+00	5.551E+00
8	4.000E+00	0.000E+00	1.919E+00	- 1.714E+00	5.551E+00
9	4.000E+00	0.000E+00	1.919E+00	- 1.714E+00	5.551E+00
10	4.000E+00	3.300E-01	1.919E+00	- 1.714E+00	5.551E+00
11	6.000E+00	7.500E-01	2.912E+00	- 5.506E-01	6.375E+00
12	6.000E+00	7.500E-01	2.912E+00	- 5.506E-01	6.375E+00
13	6.000E+00	7.500E-01	2.912E+00	- 5.506E-01	6.375E+00
14	6.000E+00	1.000E+00	2.912E+00	- 5.506E-01	6.375E+00
15	6.000E+00	2.833E+00	2.912E+00	- 5.506E-01	6.375E+00
16	8.000E+00	1.100E+01	4.304E+00	1.054E+00	7.553E+00
17	8.000E+00	1.500E+00	4.304E+00	1.054E+00	7.553E+00
18	8.000E+00	1.500E+00	4.304E+00	1.054E+00	7.553E+00
19	8.000E+00	3.330E+00	4.304E+00	1.054E+00	7.553E+00
20	8.000E+00	7.833E+00	4.304E+00	1.054E+00	7.553E+00
21	1.200E+01	2.150E+01	8.279E+00	5.429E+00	1.113E+01
22	1.200E+01	3.000E+00	8.279E+00	5.429E+00	1.113E+01
23	1.200E+01	5.000E+00	8.279E+00	5.429E+00	1.113E+01
24	1.200E+01	1.017E+01	8.279E+00	5.429E+00	1.113E+01
25	1.200E+01	7.833E+00	8.279E+00	5.429E+00	1.113E+01
26	1.500E+01	2.883E+01	1.230E+01	9.451E+00	1.516E+01
27	1.500E+01	4.167E+00	1.230E+01	9.451E+00	1.516E+01
28	1.500E+01	7.500E+00	1.230E+01	9.451E+00	1.516E+01
29	1.500E+01	1.900E+01	1.230E+01	9.451E+00	1.516E+01
30	1.500E+01	2.083E+01	1.230E+01	9.451E+00	1.516E+01
31	1.900E+01	3.367E+01	1.906E+01	1.535E+01	2.278E+01
32	1.900E+01	6.000E+00	1.906E+01	1.535E+01	2.278E+01
33	1.900E+01	9.160E+00	1.906E+01	1.535E+01	2.278E+01
34	1.900E+01	2.183E+01	1.906E+01	1.535E+01	2.278E+01

35	1.900E+01	2.700E+01	1.906E+01	1.535E+01	2.278E+01
36	2.500E+01	6.333E+00	3.218E+01	2.547E+01	3.889E+01
37	2.500E+01	5.000E+01	3.218E+01	2.547E+01	3.889E+01
38	2.500E+01	1.267E+01	3.218E+01	2.547E+01	3.889E+01
39	2.500E+01	4.267E+01	3.218E+01	2.547E+01	3.889E+01
40	2.500E+01	4.000E+01	3.218E+01	2.547E+01	3.889E+01

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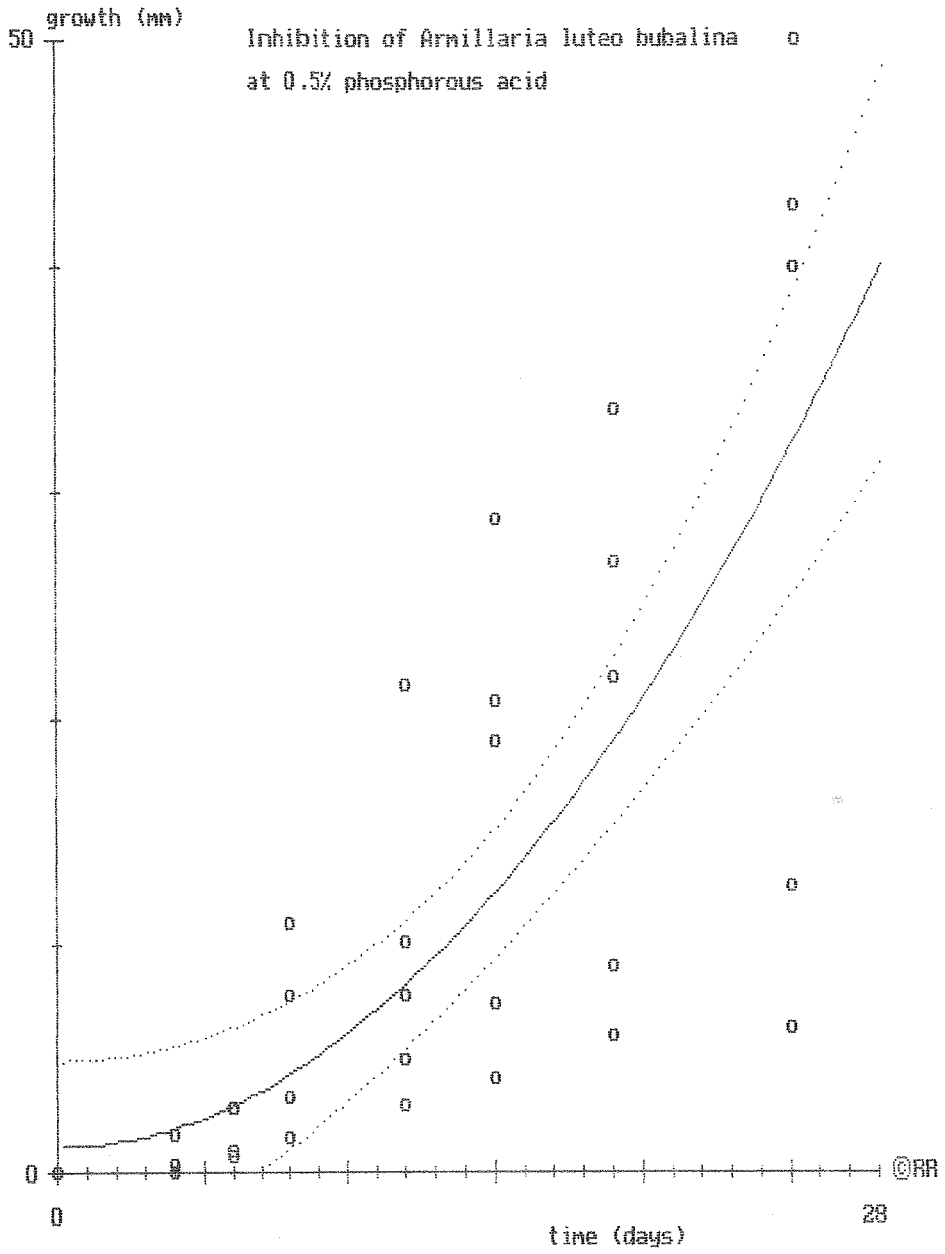

o original points
..... 95% confidence interval

Figure 7C

Armillaria, inhibition of 1% phos.acid

Function obtained:
Y = +(1.84 +- 0.11)*E-02*(X*X)
    +(1.2 +- 4.2)*E-01*(1)

Analysis of Variance

Sum of Squares	Value	Degr.Freedom	Variance
Total	2.2781E+03	45	
Due to regression	2.0981E+03	2	1.0490E+03
Residual	1.8001E+02	43	4.1864E+00

If the model is assumed to be correct, the estimated standard deviation of Y is 2.0461E+00 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 45 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	1.226E-01	- 7.191E-01	643E-01
2	0.000E+00	0.000E+00	1.226E-01	- 7.191E-01	643E-01
3	0.000E+00	0.000E+00	1.226E-01	- 7.191E-01	643E-01
4	0.000E+00	0.000E+00	1.226E-01	- 7.191E-01	643E-01
5	0.000E+00	0.000E+00	1.226E-01	- 7.191E-01	643E-01
6	4.000E+00	0.000E+00	4.165E-01	- 4.006E-01	234E+00
7	4.000E+00	0.000E+00	4.165E-01	- 4.006E-01	234E+00
8	4.000E+00	0.000E+00	4.165E-01	- 4.006E-01	234E+00
9	4.000E+00	0.000E+00	4.165E-01	- 4.006E-01	234E+00
10	4.000E+00	0.000E+00	4.165E-01	- 4.006E-01	234E+00
11	6.000E+00	0.000E+00	7.840E-01	- 3.689E-03	272E+00
12	6.000E+00	0.000E+00	7.840E-01	- 3.689E-03	272E+00
13	6.000E+00	0.000E+00	7.840E-01	- 3.689E-03	272E+00
14	6.000E+00	0.000E+00	7.840E-01	- 3.689E-03	272E+00
15	6.000E+00	0.000E+00	7.840E-01	- 3.689E-03	272E+00
16	8.000E+00	0.000E+00	1.298E+00	5.492E-01	48E+00
17	8.000E+00	0.000E+00	1.298E+00	5.492E-01	48E+00
18	8.000E+00	0.000E+00	1.298E+00	5.492E-01	48E+00
19	8.000E+00	0.000E+00	1.298E+00	5.492E-01	48E+00
20	8.000E+00	0.000E+00	1.298E+00	5.492E-01	48E+00
21	1.200E+01	3.333E+00	2.768E+00	2.106E+00	30E+00
22	1.200E+01	1.500E+00	2.768E+00	2.106E+00	30E+00
23	1.200E+01	3.667E+00	2.768E+00	2.106E+00	30E+00
24	1.200E+01	5.000E+00	2.768E+00	2.106E+00	30E+00
25	1.200E+01	4.333E+00	2.768E+00	2.106E+00	30E+00
26	1.500E+01	6.000E+00	4.256E+00	3.639E+00	74E+00
27	1.500E+01	2.833E+00	4.256E+00	3.639E+00	74E+00
28	1.500E+01	7.167E+00	4.256E+00	3.639E+00	74E+00
29	1.500E+01	6.667E+00	4.256E+00	3.639E+00	74E+00
30	1.500E+01	7.333E+00	4.256E+00	3.639E+00	74E+00
31	1.900E+01	8.333E+00	6.755E+00	6.090E+00	20E+00
32	1.900E+01	9.667E+00	6.755E+00	6.090E+00	20E+00
33	1.900E+01	9.667E+00	6.755E+00	6.090E+00	20E+00
34	1.900E+01	3.833E+00	6.755E+00	6.090E+00	20E+00

35	1.900E+01	8.000E+00	6.755E+00	6.090E+00	7.420E+00
36	2.500E+01	1.033E+01	1.161E+01	1.055E+01	1.266E+01
37	2.500E+01	7.000E+00	1.161E+01	1.055E+01	1.266E+01
38	2.500E+01	1.350E+01	1.161E+01	1.055E+01	1.266E+01
39	2.500E+01	1.167E+01	1.161E+01	1.055E+01	1.266E+01
40	2.500E+01	1.450E+01	1.161E+01	1.055E+01	1.266E+01
41	2.800E+01	1.117E+01	1.453E+01	1.316E+01	1.590E+01
42	2.800E+01	9.667E+00	1.453E+01	1.316E+01	1.590E+01
43	2.800E+01	1.750E+01	1.453E+01	1.316E+01	1.590E+01
44	2.800E+01	1.183E+01	1.453E+01	1.316E+01	1.590E+01
45	2.800E+01	1.817E+01	1.453E+01	1.316E+01	1.590E+01

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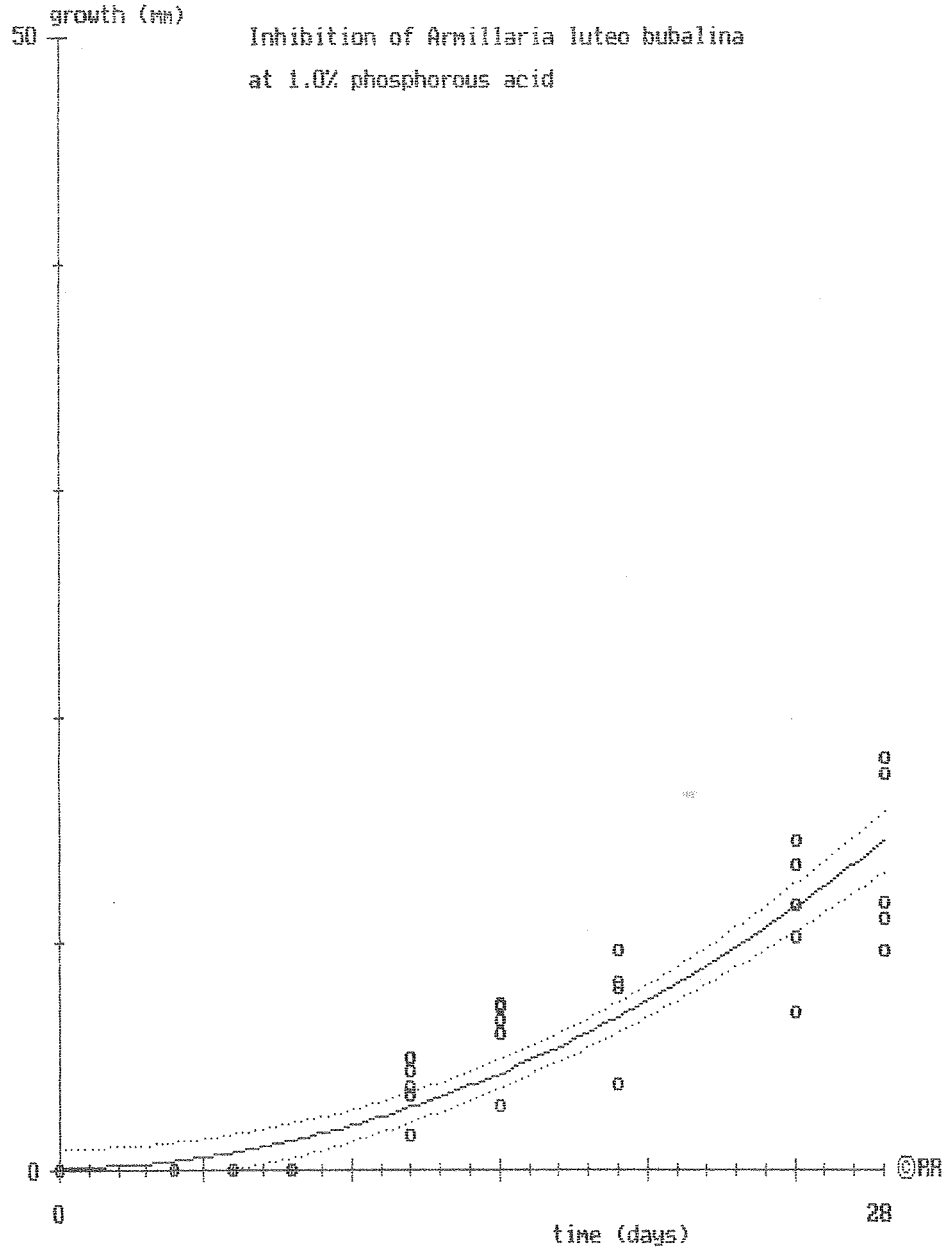


o original points
..... 95% confidence interval

Figure 7D

Armillaria, inhibition 2.5% phos.acid

Function obtained:
Y = +(7.5 +- 1.0)*E-03*(X*X)
-(5.1 +- 3.6)*E-01*(1)

Analysis of Variance

Sum of Squares	Value	Degr.Freedom	Variance
Total	4.2793E+02	50	
Due to regression	2.6758E+02	2	1.3379E+02
Residual	1.6035E+02	48	3.3407E+00

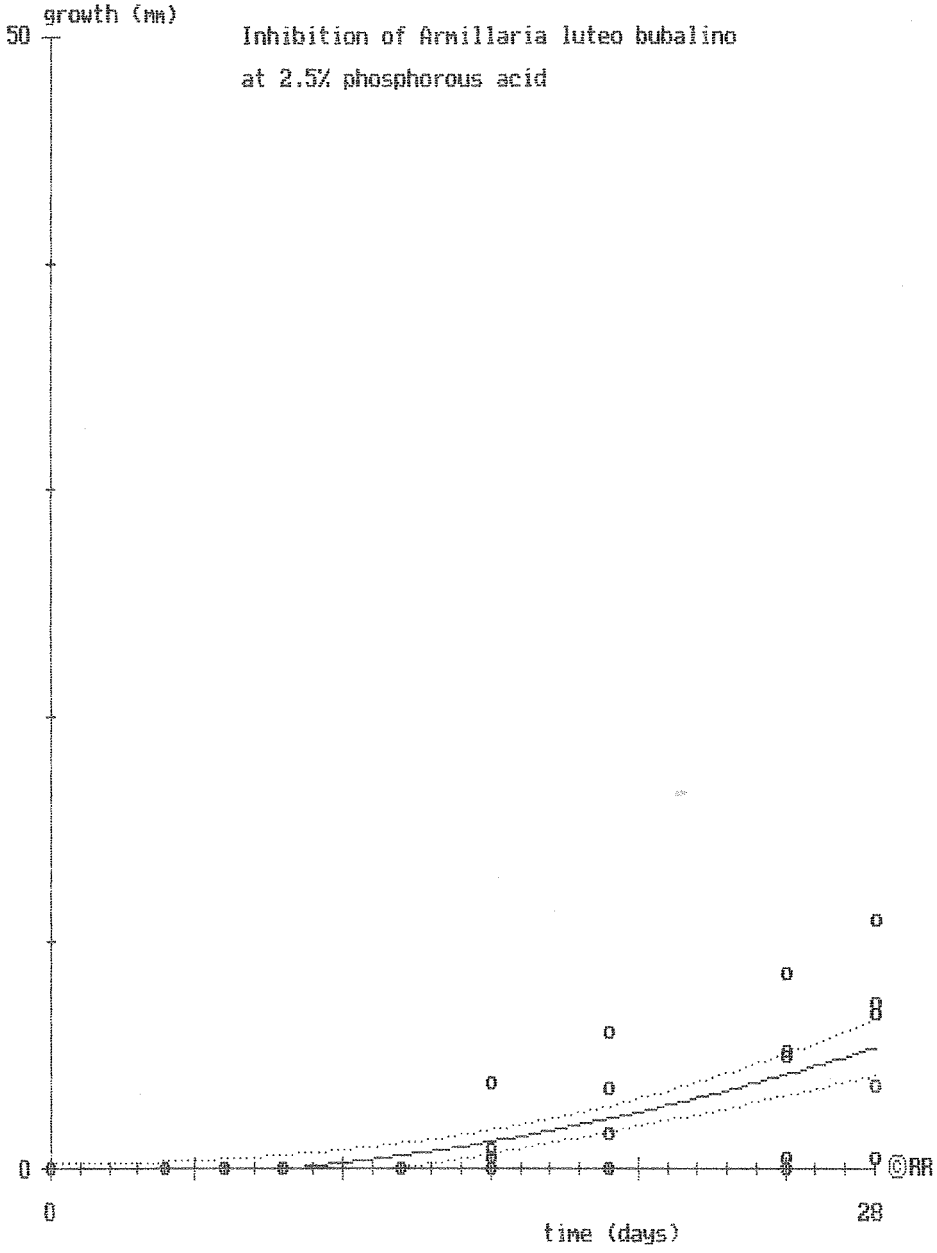
If the model is assumed to be correct, the estimated standard deviation of Y is 1.8278E+00 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 50 observations and use the same type and order of equation to obtain Yreg at X

Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 5.109E-01	- 1.225E+00	2.035E-01
2	0.000E+00	0.000E+00	- 5.109E-01	- 1.225E+00	2.035E-01
3	0.000E+00	0.000E+00	- 5.109E-01	- 1.225E+00	2.035E-01
4	0.000E+00	0.000E+00	- 5.109E-01	- 1.225E+00	2.035E-01
5	0.000E+00	0.000E+00	- 5.109E-01	- 1.225E+00	2.035E-01
6	4.000E+00	0.000E+00	- 3.912E-01	- 1.084E+00	3.013E-01
7	4.000E+00	0.000E+00	- 3.912E-01	- 1.084E+00	3.013E-01
8	4.000E+00	0.000E+00	- 3.912E-01	- 1.084E+00	3.013E-01
9	4.000E+00	0.000E+00	- 3.912E-01	- 1.084E+00	3.013E-01
10	4.000E+00	0.000E+00	- 3.912E-01	- 1.084E+00	3.013E-01
11	6.000E+00	0.000E+00	- 2.415E-01	- 9.079E-01	4.248E-01
12	6.000E+00	0.000E+00	- 2.415E-01	- 9.079E-01	4.248E-01
13	6.000E+00	0.000E+00	- 2.415E-01	- 9.079E-01	4.248E-01
14	6.000E+00	0.000E+00	- 2.415E-01	- 9.079E-01	4.248E-01
15	6.000E+00	0.000E+00	- 2.415E-01	- 9.079E-01	4.248E-01
16	8.000E+00	0.000E+00	- 3.205E-02	- 6.644E-01	6.003E-01
17	8.000E+00	0.000E+00	- 3.205E-02	- 6.644E-01	6.003E-01
18	8.000E+00	0.000E+00	- 3.205E-02	- 6.644E-01	6.003E-01
19	8.000E+00	0.000E+00	- 3.205E-02	- 6.644E-01	6.003E-01
20	8.000E+00	0.000E+00	- 3.205E-02	- 6.644E-01	6.003E-01
21	1.200E+01	0.000E+00	5.665E-01	1.035E-02	1.123E+00
22	1.200E+01	0.000E+00	5.665E-01	1.035E-02	1.123E+00
23	1.200E+01	0.000E+00	5.665E-01	1.035E-02	1.123E+00
24	1.200E+01	0.000E+00	5.665E-01	1.035E-02	1.123E+00
25	1.200E+01	0.000E+00	5.665E-01	1.035E-02	1.123E+00
26	1.500E+01	0.000E+00	1.172E+00	6.517E-01	1.693E+00
27	1.200E+01	0.000E+00	5.665E-01	1.035E-02	1.123E+00
28	1.200E+01	0.000E+00	5.665E-01	1.035E-02	1.123E+00
29	1.200E+01	0.000E+00	5.665E-01	1.035E-02	1.123E+00
30	1.200E+01	0.000E+00	5.665E-01	1.035E-02	1.123E+00
31	1.500E+01	8.330E-01	1.172E+00	6.517E-01	1.693E+00
32	1.500E+01	0.000E+00	1.172E+00	6.517E-01	1.693E+00
33	1.500E+01	5.000E-01	1.172E+00	6.517E-01	1.693E+00
34	1.500E+01	0.000E+00	1.172E+00	6.517E-01	1.693E+00

35	1.500E+01	3.833E+00	1.172E+00	6.517E-01	1.693E+00
36	1.900E+01	3.500E+00	2.190E+00	1.616E+00	2.763E+00
37	1.900E+01	0.000E+00	2.190E+00	1.616E+00	2.763E+00
38	1.900E+01	1.500E+00	2.190E+00	1.616E+00	2.763E+00
39	1.900E+01	0.000E+00	2.190E+00	1.616E+00	2.763E+00
40	1.900E+01	6.000E+00	2.190E+00	1.616E+00	2.763E+00
41	2.500E+01	5.000E+00	4.165E+00	3.229E+00	5.101E+00
42	2.500E+01	0.000E+00	4.165E+00	3.229E+00	5.101E+00
43	2.500E+01	5.167E+00	4.165E+00	3.229E+00	5.101E+00
44	2.500E+01	5.000E-01	4.165E+00	3.229E+00	5.101E+00
45	2.500E+01	8.667E+00	4.165E+00	3.229E+00	5.101E+00
46	2.800E+01	7.333E+00	5.355E+00	4.137E+00	6.572E+00
47	2.800E+01	7.670E+00	5.355E+00	4.137E+00	6.572E+00
48	2.800E+01	6.800E+00	5.355E+00	4.137E+00	6.572E+00
49	2.800E+01	3.000E-01	5.355E+00	4.137E+00	6.572E+00
50	2.800E+01	1.100E+01	5.355E+00	4.137E+00	6.572E+00

RR--



o original points
..... 95% confidence interval

Figure 7E

Armillaria, inhibition of 5% phos.acid

Function obtained:
Y = +(7.27 +- 0.53)*E-03*(X*X)
    -(3.0 +- 1.9)*E-01*(1)

Analysis of Variance

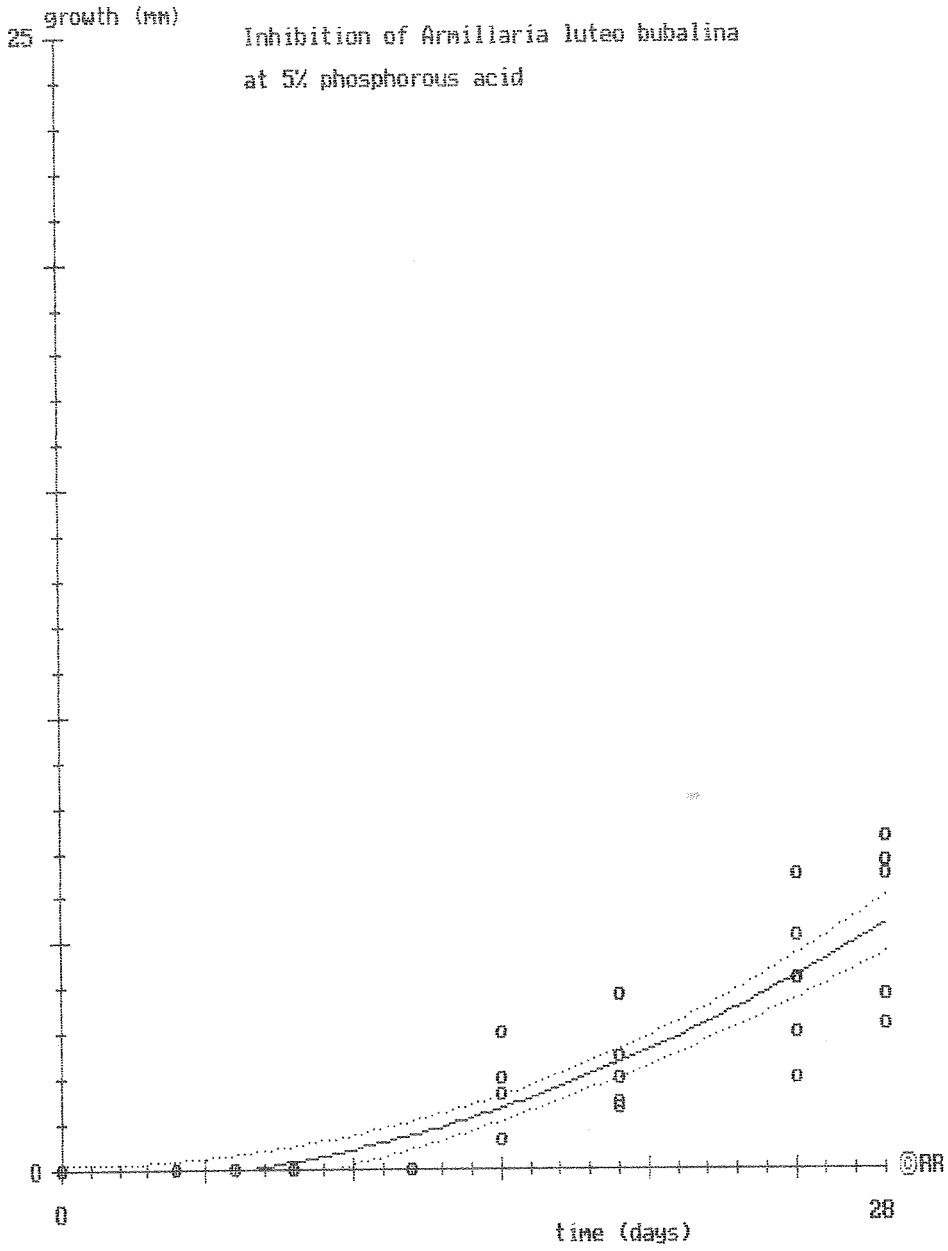
Sum of Squares	Value	Degr.Freedom	Variance
Total	3.1427E+02	45	
Due to regression	2.7588E+02	2	1.3794E+02
Residual	3.8384E+01	43	8.9264E-01

If the model is assumed to be correct, the estimated standard deviation of Y is 9.4480E-01 (absolute)

The 95% confidence values show the limits between which you can expect the value of Yreg if you repeat all 45 observations and use the same type and order of equation to obtain Yreg at X

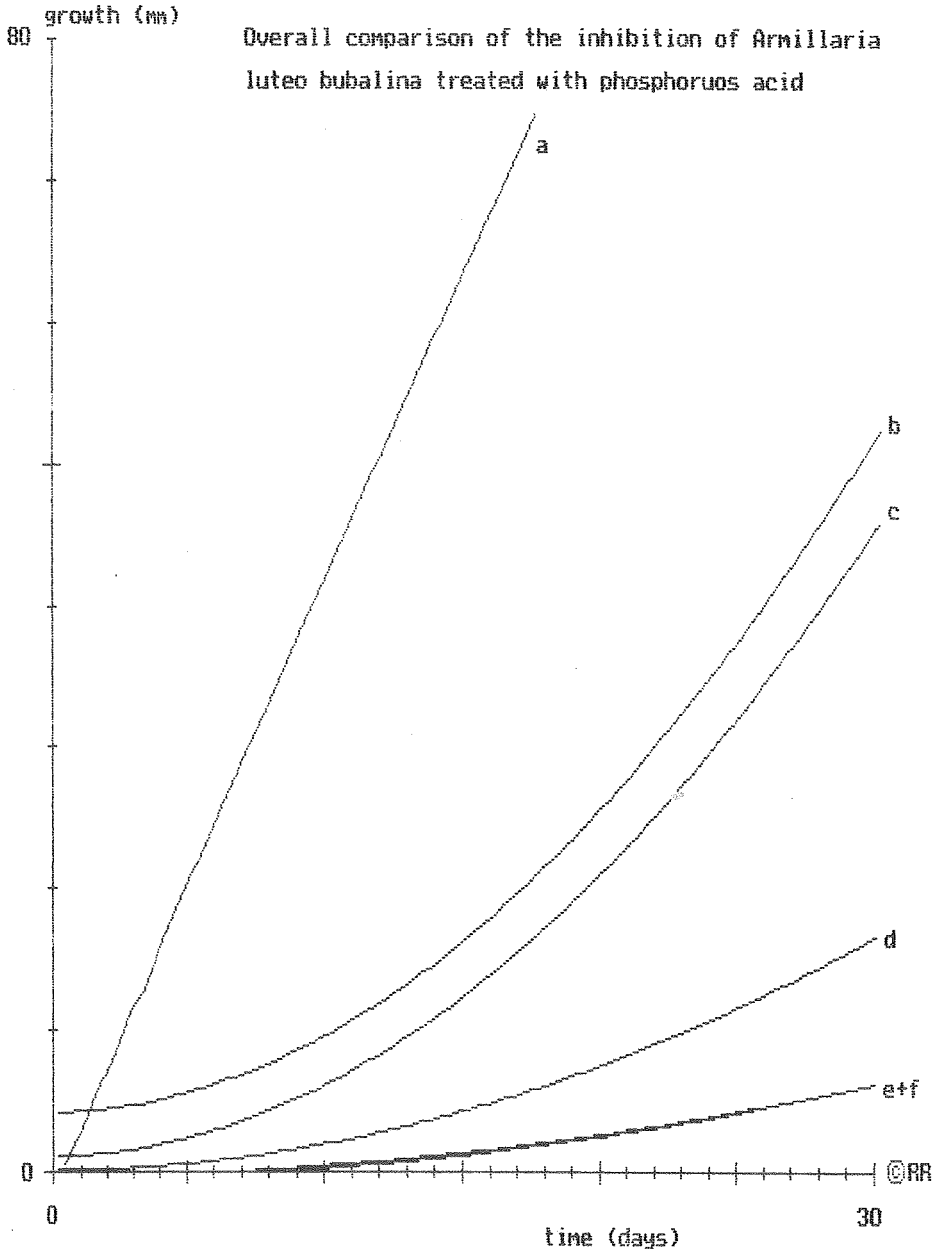
Point	X	Y	Yreg	YLo95%	YHi95%
1	0.000E+00	0.000E+00	- 2.967E-01	- 6.854E-01	9.196E-02
2	0.000E+00	0.000E+00	- 2.967E-01	- 6.854E-01	9.196E-02
3	0.000E+00	0.000E+00	- 2.967E-01	- 6.854E-01	9.196E-02
4	0.000E+00	0.000E+00	- 2.967E-01	- 6.854E-01	9.196E-02
5	0.000E+00	0.000E+00	- 2.967E-01	- 6.854E-01	9.196E-02
6	4.000E+00	0.000E+00	- 1.804E-01	- 5.577E-01	1.969E-01
7	4.000E+00	0.000E+00	- 1.804E-01	- 5.577E-01	1.969E-01
8	4.000E+00	0.000E+00	- 1.804E-01	- 5.577E-01	1.969E-01
9	4.000E+00	0.000E+00	- 1.804E-01	- 5.577E-01	1.969E-01
10	4.000E+00	0.000E+00	- 1.804E-01	- 5.577E-01	1.969E-01
11	6.000E+00	0.000E+00	- 3.494E-02	- 3.987E-01	3.288E-01
12	6.000E+00	0.000E+00	- 3.494E-02	- 3.987E-01	3.288E-01
13	6.000E+00	0.000E+00	- 3.494E-02	- 3.987E-01	3.288E-01
14	6.000E+00	0.000E+00	- 3.494E-02	- 3.987E-01	3.288E-01
15	6.000E+00	0.000E+00	- 3.494E-02	- 3.987E-01	3.288E-01
16	8.000E+00	0.000E+00	1.687E-01	- 1.773E-01	5.146E-01
17	8.000E+00	0.000E+00	1.687E-01	- 1.773E-01	5.146E-01
18	8.000E+00	0.000E+00	1.687E-01	- 1.773E-01	5.146E-01
19	8.000E+00	0.000E+00	1.687E-01	- 1.773E-01	5.146E-01
20	8.000E+00	0.000E+00	1.687E-01	- 1.773E-01	5.146E-01
21	1.200E+01	0.000E+00	7.504E-01	4.447E-01	1.056E+00
22	1.200E+01	0.000E+00	7.504E-01	4.447E-01	1.056E+00
23	1.200E+01	0.000E+00	7.504E-01	4.447E-01	1.056E+00
24	1.200E+01	0.000E+00	7.504E-01	4.447E-01	1.056E+00
25	1.200E+01	0.000E+00	7.504E-01	4.447E-01	1.056E+00
26	1.500E+01	1.667E+00	1.339E+00	1.054E+00	1.625E+00
27	1.500E+01	1.667E+00	1.339E+00	1.054E+00	1.625E+00
28	1.500E+01	6.660E-01	1.339E+00	1.054E+00	1.625E+00
29	1.500E+01	3.000E+00	1.339E+00	1.054E+00	1.625E+00
30	1.500E+01	2.000E+00	1.339E+00	1.054E+00	1.625E+00
31	1.900E+01	2.500E+00	2.328E+00	2.021E+00	2.635E+00
32	1.900E+01	1.500E+00	2.328E+00	2.021E+00	2.635E+00
33	1.900E+01	1.333E+00	2.328E+00	2.021E+00	2.635E+00
34	1.900E+01	3.833E+00	2.328E+00	2.021E+00	2.635E+00

35	1.900E+01	2.000E+00	2.328E+00	2.021E+00	2.635E+00
36	2.500E+01	5.167E+00	4.248E+00	3.760E+00	4.736E+00
37	2.500E+01	3.000E+00	4.248E+00	3.760E+00	4.736E+00
38	2.500E+01	4.167E+00	4.248E+00	3.760E+00	4.736E+00
39	2.500E+01	6.500E+00	4.248E+00	3.760E+00	4.736E+00
40	2.500E+01	2.000E+00	4.248E+00	3.760E+00	4.736E+00
41	2.800E+01	7.333E+00	5.404E+00	4.772E+00	6.036E+00
42	2.800E+01	3.167E+00	5.404E+00	4.772E+00	6.036E+00
43	2.800E+01	6.800E+00	5.404E+00	4.772E+00	6.036E+00
44	2.800E+01	6.500E+00	5.404E+00	4.772E+00	6.036E+00
45	2.800E+01	3.833E+00	5.404E+00	4.772E+00	6.036E+00



o original points
..... 95% confidence interval

Figure 7F



a : incubation on a control medium in a petri dish

b : incubation on a 0.25% (v/v) phosphorous acid containing medium, in a petri dish

c : incubation on a 0.50% (v/v) phosphorous acid containing medium, in a petri dish

d : incubation on a 1.00% (v/v) phosphorous acid containing medium, in a petri dish

e : incubation on a 2.50% (v/v) phosphorous acid containing medium, in a petri dish

f : incubation on a 5.00% (v/v) phosphorous acid contianing medium, in a petri dish

Figure 7G

POTATO DEXTROSE AGAR / PVPH **P 10**

PROCEDURE FOR PREPARING SELECTIVE AGAR

100ml. erlenmyer containing distilled water

100ml. erlenmyer.

Place 78gms. Potato Dextrose Agar
35gms. Bacto Agar in 5000ml. erlenmyer and cover with 4000ml. distilled water.

Autoclave at 15lb. p.s.i. for 15 minutes.

Check water bath level and turn on to 50°C.

Remove articles from the autoclave when pressure has dropped. Place melted agar into water bath to cool.

Place remaining articles in the clean air station.

Ingredients of Media:

Pimafucin	1.6ml.
Vancocin	800mgm.
PCNB	400mgm.
Hymexazol	200mgm.

Pimafucin - place bottle in clean air station.

Vancocin - weigh out in 50ml. beaker and then place in clean air station.

PCNB - weigh out in a 10ml. beaker, place crystals in the sterile erlenmyer and pipette 10mls. Acetone in to sterilize the PCNB.

Hymexazol - weigh out in a 10ml. beaker and place in the clean air station.

Place on the right hand side of clean air station 80-90 stermined disposable 15cm. petri dishes.

Put kettle onto boil.

Add a little sterile distilled water to the Vancocin and Hymexazol and stir until completely dissolved.

Rinse machine with freshly boiled distilled water before and after each agar batch. Clean machine regularly.

When agar has cooled to 50°C:

Remove from the water bath to the clean air station.

Using 2ml. syringe and hypodermic needle asceptically withdraw 1.6ml. pimafucin and add to the agar.

Gently add the dissolved Vancocin and Hymexazol.

When the PCNB has completely dissolved, add french square of Tween 80 and distilled water and shake into a fine milky suspension. Add to the agar.

Gently shake flask to mix. Must be completely mixed.

Commence using the filamatic (foot control). Use the first 200mls. to rinse antibiotic containers out, then commence pouring plates.

Rinse with boiling water at completion of pouring agar. Recipe makes approx. 85 plates. Store in fridge when plates are set.

Medium P5 / PDA

for 5 liters :

78 g. Potato Dextrose Agar.
35 g. Bacto Agar
50 mg. Amplicillin.
200 mg. Hymexazol
1.6 ml. Pimafucin
0.8 ml. Rifampicin

Autoclave at 15 lb. p.s.i. for 15 minutes.
Check water bath level and turn to 50 degrees Celsius.
After cooling antimicrobials are added and mixed.