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REPORT ON RESEARCH ACTIVITIES CARRIED OUT ON THE COCONUT MITE (ERIOPHYES GUERRERONIS) IN ST LUCIA

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IICA OFFICE IN ST. LUCIA

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EVERTON AMBROSE

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EVERTON C. AMRBOSE
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SUMMARY

The investigations on coconut mite control carried out by IICA are based on the effect of rainfall on mite, the effects of chemicals on mite and an examination of fertilizer on mite damage.

In undertaking the research activities IICA developed a standard method to assess coconut mite damage. The method is quick, simple and easy to use. It is based on Mc Kinney's formula for Disease Indexing.

Observations made in a number of areas revealed that mites invade the nut soon after fertilization when the nut begins to develop and the perianth to separate. There is rapid mite population growth during the period of rapid nut growth when the nut tissues are soft and possibly nutrients are more readily available. As nut growth is reduced the perianth hardens, nutrient materials are reduced and so does the mite population. The effect of rainfall on the percentage mite infested nuts was different in the different areas. In some areas the percentage infested nuts increase with increase rainfall whilst the opposite was true in other areas. This was also the case for the effect of rainfall and damage levels of nuts. It is likely that factors other than rainfall influence population growth and damage.

Chemical control of mite was also an important aspect of this study. Low toxic chemicals were applied by spraying the bunches

The effect of fertilizer on mite was examined. The results indicate that fertilizer does not control coconut mite. Perhaps good nutrition can increase the plant's ability to withstand mite attack. The trial was not run for a long enough period to corroborate that.

It appears therefore that many factors affect coconut mite damage. Banana spray oil has proven effective but more work is required on biological control, agronomic practices and use of tolerant varieties.

1. BACKGROUND

1.1 Nature of the Problem

The coconut mite, Eriophyes guerreronis Keifer, is a serious pest of coconuts. The mite was initially reported in Mexico around 1960 but since then it has colonized most of the coconut growing areas of Latin America and the Caribbean.

The presence of the mite in St. Lucia was confirmed in 1982 by R. Griffith, Director of Red Ring Research in Trinidad (personal communication), but symptoms of coconut mite damage had been observed in St. Lucia by Dr. S. Parasram then UWI Entomologist (personal communication) since the early 1970's.

Infestation apparently begins on the very young nuts in the area underneath the bracts. The location of the mites beneath the bracts affords them protection from the weather, chemicals and biological control agents. As the nut grows, the feeding marks radiate from under the bracts as roughly triangular yellowish-green or whitish areas on the nut's surface. With time, the blemish enlargens and turns brown and with continued growth of the nut the damaged area becomes corky with reticulate cracks from which gum sometimes exudes.

The main effects of the mite are as follows:

- reduction of nut size and the quantity of kernel per nut;
- premature nut fall resulting in a reduction in the number of harvested coconuts per tree per year;
- increased labour costs for husking because of the hardened pericarp.

1.2 Past Initiatives

A survey carried out by the Ministry of Agriculture in 1982 indicated that mite symptoms were widely distributed on the island (D. Auguste, personal communication). The overall infestation level was 78%. Another survey by Alam (1984) showed infestation levels ranging from 61.6% to 87.5%.

In an effort to address the problem, the Ministry of Agriculture convened meetings of locally based agricultural organizations in March and April 1984, to discuss possible lines of action. As a result, proposals were made for a multi-faceted project to address the chemical, biological and cultural control aspects (Anon 1985).

In May 1984, an FAO financed research project was initiated in St. Lucia. Moore, a CIBC consultant, carried out experiments based on:

- the injection of Kilval (vamidothion) into the trunk of the trees as a follow-up of Griffith's recommendations,

- spraying polybutanes with or without acaricides onto the flowers and

- spraying the young coconuts with the fungus *Hirsutella thompsonii* which is known to be pathogenic on the mite.

The FAO research project was also concerned with:

- studying the biological control aspects,

- the effect of mite damage on copra yields and

- the effect of nutrient status on mite infestation.

The FAO research project ended reporting no significant control with any of the treatments tried (Moore 1986). It was concluded that control of the mite using specific treatments was not possible at present. Improved agronomy together with a replanting programme to improve the coconut industry was suggested.

IICA has implemented a systematic study of mite control with attention given to the chemical and nutrient aspects of control. The efficacy of selected low toxicity chemicals and the various methods of applying them for mite control were examined. Our research also included examination of the influence of improved fertilizer practices on mite control and the possible effect of rainfall on the population dynamics of the mite.

This report gives an account of the study carried out by IICA and makes suggestions for further work.

2. RESEARCH ON COCONUT MITE

2.1 Method to Assess Coconut Mite Damage

2.1.1 Literature Review

Assessment of mite damage has been made in various ways. In assessing chemical control experiments, Ortega et al (1965) and Ortega and Banda (1967) used an assessment method based on microscopic examination of the mites on coconuts. This method relies on laboratory assessment and is time consuming. Hall (1981) noted that Mariau and Julia 1970 used nut deformation on the dry or ripe nut as it affects copra yields to categorize damage. However, this method is confined to the ripe or dry nut and not the immature nut which sometimes are not deformed. Mariau and Julia 1970, Suah 1973 in Hall (1981) assessed damage on the basis of the proportion of nuts attacked per bunch. This method is not very accurate in assessing the efficiency of control methods as a high proportion of nuts on a tree may be slightly damaged yet the treatment may be considered ineffective. Thus, this method does not convey the true effect of a control method. Hall (1981) assessed damage on the basis of lesion size. However, it is necessary to standardize mite damage levels to evaluate objectively not only effectiveness of control but also to compare damage levels from different workers. The method needs to be quick, simple and could be used internationally in assessing coconut mite damage. Such a method is described below and is used in assessing mite damage throughout this report.

2.1.2 Method

The inflorescence which is considered to be less than one month old is noted as zero. The bunch after the inflorescence (No. 1) is considered to be one month old since an inflorescence is produced approximately monthly, bunch No. 2 - two months old and so on. The nuts on either bunch No. 4 or 5 are individually assessed on a 0 through 4 scale of damage rating (Table 1) and the Damage Index (D.I.) of the bunch under examination and hence.

the tree is determined by using a modification of McKinney's formula (1959) which follows:

$$D.I. = \frac{\text{Sum of all ratings}}{\text{No. of Nuts examined}} \times \frac{100}{\text{Maximum disease category}}$$

TABLE 1: Measurement of Intensity of Mite Damage on Coconut

(Rating) Scale		Description
0	Clean -	No visible signs of damage on any part of the coconut.
1	Speck -	Damage visible, not more than 5% of area of one side damaged and remaining two sides undamaged.
2	Light -	Damage visible on about 33% of one surface. Damage on other surfaces if present should be in the speck category.
3	Severe -	Visible brown signs on nearly half of one surface or all surfaces to the extent of approximately 10%.
4	Very Severe -	Visible brown signs on more than half of one, two or three surfaces.

2.1.3 Discussion

The method described above is quick and simple. It can be used by any one who understands the description of the scale in Table 1. The disadvantages is that the nut has to be examined carefully. This entails picking the nut or climbing the tree.

2.2 The Effect of Rainfall on The Incidence of Mite

2.2.1 Introduction

The inflorescence of the coconut palm bursts from the spathe at monthly intervals. Thus, the first coconut bunch after the inflorescence is considered to be one month old while the infloresence is less than one month or zero month old.

The nut normally develops to its full size in 5-7 months when the kernel or solid endosperm is being accumulated. The endosperm then thickens and hardens at maturity (8-9 months old). At maturity the exocarp retains its characteristic colour and the mesocarp its white and tough texture. When the mature nut ripens after 13-16 months, the exocarp dries to a greyish brown colour and the mesocarp of the very ripe nut is a fibrous mass.

Observations made on bunches 1-12 should indicate mite activities as it relates to the rainfall in that area one year before.

2.2.2 Materials and Methods

Observations were made at Errard October 1985, Anse Canot in November 1985, Grace in December 1985, Babonneau in February 1986, Forestierre in February 1986, Louvet in March 1986 and Belle Vue in June 1986. Mean monthly rainfall for each area is presented in Table 2.

TABLE 2: Mean Monthly Rainfall of some areas in St Lucia (Land and Water Use Unit, Ministry of Agriculture)

Area	Mean Monthly Rainfall in (in)	(mm)
Errand	6.24	(159.5)
Anse Canot	5.31	(134.8)
Grace	4.72	(119.9)
Babonneau	5.83	(148.0)
Forestierre	7.52	(191.0)
Louvet	5.3	(134.6)
Belle Vue	7.41	(188.2)

At each site bunches No. 1-12 or 13 (Louvet No. 1-10) were cut from one coconut tree. Two coconut trees were examined at Errard. The nuts were examined closely noting the number of nuts damaged per bunch, the level of

damage on all nuts on a 0 through to 4 scale and the presence or absence of mites on a sample of not more than 10 nuts from each bunch.

The perianth lobes of each of the nuts were examined with a hand lens magnification x 10.

2.2.3 RESULTS

2.2.3.1 Mite Infestation

The percentage of infested nuts observed on the bunches examined in the different areas are presented in Figures 1a to 1h.

Where mites were present on the nuts in the different areas, they were found beneath the inner and/or outer bracts but in the one month old bunches were commonly found beneath the outer bracts.
Generally, mite infestation increased from bunch 1 to a maximum on bunches 3, 4 or 5 and then began to decrease.

2.2.3.2 Percentage Mite Infested Nut and Rainfall

Significant correlation between rainfall and percentage of nuts infested on the bunch was observed at Grace (Fig. 2a) and Forestierre (Fig. 2b). The (r) correlation coefficient at these sites were 0.71 and 0.60 respectively with regression of rainfall on percentage nuts infested of 0.51 and 0.35. The best fit was within the same month for Forestierre and rainfall one month before for Grace.

There was some evidence of association between rainfall and percentage of nuts infested on the bunch at Louvet 0.54, Anse Canot -0.13, Errard -0.34 and -0.45 and Babonneau 0.38, but it was not significant.

2.2.3.3 Mite Damage

The level of damage observed on the bunches examined in the different areas are presented in Figures 3a to 3h.

2.2.3.4 Mite Damage and Rainfall

Significant correlation(r) between rainfall and damage level on the nuts was observed at Errard (-0.69 and -0.97) Fig 4a and b and Grace (-0.64) Fig. 4c with a regression of rainfall on mite damage of 0.47, 0.93 and 0.41 respectively. There was some evidence of association between rainfall and the level of mite damage at Louvet 0.57, Babonneau 0.35, Anse Canot 0.52, Forestierre 0.27 and Belle Vue 0.31 but they were not significant. Generally, the line with the best fit (significance) was rainfall two months before damage at Errard and the same month of damage at Grace.

During observations on coconuts, scarring of a different nature than that of the coconut mite was observed. This damage is almost similar to that of the coconut mite but is not as intense as the latter. The scarring may be a result of the feeding activity of another mite *Steneotarsonemus furcatus* De Leon, a pest of *Paspalum* sp. That mite was observed on bunch No. 2 but was mostly found on bunch No. 3. Where the scarring and that mite were observed, the population of the coconut mite was either very low or no coconut mites were observed.

2.2.4 Discussion of Results

Mites apparently invade the nuts very early possibly after fertilization. When the inflorescence is about 22 days the female flowers open and are receptive up to about eight days. Thus, within about one month (30 days) the ovary is fertilized and the nut begins to develop. As the nut develops, the perianth separates and loosens creating portals of entry for the coconut mite. This is in agreement with findings by Mariau (1977) who observed mites beneath bracts of 1-2 week old nuts or less than 2 month old bunches. Invasion may occur through the outer or inner bracts.

There appears to be rapid mite population growth during the period of fast nut growth when the tissues are soft and possibly materials are more readily available. As growth is reduced at about six months and the

pericarp begins to harden, nutrient availability reduces and so does the mite population (Fig. 1a-1h). Perhaps the mite population found on nuts after maturity (9 months) is the residue of the original population which developed when the bunch was younger. Perhaps protecting the infloresence and bunches 1 to 4, either physically with a non-poisonous material or with low toxic acaricide, will reduce mite population and damage. However, frequency of application has to be worked out. On the other hand, one has to consider the effect of the material on natural enemies. Thus, there is a need for work on an integrated approach to mite control.

There is evidence that the effect of rainfall on the percentage of mite infested nuts is different in the areas examined. At Grace (Fig. 2a) and Forestierre (Fig. 2b), the percentage infested nuts increases with increase in rainfall. However, except for Grace (CD = 50.8%) less than 50% of this variation of infested nuts was explained by its relationship with rainfall (Forestierre CD = 35%). At Babonneau (r = 0.38), Anse Canot (r = -0.13), Errard (r = -0.46 and -0.34), Louvet (r = 0.54) and Belle Vue (r = 0.45), there was no significant association between rainfall and percentage of mite infested nuts. Possibly plant growth and natural enemies are responsible. Perhaps at certain times during the rainy season in some areas there is better plant growth and softer nut cells increasing the mite population.

On the other hand, rainfall and damage level of nuts were associated at Grace (r = -0.64), (Fig 4c) and Errard (r = -0.69, -0.97), (Fig 4a and 4b). Except for one tree at Errard (93%), only 40-47% of association is explained by the relationship of rainfall and damage level. Damage apparently decreases with increase in rainfall. Perhaps there is greater migration during that period and more mites are washed off the nut. Again, the effect of rainfall may be different depending on the site.

It appears, therefore, that many factors affect percentage infested nuts and mite damage levels on coconuts. The number of nuts and the growth rate of the young fruit have been mentioned as possible causes (Julia and Maraiu, 1979). In addition, the effect of *Steneotarsonemus furcatus* on

coconut mite should be studied further, as the former may be competing with the coconut mite for sites on the nut. It may be possible that some factor or factors kept the mite population low and the increase in sanitation and chemical spray in bananas may have disturbed the pest/natural enemy system causing an increase in pest population.

2.3 The Effect of Banana Spray Oil and Sulphur On Coconut Mite

2.3.1 Objectives

To assess the effect of monthly applications of banana spray oil and sulphur on coconut mite damage.

2.3.2 Materials and Methods

Two observation trials were established on dwarf coconuts at Belle Vue and La Caye. The treatments were as follows:

- Banana spray oil
- Flowable Sulphur
- Untreated control

There were six (6) replicates of the treatments of oil and sulphur and four (4) of the control. Single tree plots were used in all cases. Each plot was sprayed monthly and application began in May 1985.

From May through August 1985, the treatments were applied with a high volume (CP100) pneumatic sprayer at about 400 ml per tree. From September to December 1985, treatments were applied with a (Solo) mist blower at a rate of about 230 ml per tree. The trial at La Caye was terminated in October 1985. The Belle Vue trial continued without the sulphur treatment since October 1985 and from February 1986, had been sprayed with a Hudson Porta Pak Ultra-Low Volume sprayer at a rate of about 90 ml per tree. In July 1986, the application rate had been increased to about 200 ml per tree. The trial at Belle Vue was terminated in August 1986.

A pretreatment assessment of mite damage at each site was made in May. This assessment was on ten (10) trees per site using bunch No. 3 as the indicator for mite damage assessment on a tree. Assessment of treatment plots for mite damage began in July using bunch No. 3 as the indicator. Subsequently, assessments were carried out on a monthly basis using bunch No. 4 as the indicator.

In addition, the oil treatment was repeated at Fond Estate in Micoud, Anse Canot Estate, Cadet Estate (Errard) in Dennery and Melius Estate in Babonneau.

2.3.3 Results and Discussion

Assessment indicates that at Belle Vue the trees treated with banana spray oil maintained a low mite damage level from September 1985 about four months after the initial spray (Fig. 5). During the period September to November 1985, February, to June and August 1986 the damage level was lower in the oil treated trees than in the control. Sulphur was not different from the control but was different from oil in September 1985. There was no significant difference between oil and sulphur. Perhaps the sulphur treatment was not very effective because no spray additives were used.

The monthly spray with oil has been effective in protecting the nuts from mite damage. During October natural factors possibly rainfall caused a reduction of mite population in the control trees. Rainfall was high between July 1985 to January 1986. Control was less effective when the ULV sprayer was introduced possibly because of the reduced volume of oil. When the volume was increased in August there was good control; unfortunately, this coincided with the period of low rainfall. Possibly a large volume of oil is required to maintain control.

During the initial period until December the number of coconuts at bunch No. 4 and 5 were low in all treatments. This may be due to a number of

factors including damage by a moth borer Atheloca bondari which was found in the nutlets and possibly the beetle Cholus zonatus, a known pest of coconut midrib, was observed feeding on the nutlets for the first time during the period May to about August.

At La Caye, the effect of oil was not as dramatic possibly because of the high incidence of nut fall. The conditions under which the plants were growing were sub-standard. The area was water-logged in the wet season and was very weedy. There was also a high incidence of nutlet moth borer damage Atheloca bondari. The experiment at La Caye was terminated in October 1985.

At Fond Estate (Fig. 6), the damage level was low in both the oil treated and untreated trees. Only in April 1986 was the level of the oil treated trees lower than in the control trees. In such a situation, it may not be economical to treat with oil since other factors reduce the mite population to a low level. The mite Steneotarsonemus furcatus was observed on the nuts.

At Anse Canot (Fig. 7) oil reduced mite damage level lower than the untreated for the period February to June and October to December 1986. On the other hand, the damage in the untreated trees was kept at an almost steady level indicating that some factor was responsible. At Errard (Fig. 8), oil reduced mite damage level lower than the untreated in April, May and July 1986. The trend was towards low damage level in the oil treated trees. At Babonneau (Fig. 9), there was also a trend indicating that oil treatment was effective. Significant results were obtained in October and August and June 1986.

Results suggest that banana spray oil controls coconut mite. It is possible that mites were being controlled by banana spray oil during the period up to the mid-1970's when 26 cycles of oil per year were being applied to control banana leaf spot. With the introduction of the systemic fungicide to oil in the late 1970's, the cycles were reduced to 8 to 10 per year. During the period of heavy oil application natural enemies

(predators and fungi) may have been reduced also so that the mite population was able to develop to pest levels at a very fast rate in the absence of competition.

2.4 Efficacy of Soil Applied Systemic Chemicals on Coconut Mite

2.4.1 Objective

To assess the efficacy of different systemic insecticides applied to the soil at the base of the plant on coconut mite.

2.4.2 Materials and Methods

A trial was established at Grace on dwarf coconuts (10-15 ft. tall). There were six plants per treatment and the chemicals were applied to the soil about 4-6 ft. from the base of the tree at a rate of 8.4 g. or 8.4 ml. per inch of trunk diameter measured at 80-90 cm high (Tashiro 1973). The treatments were as follows:

Treatment	Rate Applied
Oxamyl (Vydate L 24)	100-120 ml
Carbofuran (Furadan 10G)	100-120 g
Carbosulfan (Marshall L4)	100-120 ml
Vamidothion (Kilval L40)	100-120 ml
Control	no treatment

Liquid was applied with a "spot gun" while granules were applied with a granule applicator. An initial assessment was made on the day the trial was established in October. Subsequent assessments and chemical applications were made every two months. Marshall and Kilval were applied once because of an insufficient supply at establishment. A supply of Kilval was received eight months after establishment.

The Vydate and Furadan treatments were repeated at Belle Vue and Babonneau under different conditions than those which exist at Grace.

2.4.3 Results

The damage indices recorded for the trial at Grace are summarized in Fig. 10. In December 1985 February, April and June 1986, Vydate and Furadan were superior to the control but not different from each other. In August Vydate behaved worse than Furadan.

At Belle Vue (Fig. 11) and at Babonneau (Fig 9) the damage by the coconut mite was not significantly lower than the control.

2.4.4 Discussion

Except for Grace the soil applied systemic chemicals were not effective in controlling mite damage. At Grace the effect may well be that of some natural factor possible rainfall as the effect appear to follow expected rainfall pattern. Possibly the method is effective in the drier areas but it was not effective at Babonneau where the rainfall is about the same as Grace. The results at Grace cannot be explained.

2.5 Effect of Fertilizers on Coconut Mite Damage

2.5.1 Objective

To assess the effect of different fertilizers on coconut mite.

2.5.2 Materials and Methods

A fertilizer trial was established in a pasture at Choc Estate, Castries in collaboration with the FAO project. Fertilizer levels used for the trial were based on a suitable manure mixture for bearing trees (Anon 1972).

The treatments were as follows:

Control	Untreated
Complete fertilizer N.P.K.	6 lb per tree per year
Sulphate of Ammonia	4 lb per tree per year
Muriate of Potash	2 lb per tree per year

There were ten plants per treatment replicated five times but assessments were made from five trees per plot. The fertilizers were applied in a circle 4 to 6 feet from the tree and 4 to 6 inches deep in three doses at monthly intervals starting in December in the first year. During the second year, at 14 months after establishment, each treatment was placed 4 to 6 inches deep and about 4 to 6 feet from the base of the tree.

An initial assessment of damaged nuts was made at establishment when the first dose of fertilizer was applied. Subsequent assessments were made at 4, 9, 14 and 18 months after the first fertilizer application. At 18 months 2 lb triple superphosphate was added to 10 additional trees.

2.5.3 Results and Discussion

The level of damage recorded in the various treatments was not different from each other at 4, 9, 14 and 18 months. However, a trend developed where the fertilizer treatments appeared to have higher damage levels (Fig. 12). Perhaps the mites benefited and developed more rapidly on the fertilized nuts or perhaps the cells of fertilized nuts are softer and are influencing high damage levels. Mites have been found to breed and develop more rapidly on plants given good nitrogen fertilization. In this experiment, sulphate of ammonia appeared to have the highest damage level at 4 and 9 months and muriate of potash at 14 and 18 months. Moore (personal communication) noted good positive correlation between mite damage and potassium levels.

Perhaps the fertilizer might increase the number of nuts per tree and the increase in copra yields although there was no significant increase in the total number of nuts per treatment or with time. All the treatments

appeared to have some evidence of increase nuts especially in April from the sulphate of ammonia plot. Mariau (1977) noted that the overall incidence of mite attack was small with a larger number of nuts and suggested that plantations with good yield would be proportionately less attacked than those with a low yield.

2.6 The Effect of Low Toxicity Chemicals On Coconut Mite Damage

2.6.1 Objective

To determine the efficiency of two low toxicity chemicals Citrazon and Savey on coconut mite damage.

2.6.2 Material and Methods

A trial was established on coconuts at Babonneau. The treatments were as follows:

Treatment	Rate
Citrazon	10.0 ml/l
Citrazon	20.0 ml/l
Savey	4.2 g/l
Savey	8.4 g/l
Control	no treatment

There were three plants per treatment and each treatment was applied every two months with a Hudson Porta Pak Ultra-Low Volume Sprayer at a rate of about 90 ml/tree. At La Caye the higher rates of chemicals were compared with oil and untreated control.

2.6.3 Results and Discussions

The results (Fig. 13) indicated that the chemicals had some effect on mite damage. The higher level of Citrazon appears to be the most effective having reduced the mite damage index below that of the control from October six months after the initial application of the chemicals. Savey and the lower concentration of citrazon were not effective.

At La Caye (Fig. 14), there were indications of reduced mite damage level. In fact, the chemicals were not different from the oil although except for Savey in March 1987, they were not different from the control. Considering the height of most of the trees in St. Lucia and the manner of application of these chemicals, the results obtained does not justify further work using these chemicals.

3. GENERAL DISCUSSIONS

The observations and experiments carried out indicate that mite population is being affected by natural factors. The question is whether the pest population developed above an economic threshold suddenly or whether it did gradually. There is evidence that the pest was present since 1970. If the former is the case then the population was being held below economic threshold levels but a sudden imbalance in the ecosystem caused the change in population about 1983. This may account for the theory that the mite came in after the hurricane. However, if the latter is the case, then the mite may have been introduced about the time it was observed and gradually developed to pest proportion either because natural factors were not able to keep the pest population at a balance or that some practice carried out over the years have caused the increase to pest proportions.

It was observed that many trees along the East Coast although infested with mites produced normal coconuts. It was observed also that where the populations of the mite *Steneotarsonemus furcatus* is high, the coconut mite population is either low or absent. There is evidence also that a wild strain of the fungus *Hirsutella thompsonii* a parasite of the coconut mite is present in St. Lucia. In addition, rainfall can reduce the mite population. All these, although available, had not been able to keep the mite population below pest levels.

Banana spray oil has been found to reduce mite damage. The material can also negatively affect predators and parasites like the *Hirsutella thompsonii*. It is possible that over the years the 26 oil applications per year were made, the high application rate must have affected

populations of both pest and natural enemies. When the oil applications were reduced to 6-8 per year about 1978, the coconut mite populations began developing at a faster rate than the natural enemy, thus causing the problem. In some pure stands of coconuts, although there is some damage, the nuts are not deformed. Possibly because of some natural conditions.

There is a particular field of banana intercropped with coconuts near the east cost which although showing evidence of mite damage in the tall trees the nuts are not deformed. This points to either the saline sea breeze or the good growing conditions or both abate mite damage. Perhaps both, since in some areas coconuts are intercropped with bananas yet there is a high infestation of mites, because, probably the levels of crop management are different.

4. RECOMMENDATIONS

4.1 Oil has given very good results in the experiments but the positive effect has been on the low trees. It might be worth trying aerial application for tall trees in a highly infested area.

4.1 There is need to do further work on proper agronomic practices.

4.3 Work on biological control has to be pursued, assessing the effect of the fungus

4.3.1 *Hirsutella thompsonii* and the mite

4.3.2 *Steneotarsonemus furcatus*

4.4 A serious effort should be made at introducing and evaluating tolerant/resistant varieties

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Fig. 1a: Percentage infested nuts per bunch on a tree at Errard

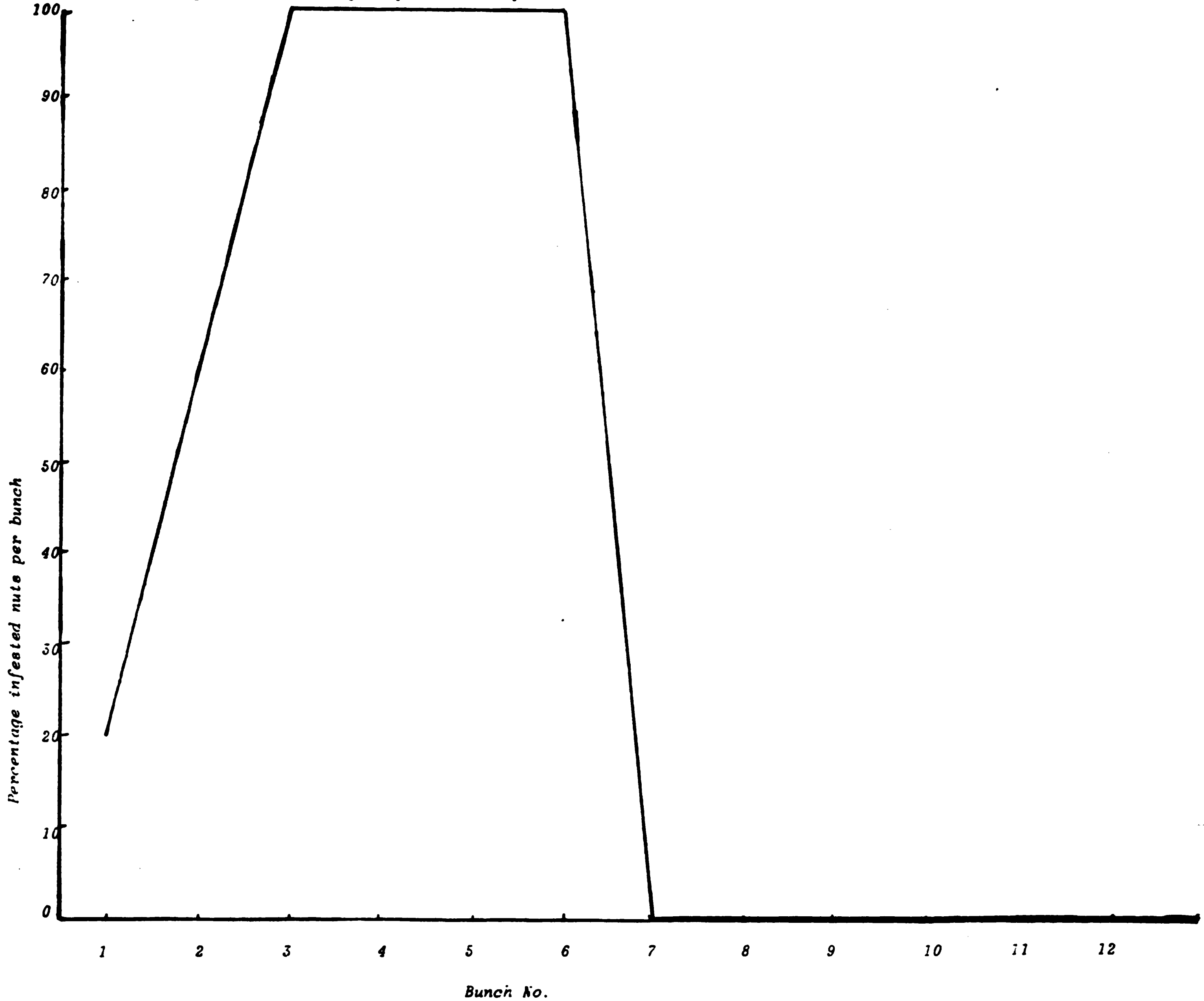


Fig. 10: Percentage infested nuts per bunch on a tree at [illegible]

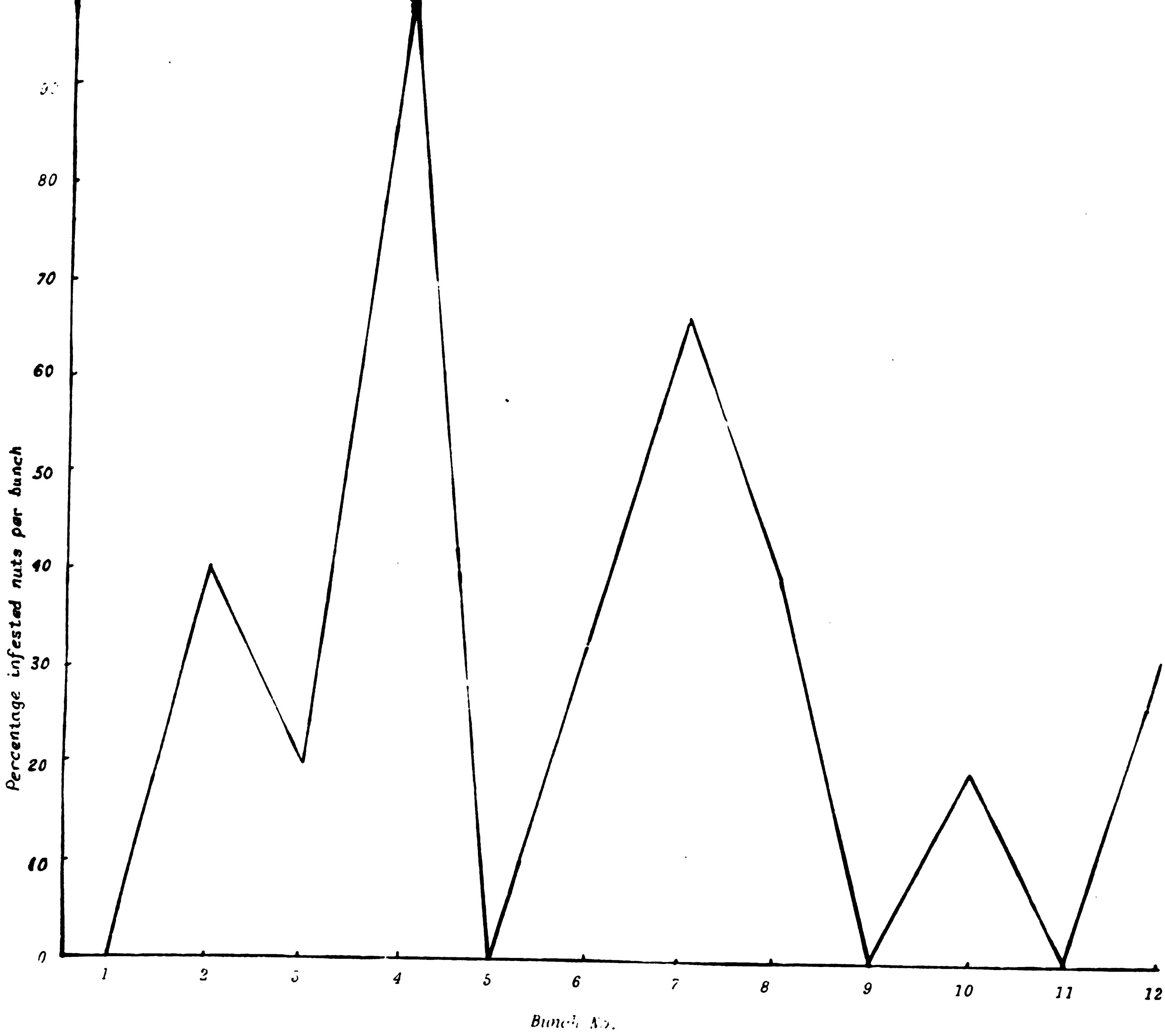


Fig. 1c: Percentage infested nuts per bunch on a tree at Anse Canot

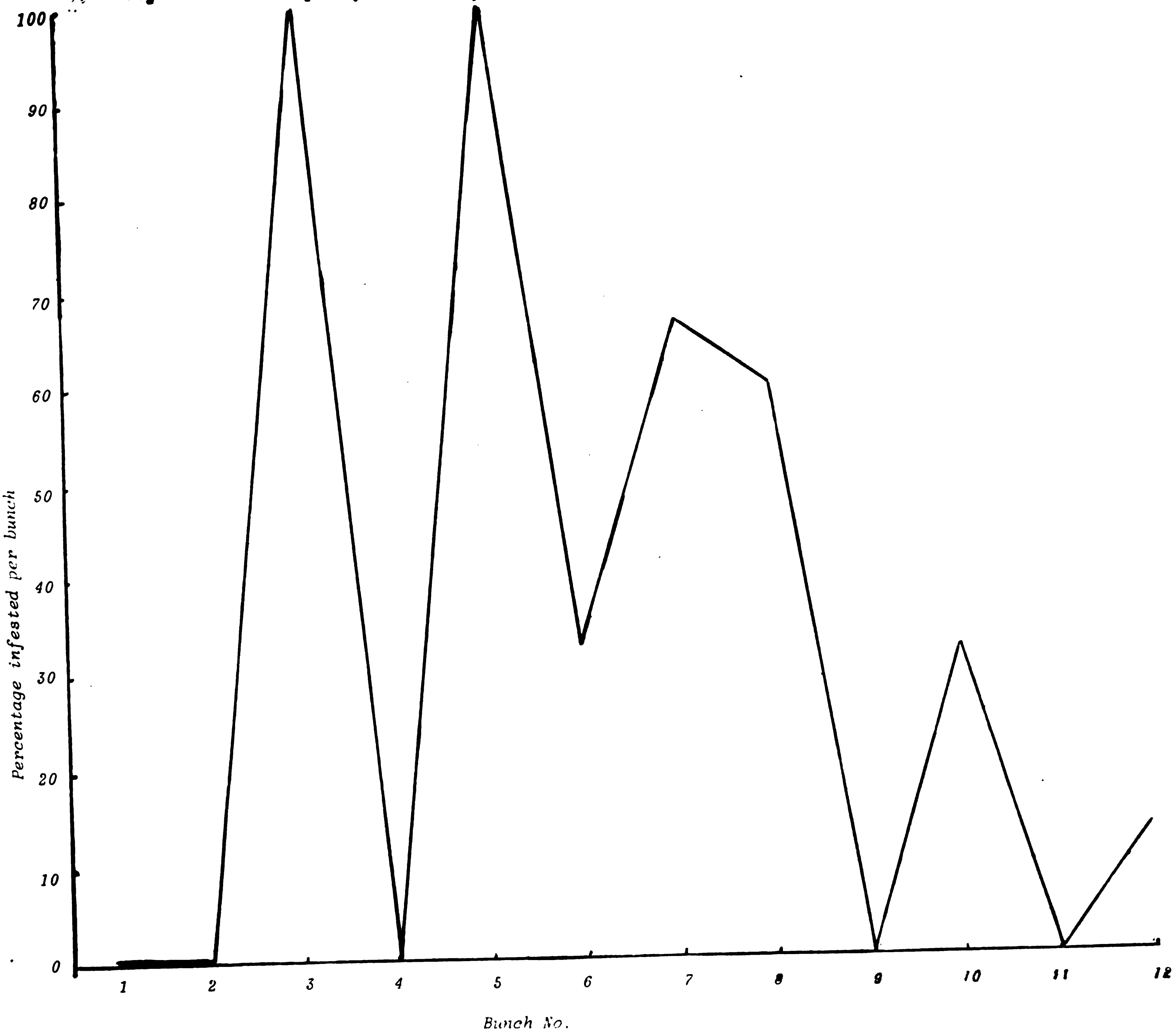


Fig. 1d: Percentage infested nuts per bunch on a tree at Graes

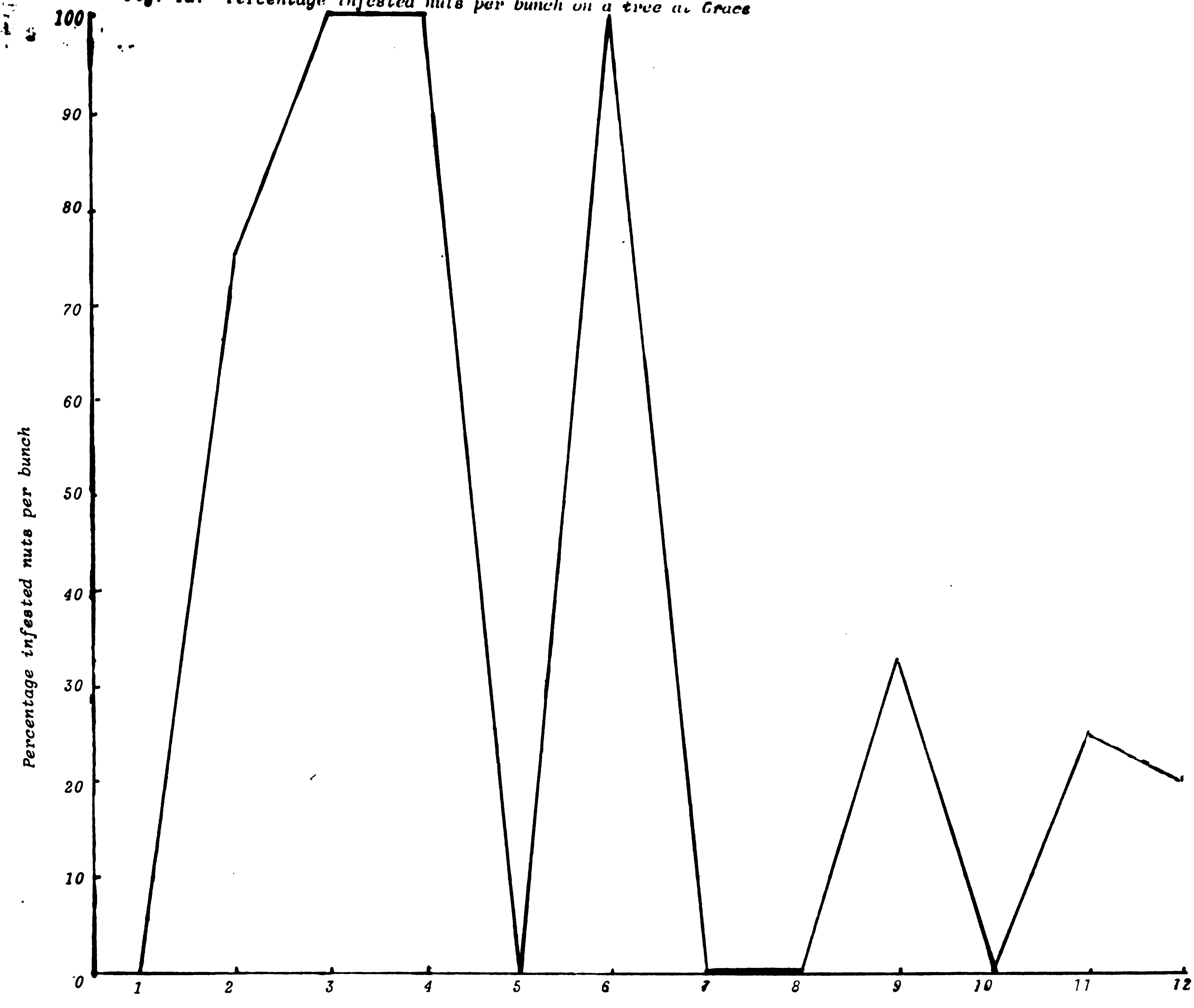


Fig. 1e: **_Percentage infested nuts per bunch on a tree at Babonneau_**

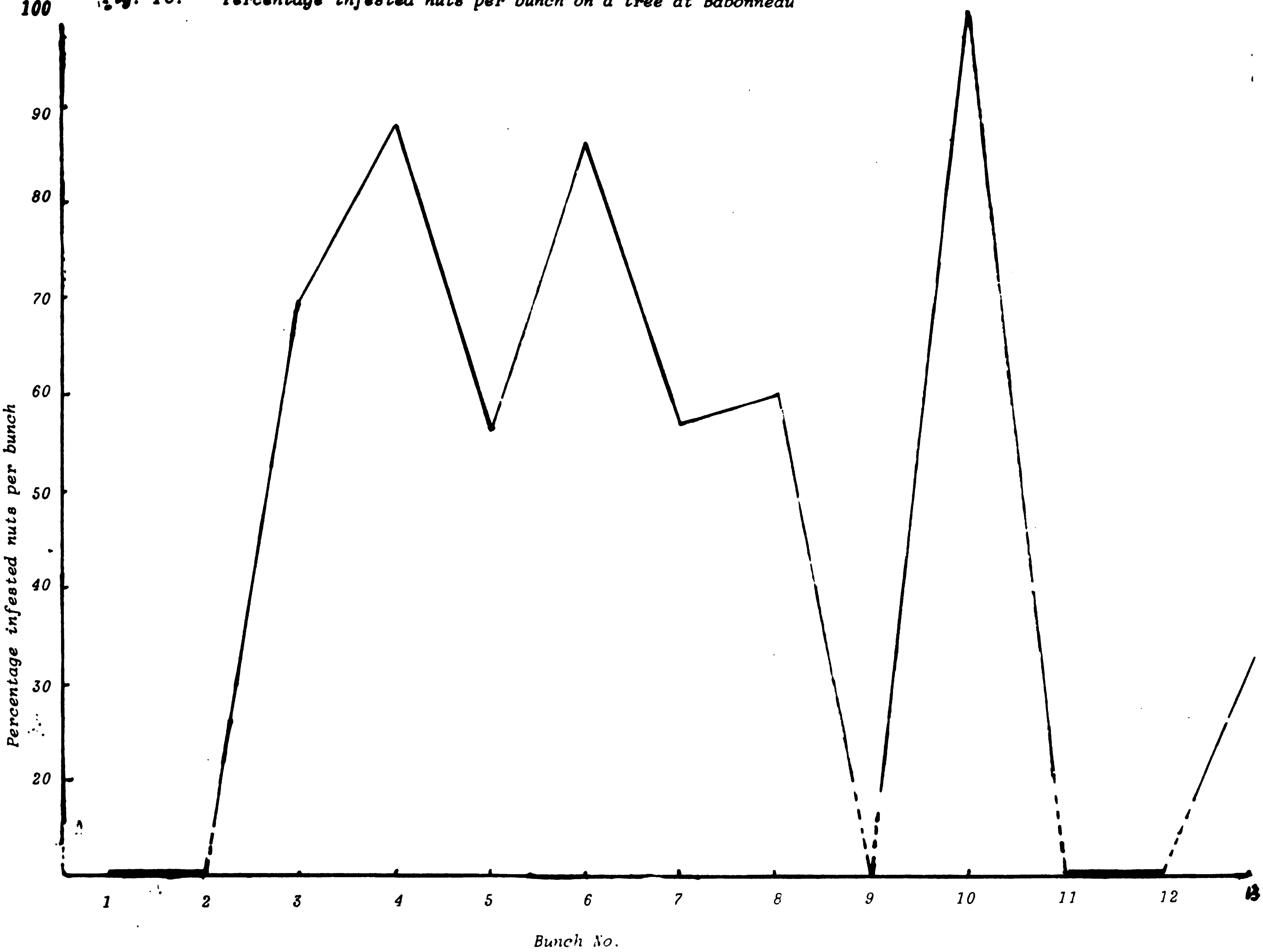


Fig. 1f: *Percentage infested nuts per bunch on a tree at Forestierre*

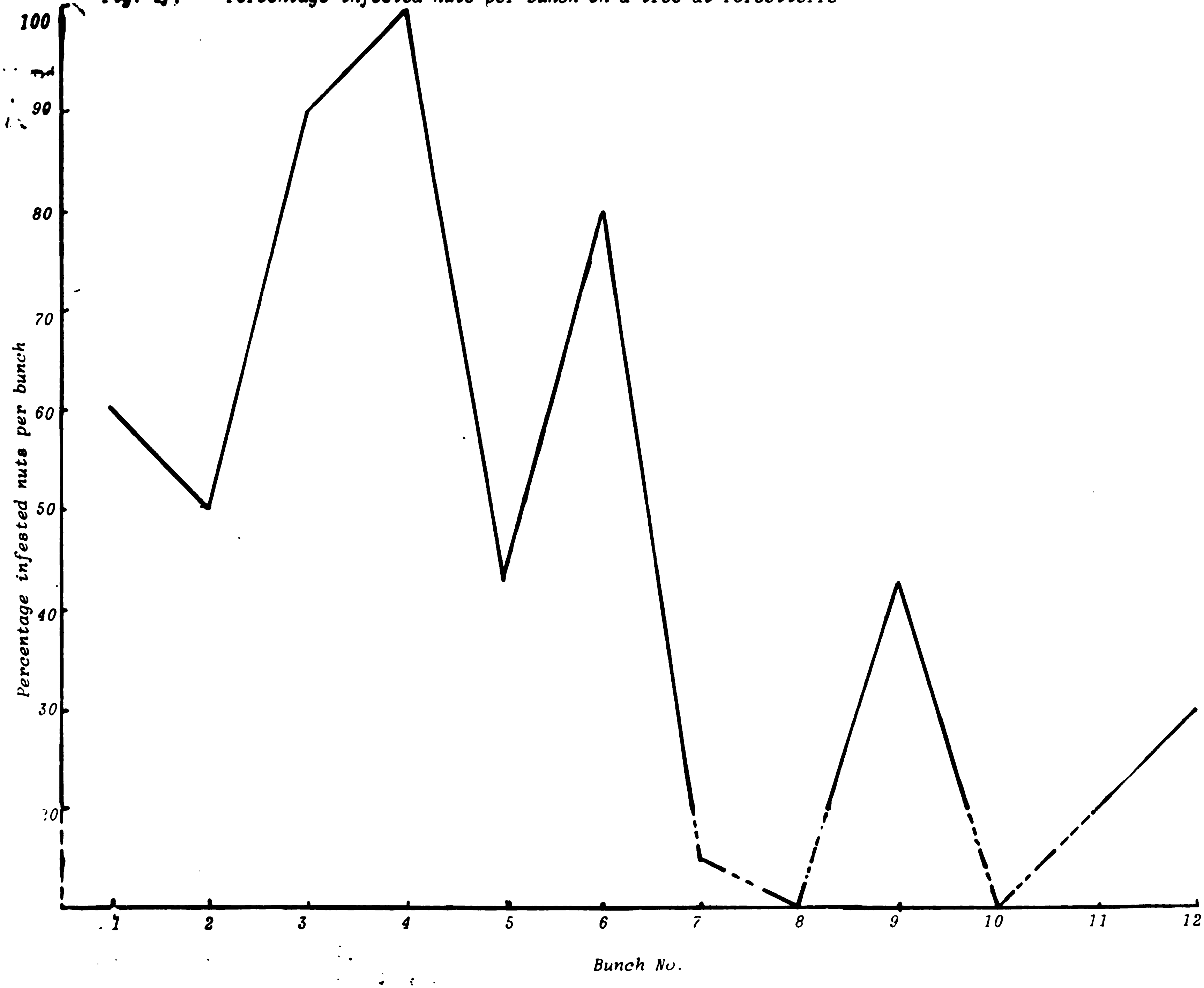


Fig. 1g: Percentage infested nuts per bunch on a tree at Louvel

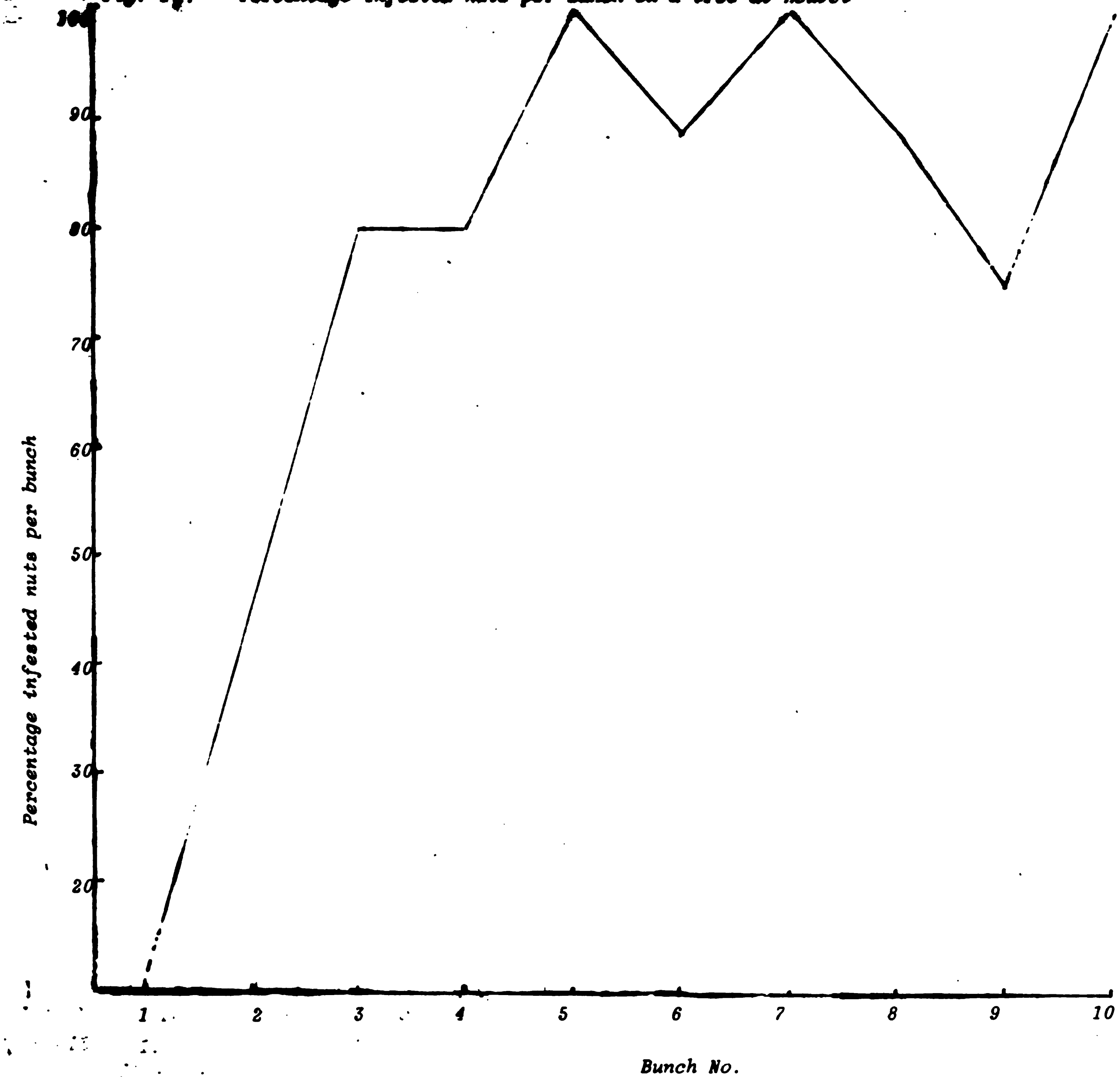


Fig. 1h: : Percentage infested nuts per bunch on a tree at Belle vue

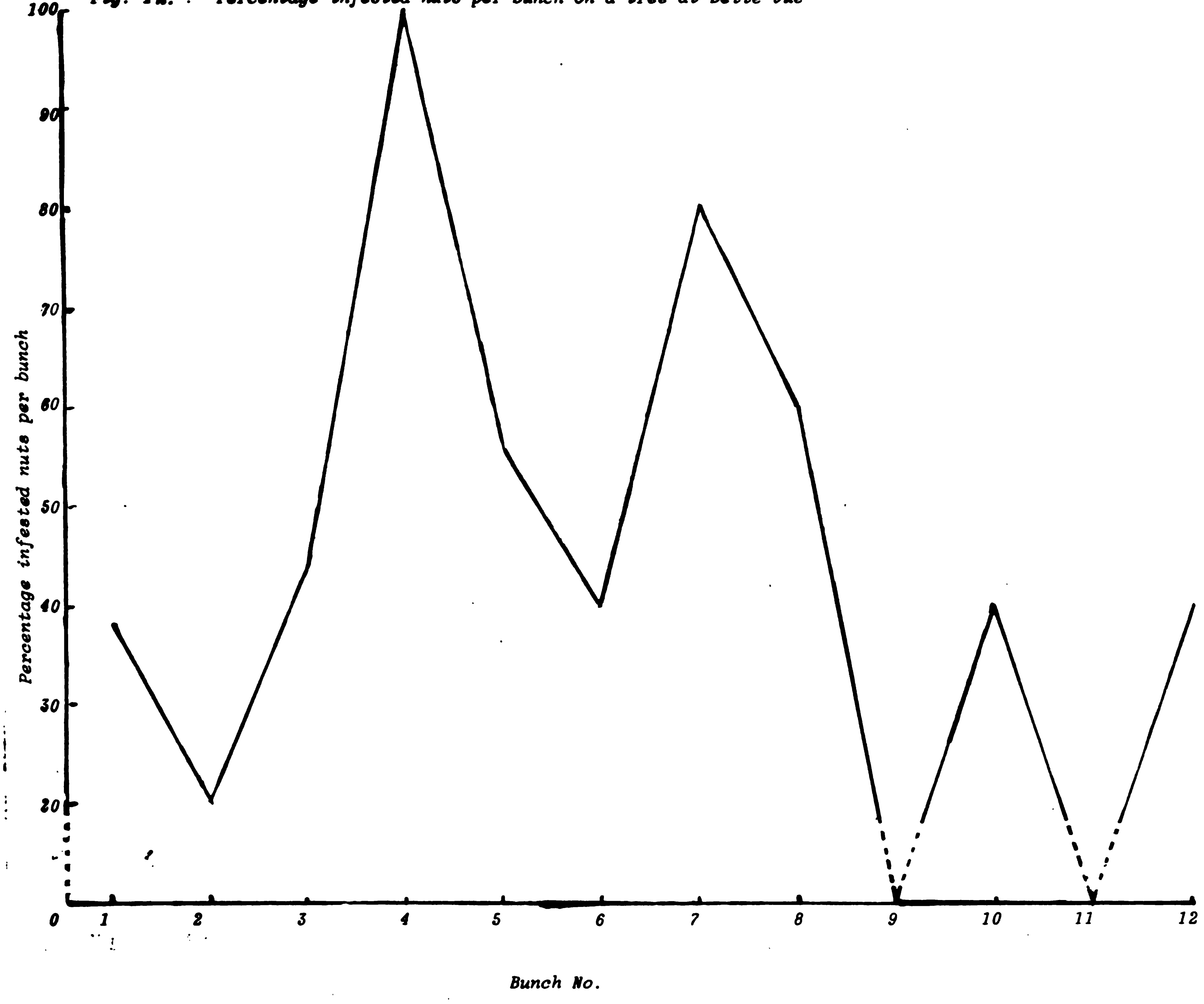


Fig. [illegible] Relationship between rainfall and % infested nuts per bunch on a tree at [illegible]

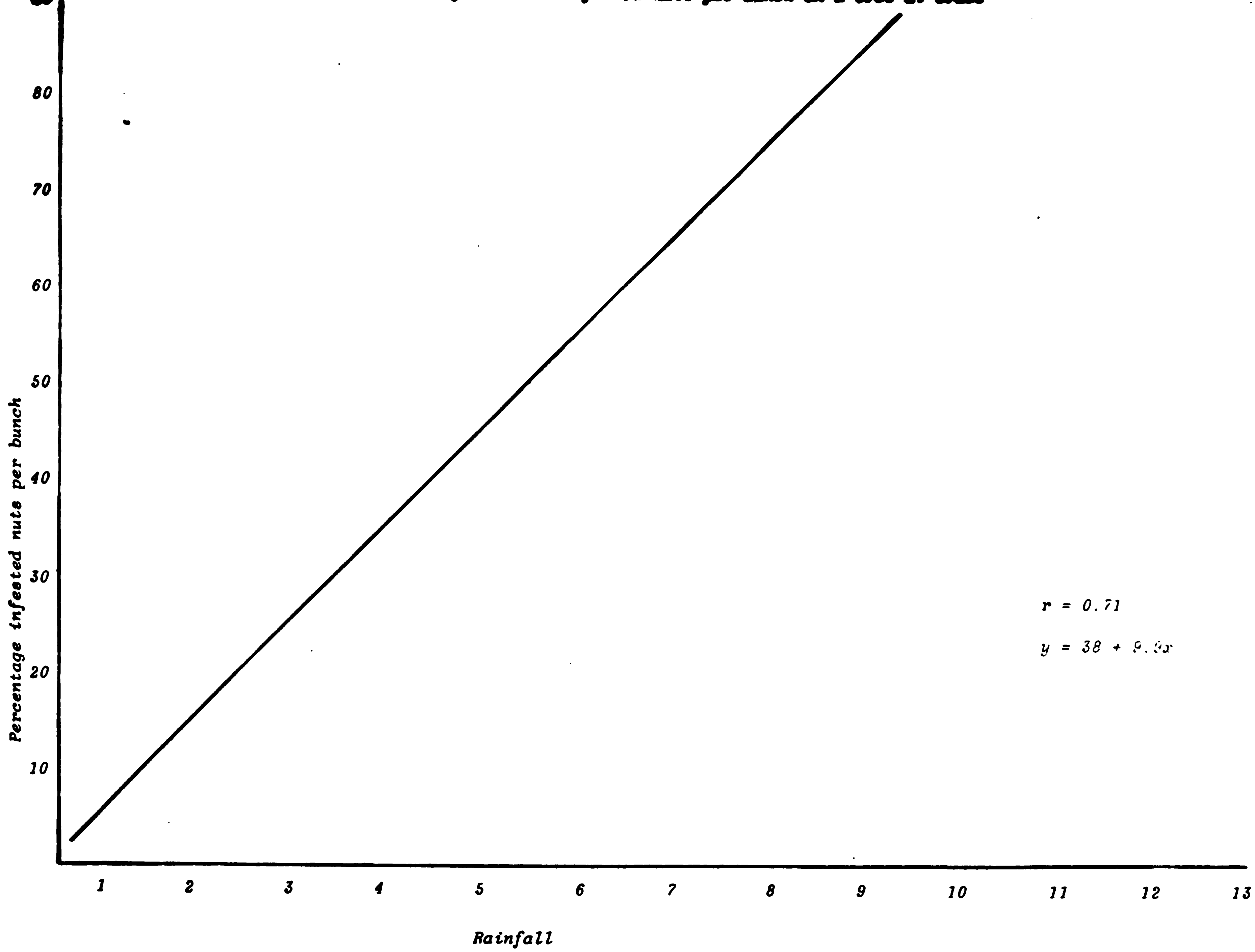


Fig. 2b Relationship between rainfall and % infested nuts per bunch on a tree at Forestierre

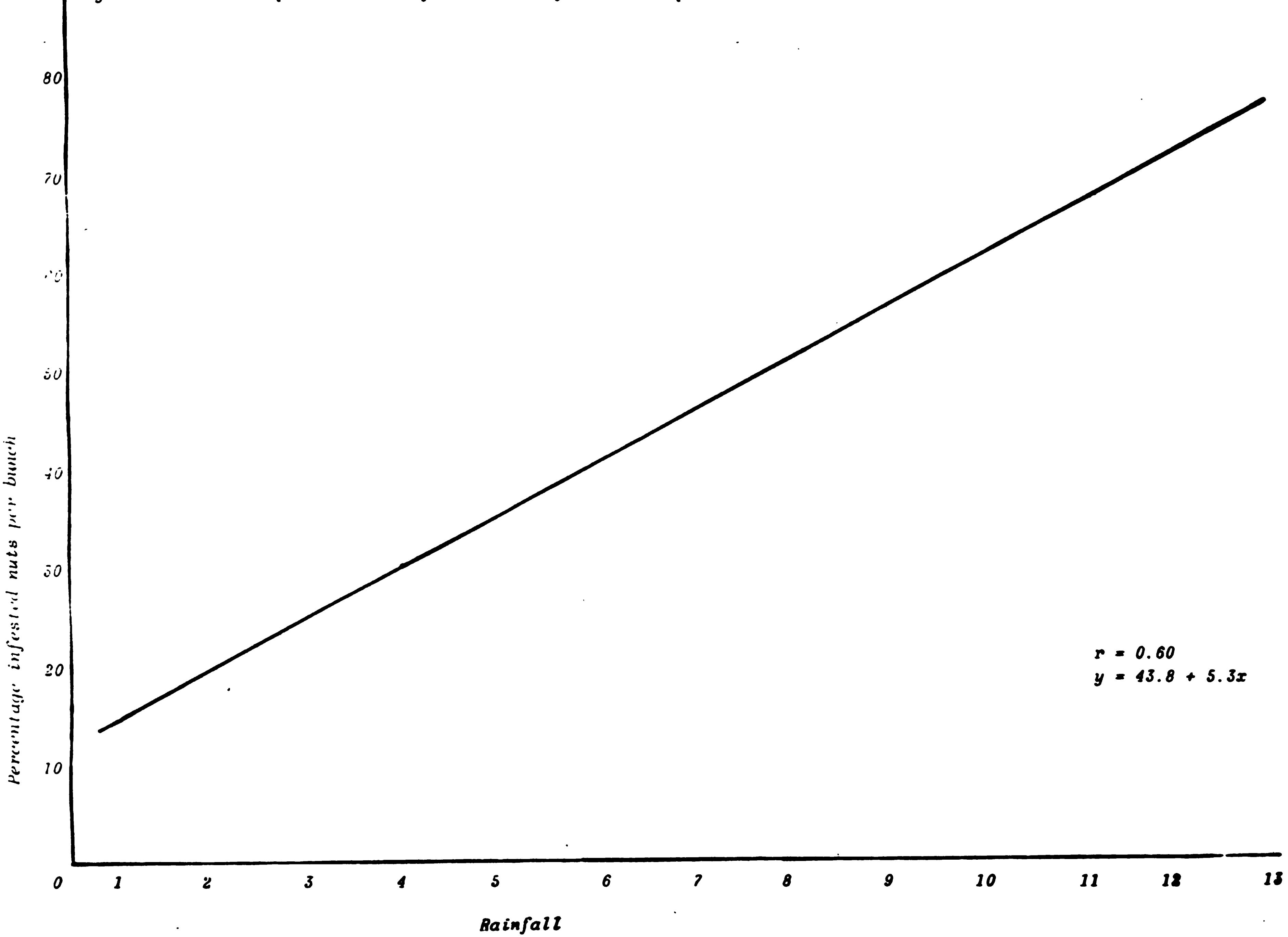


Fig. 3a: Damage index of bunch on a tree at Errard

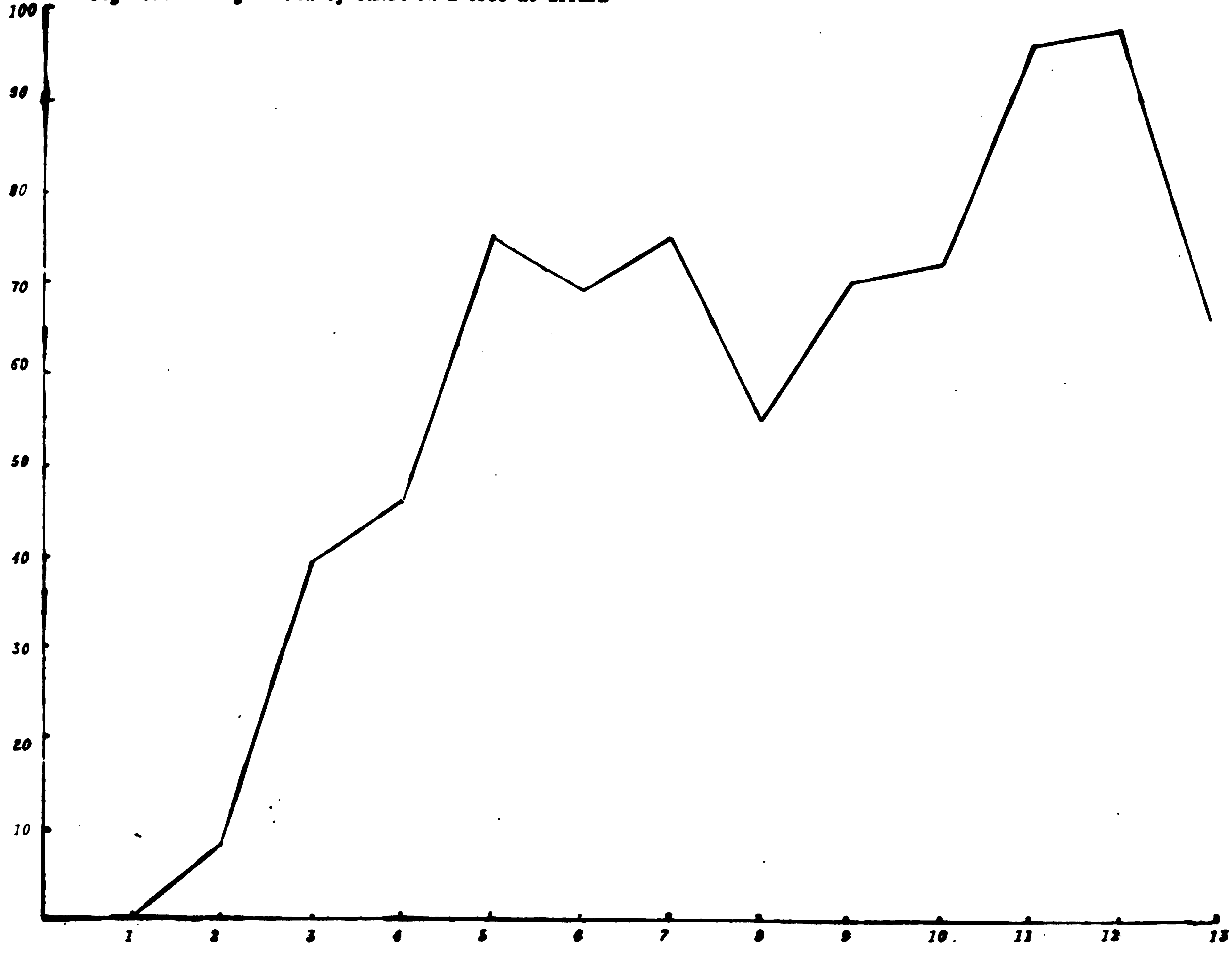


Fig. 3b : Damage index per bunch on a tree at Errard

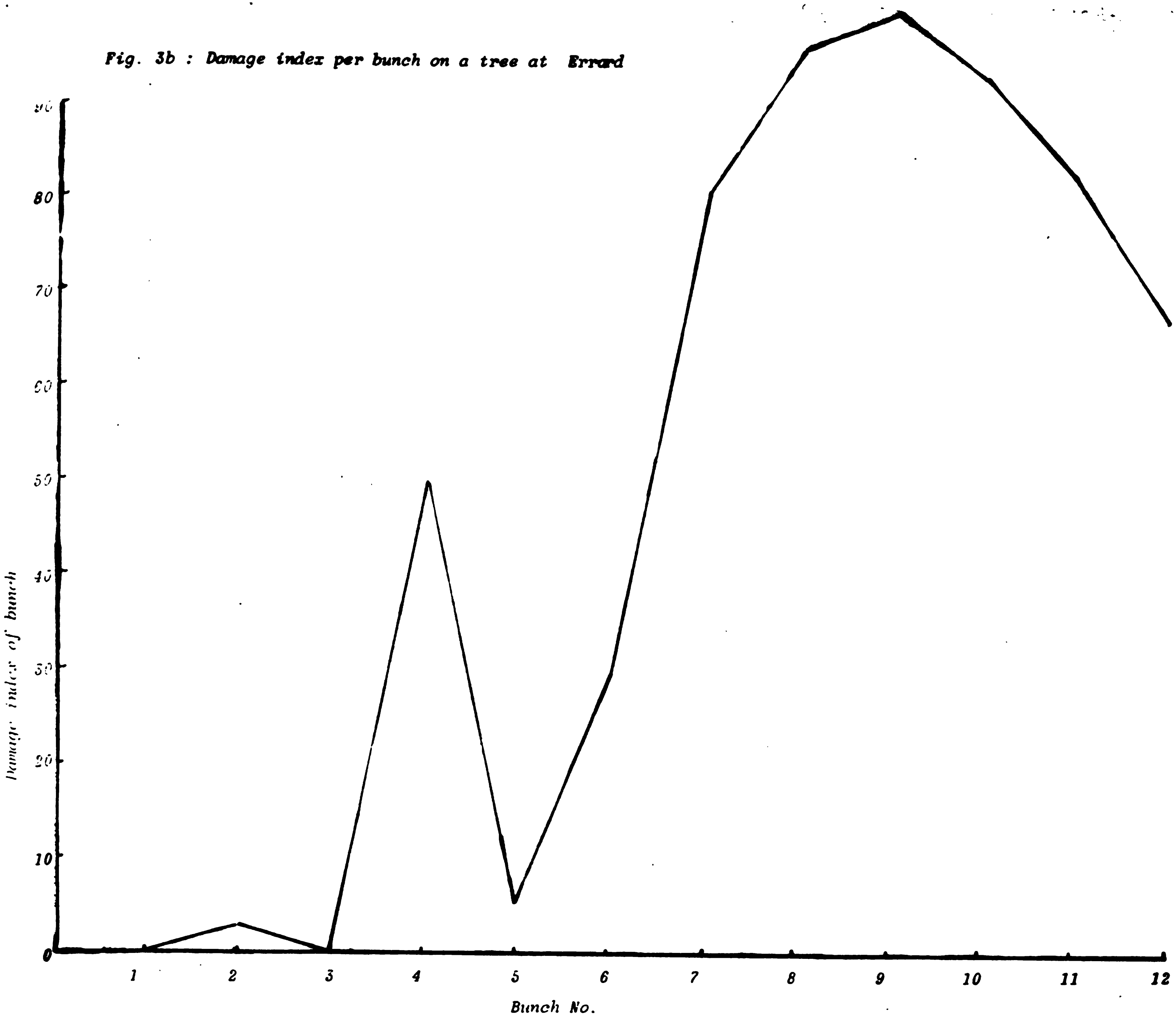


Figure 3c: Damage index per bunch on a tree at Anse Canqt

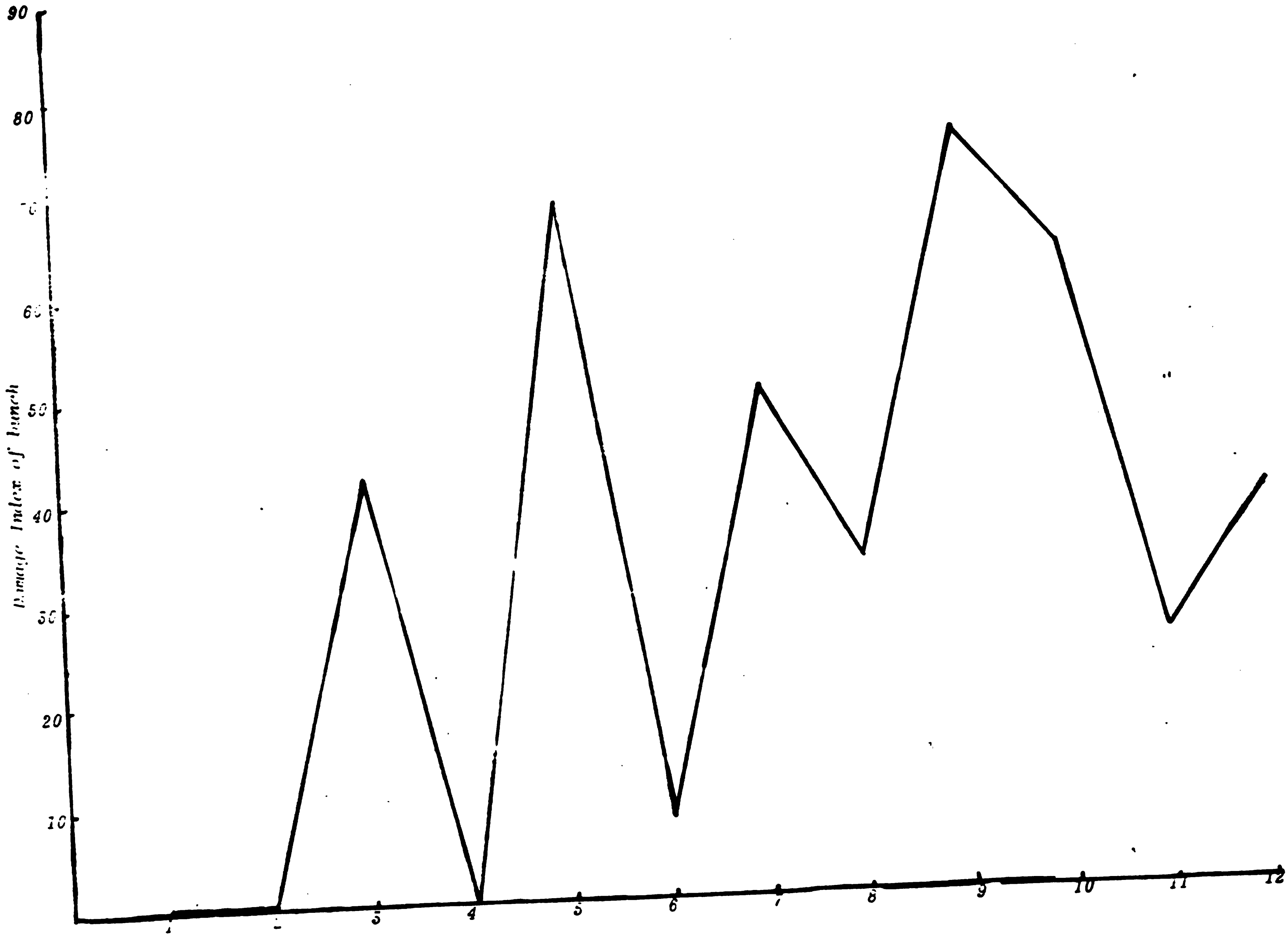


Fig. 3d: Damage index per bunch on a tree at Grace

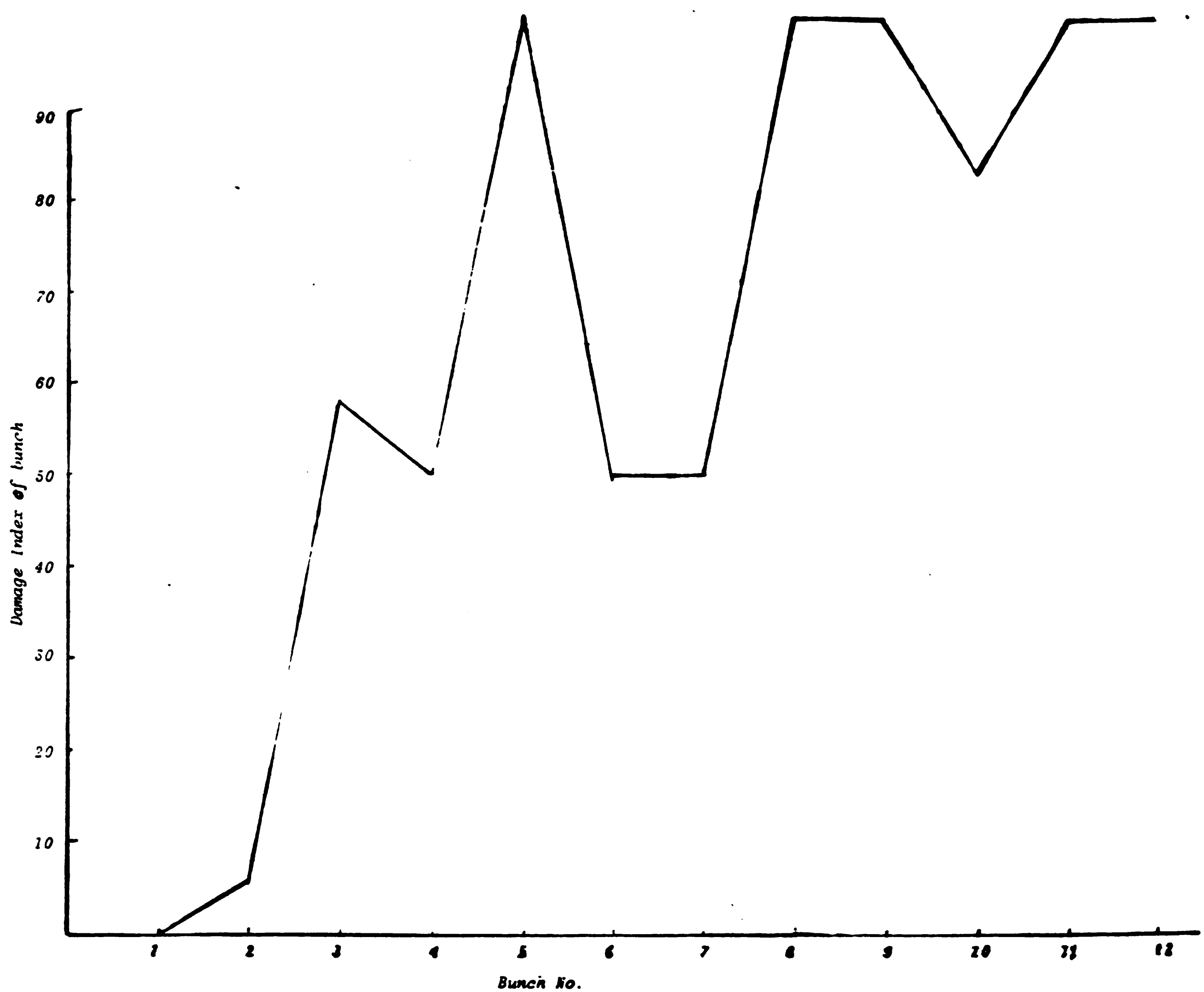


Fig. 3e: Damage index per bunch on a tree at Babonneau

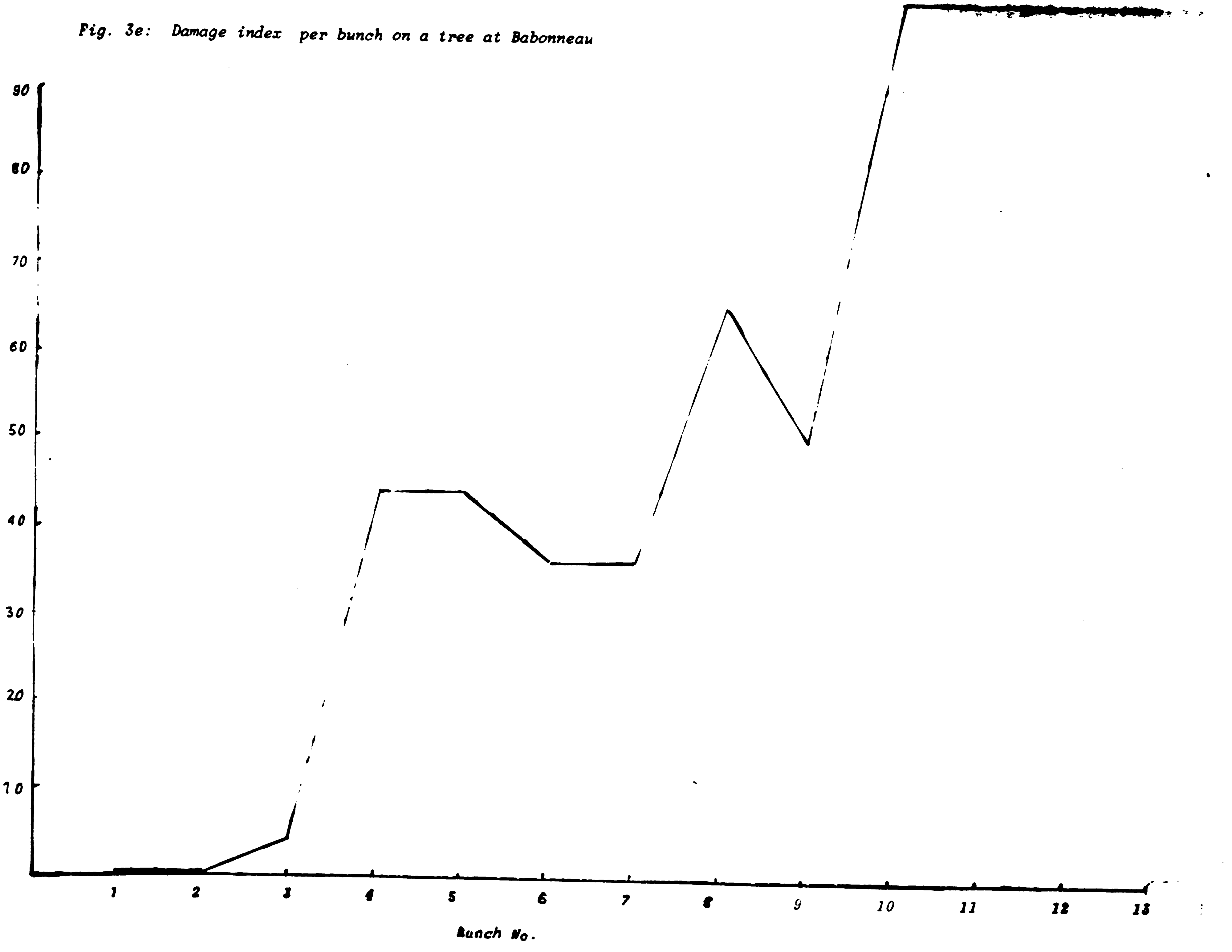


Fig. 3f: Damage index per bunch on a tree at Forestierre

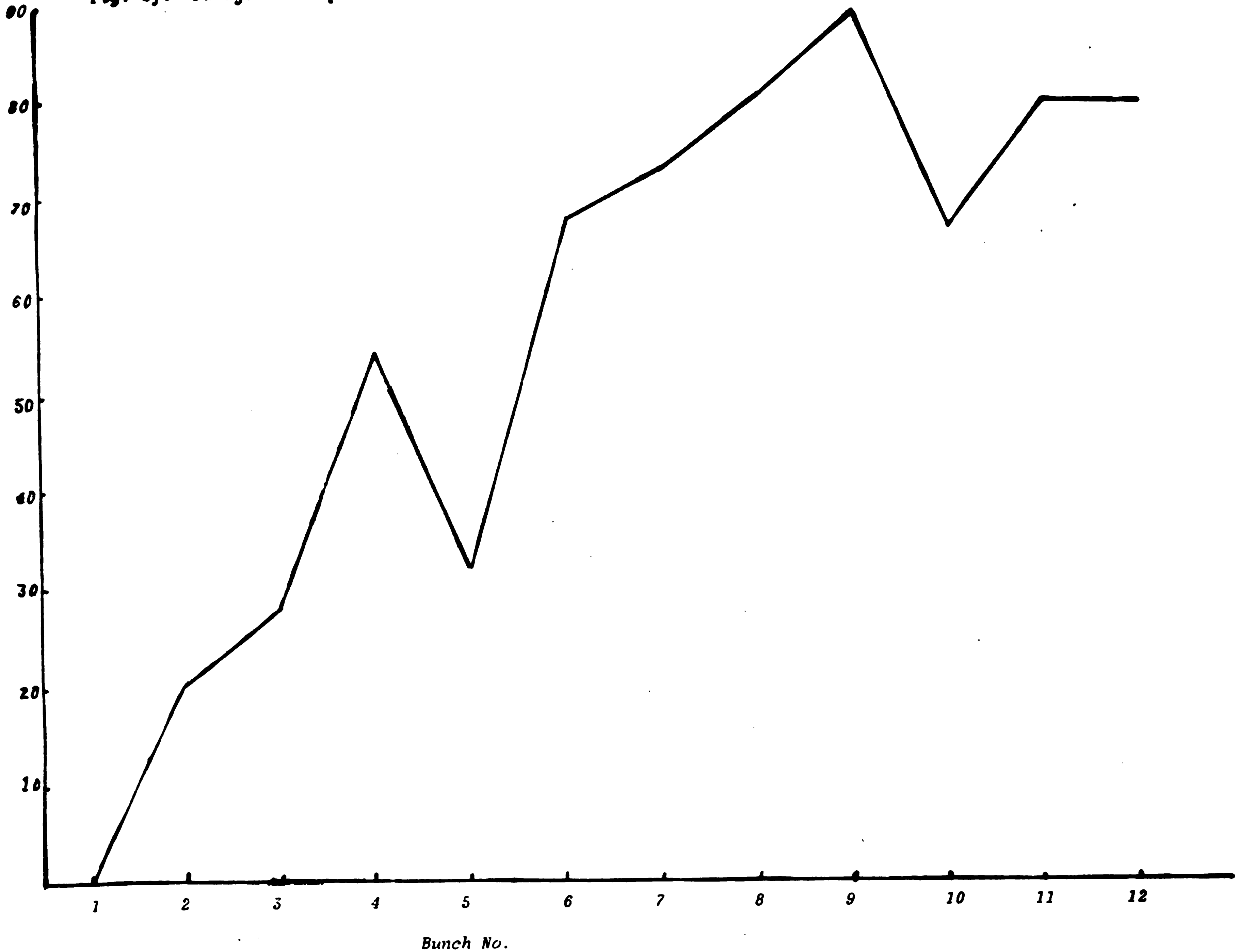


Fig. 3g: Damage index per bunch on a tree at Louvet

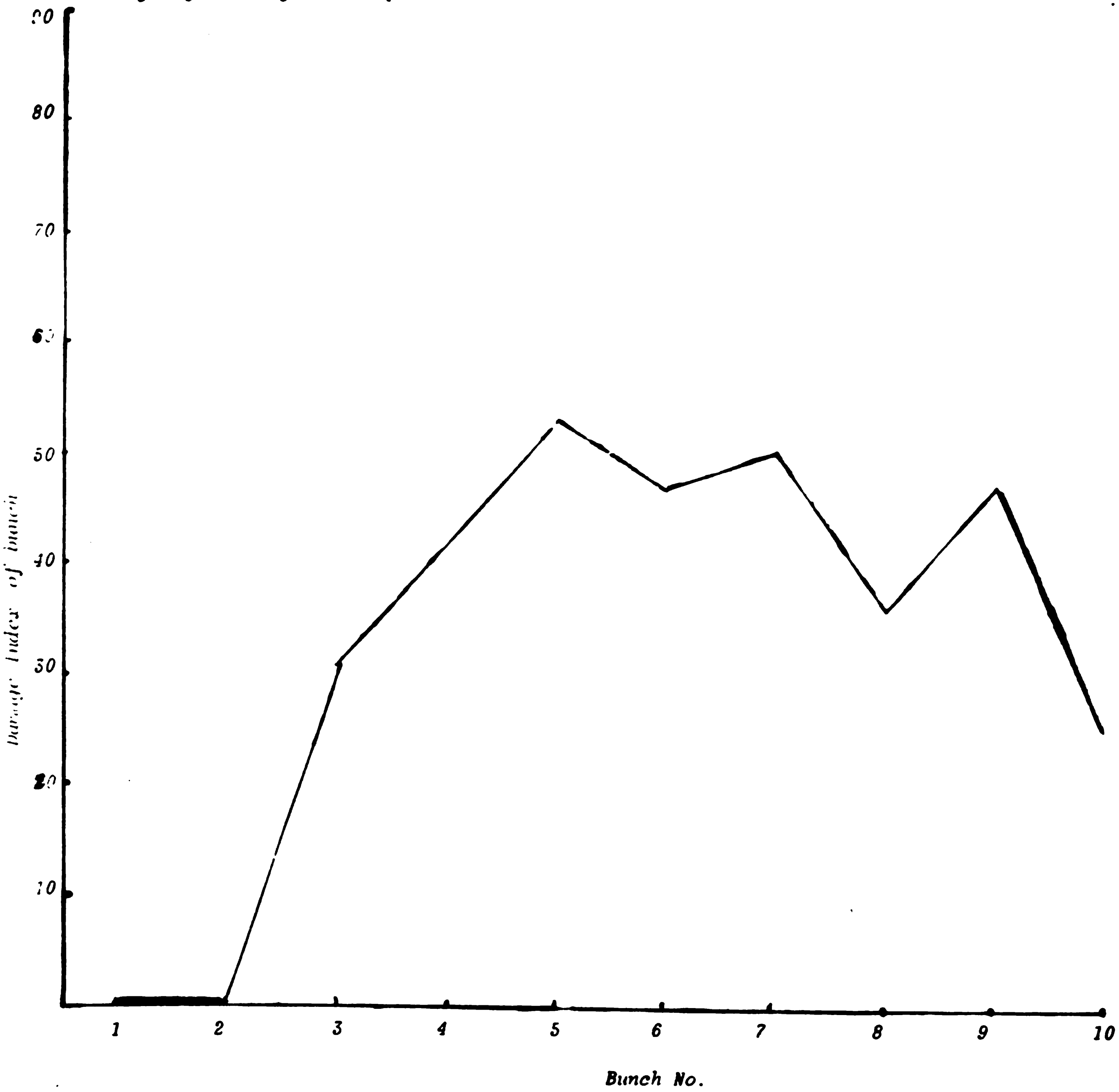


Fig. 3h: Damage index per bunch on a tree at Belle Vue

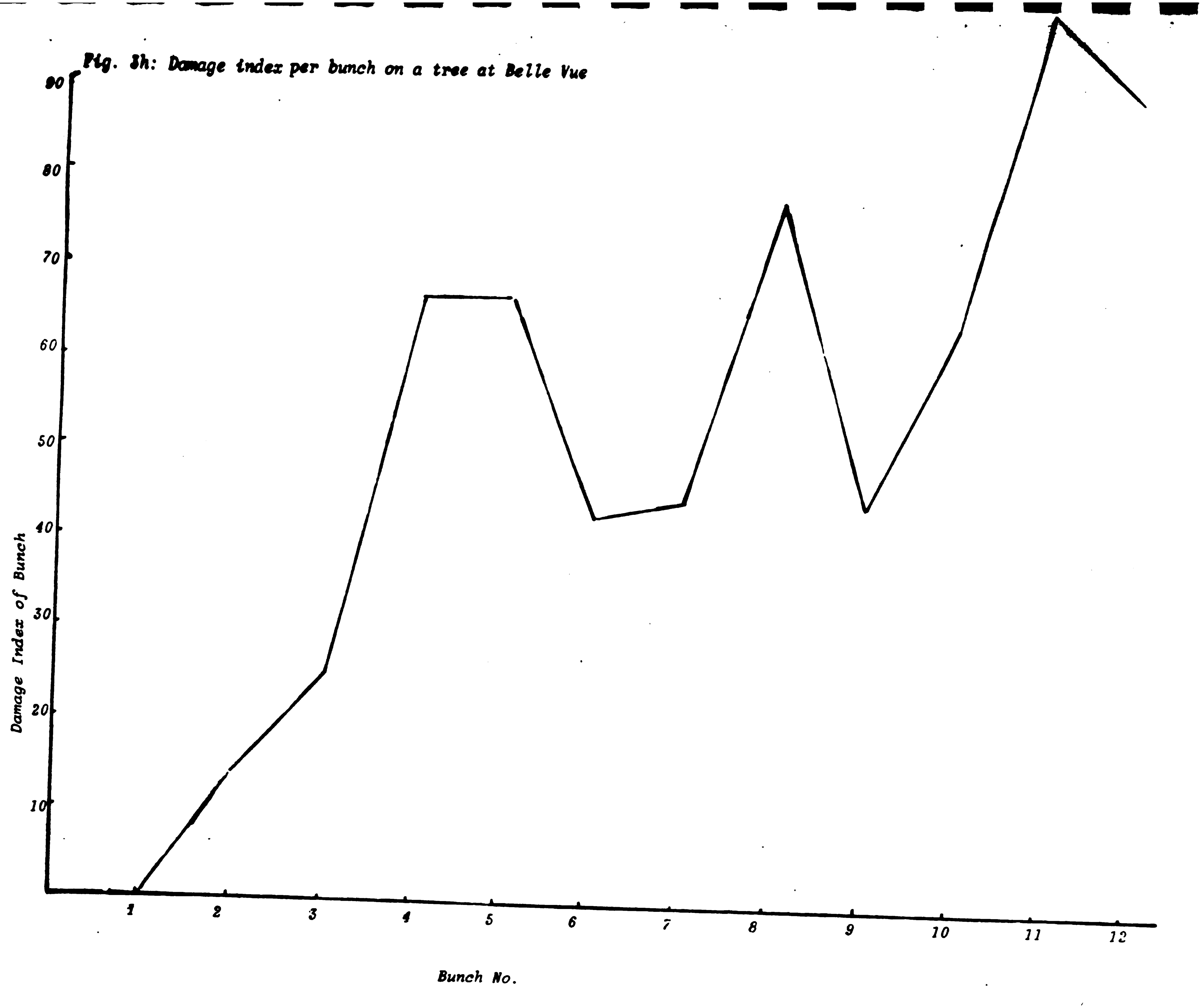


Fig. 4a: Relationship between rainfall and mite damage index - Kwansi

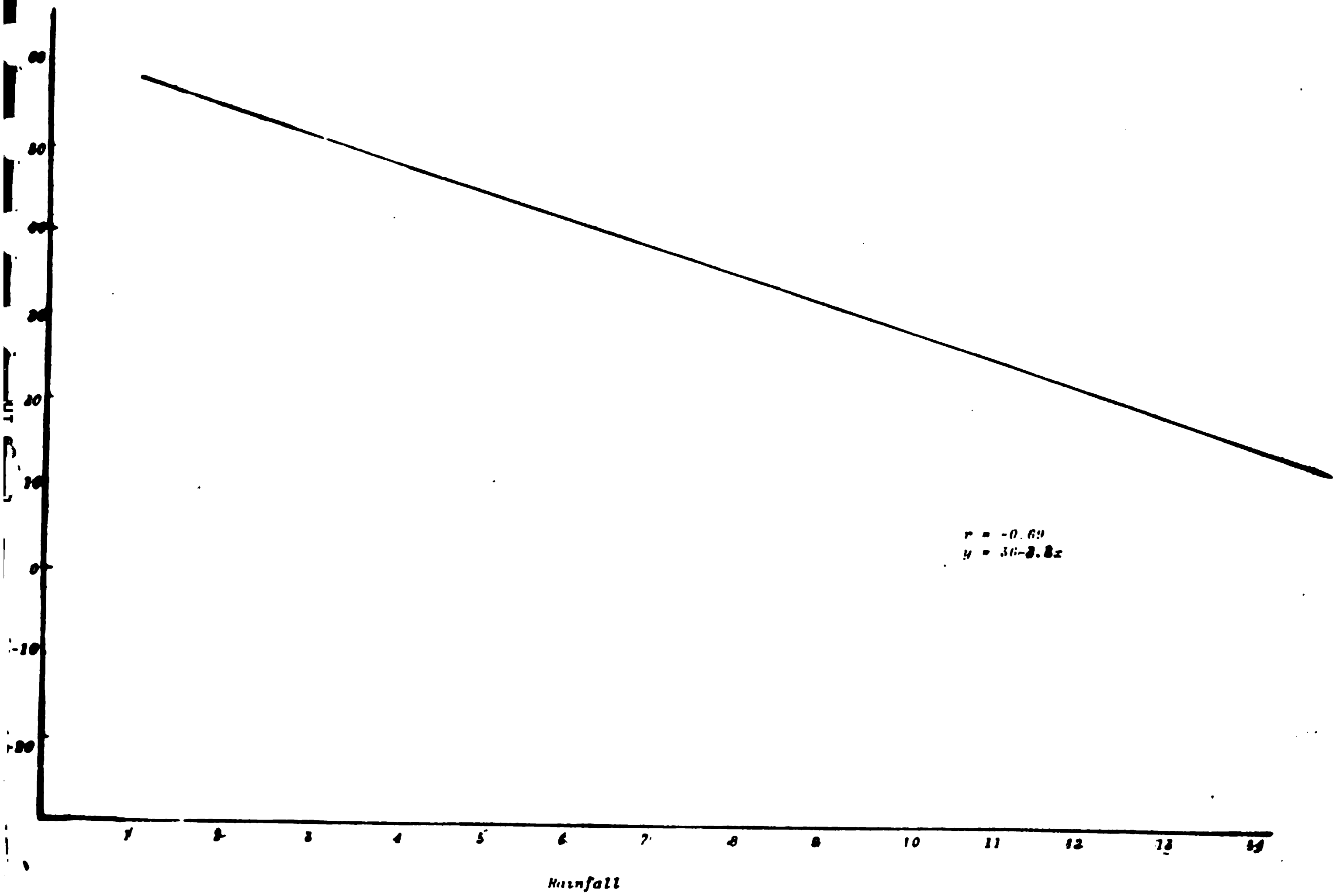


Fig. 4b: Relationship between rainfall and nut damage index at Errard

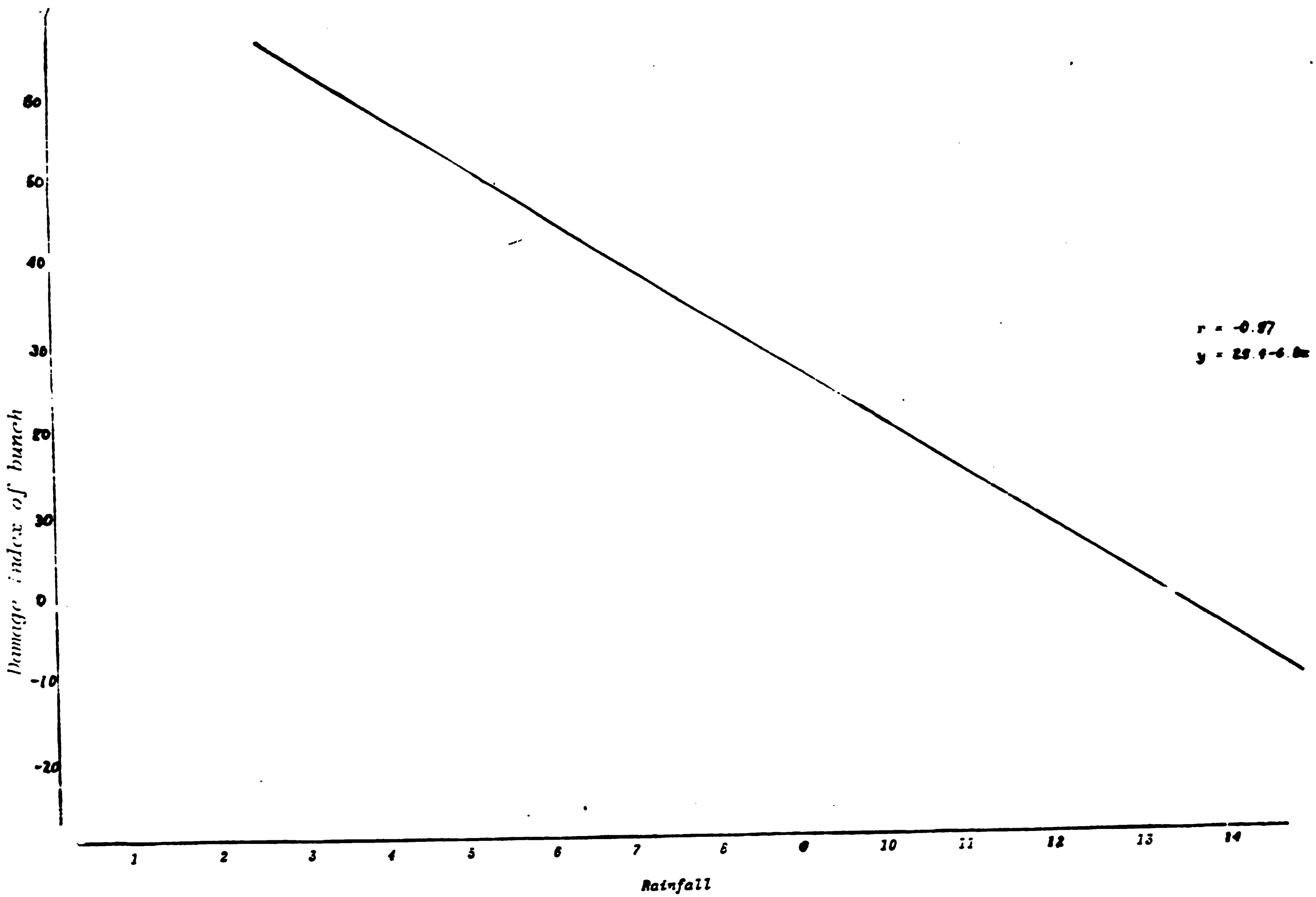


Figure [illegible] Relationship between Rainfall and Nut Damage Index per Bunch on a Tree at Grace

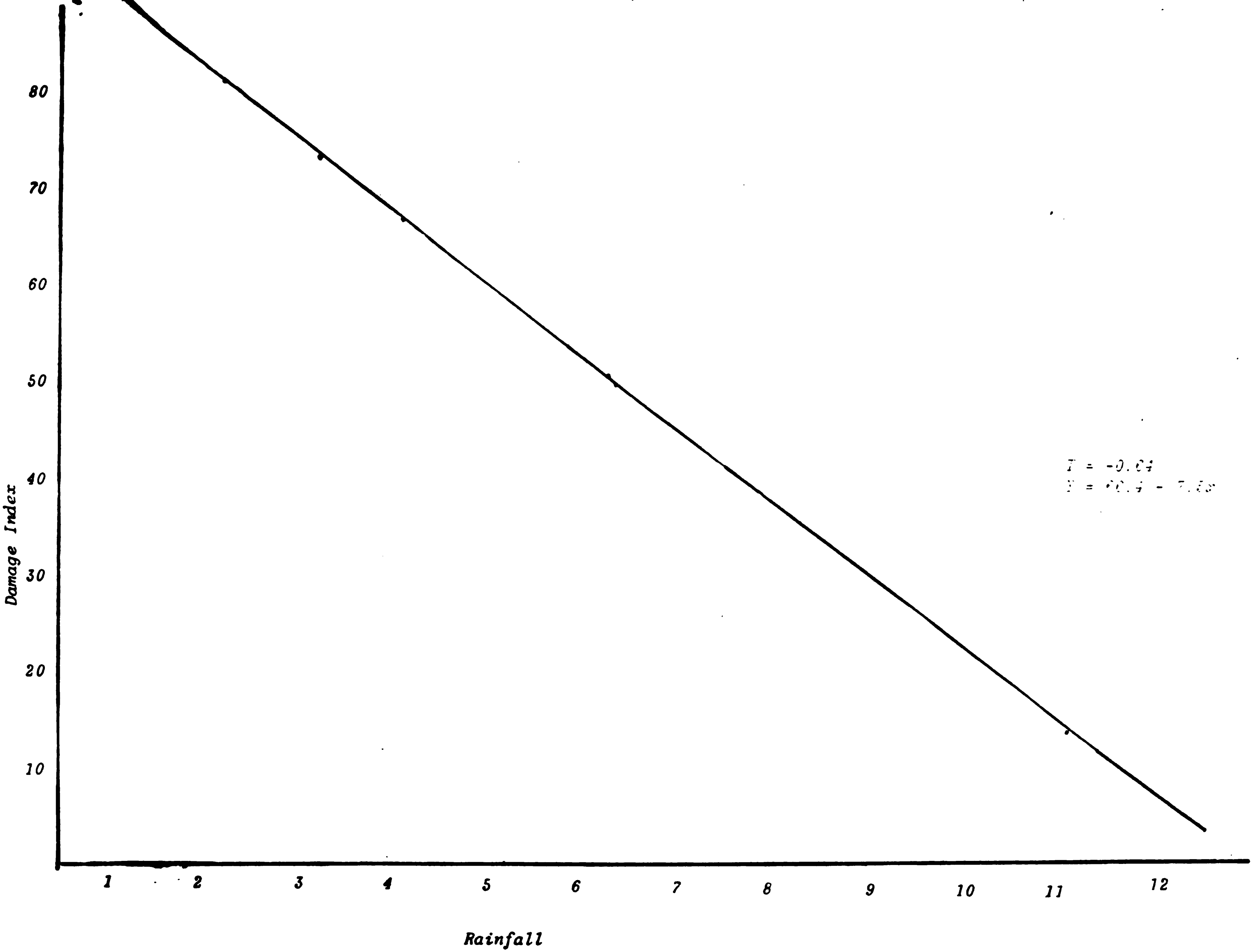


FIGURE 5 - Effect of monthly applications of oil and sulphur on coconut mite at Belle Vue

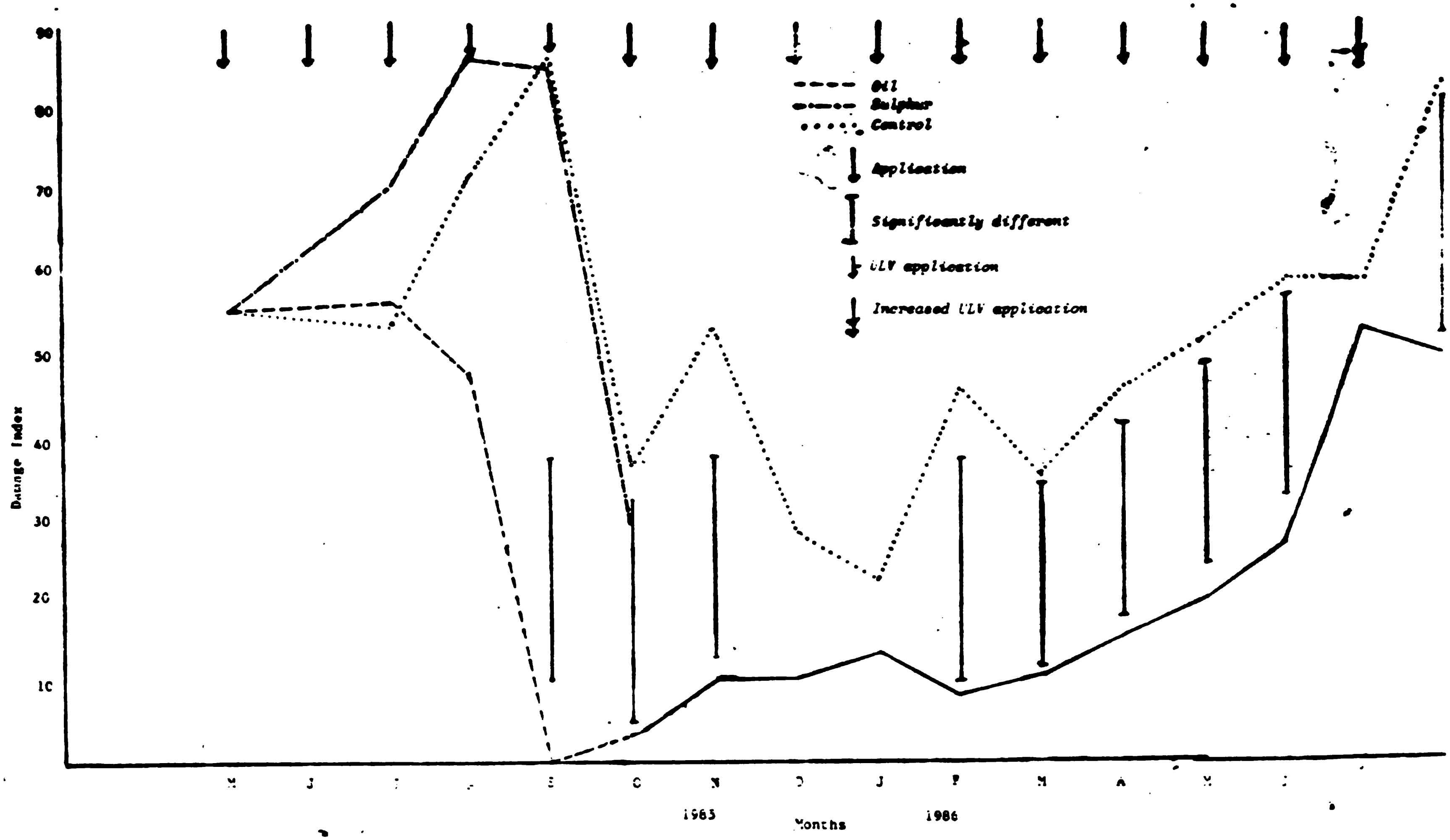


Fig. 6 Effect of monthly applications of oil on coconut mite damage at Fond Estate, Micoud

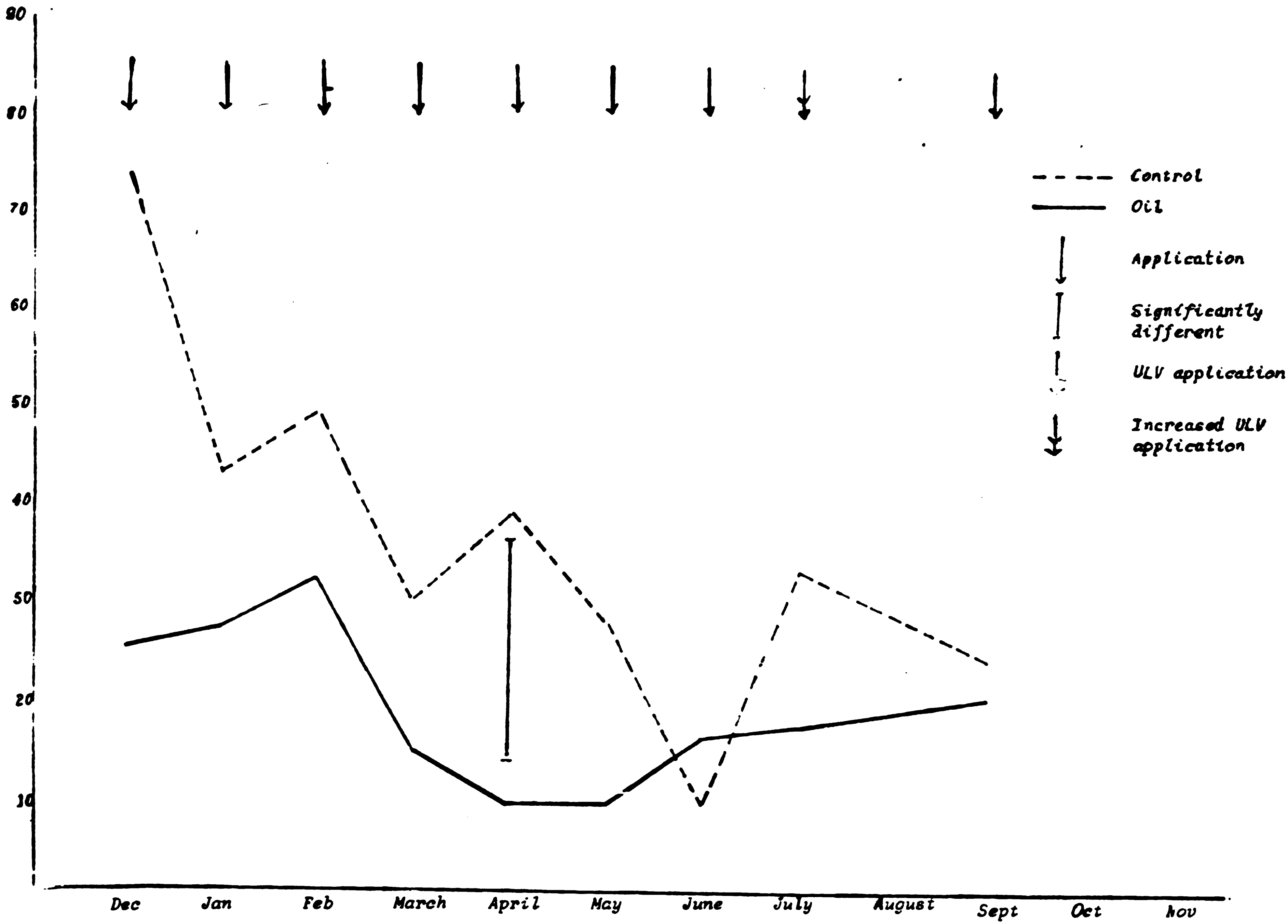


Fig. 9 Effect of monthly applications of oil on coconut mite damage at Anse Canot, Dennery

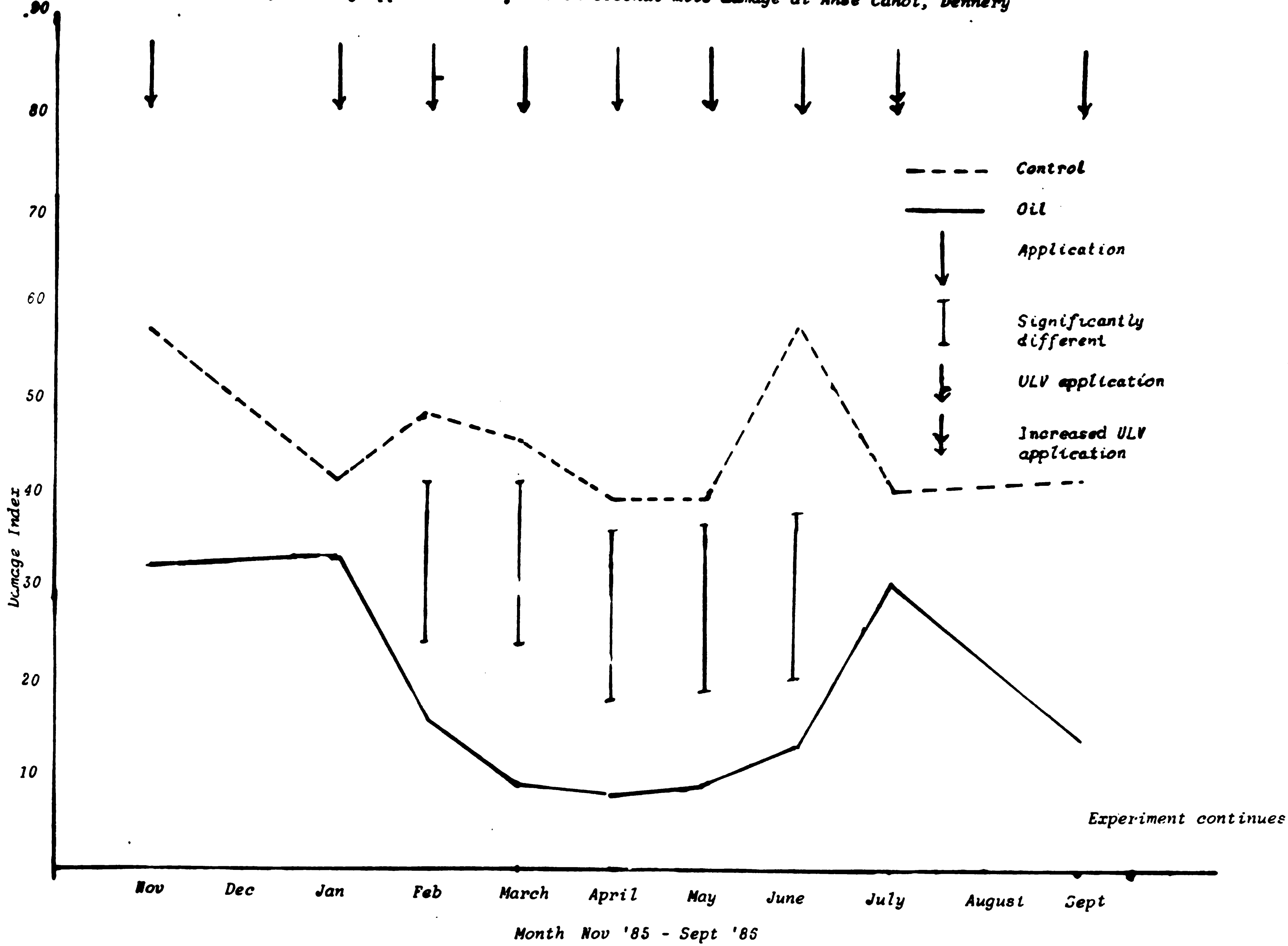


Fig. 8 Effect of monthly applications of oil on coconut mite damage at Errard

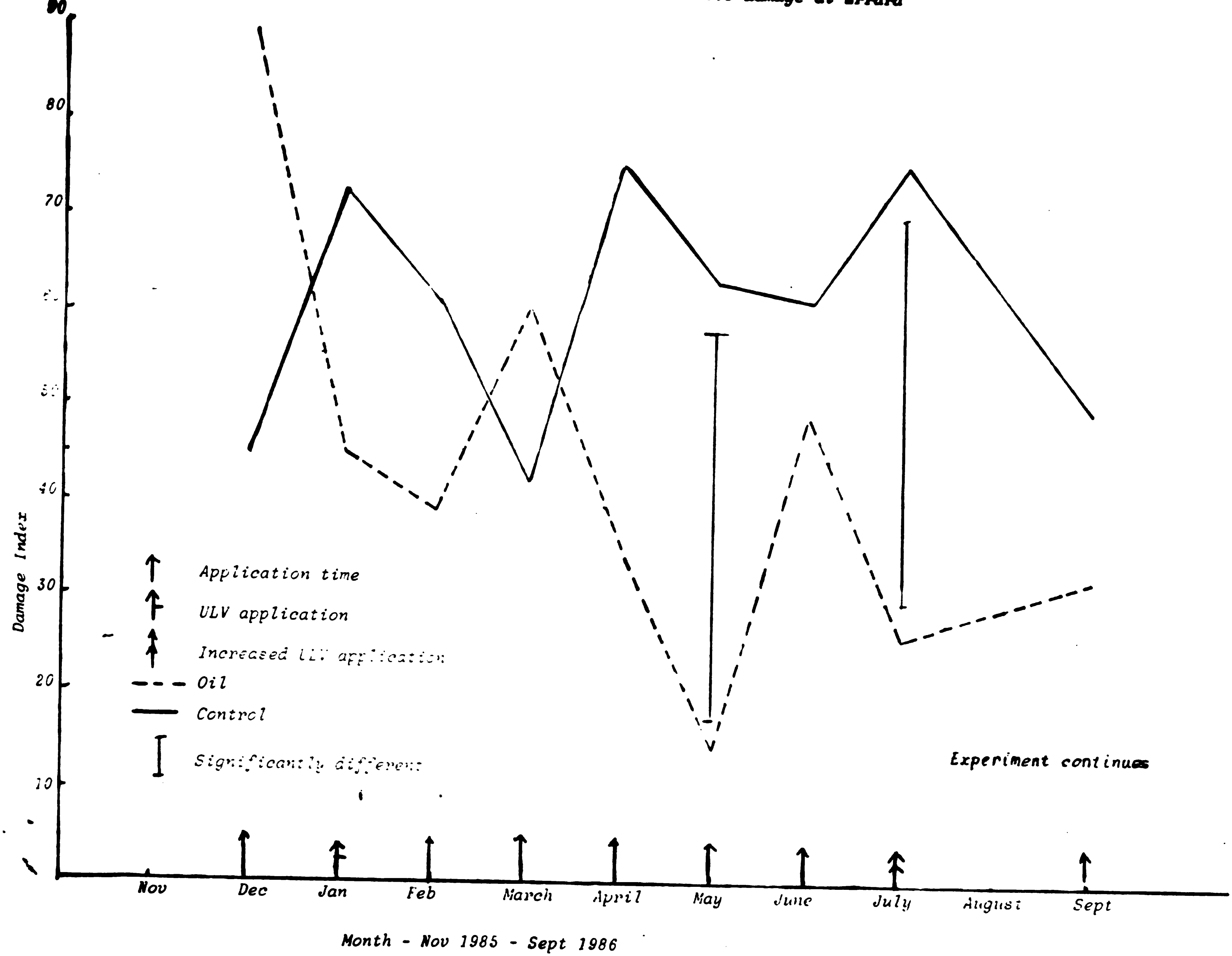


Fig. 9 Effect of application oil and systemic chemicals on coconut mite at Babonneau

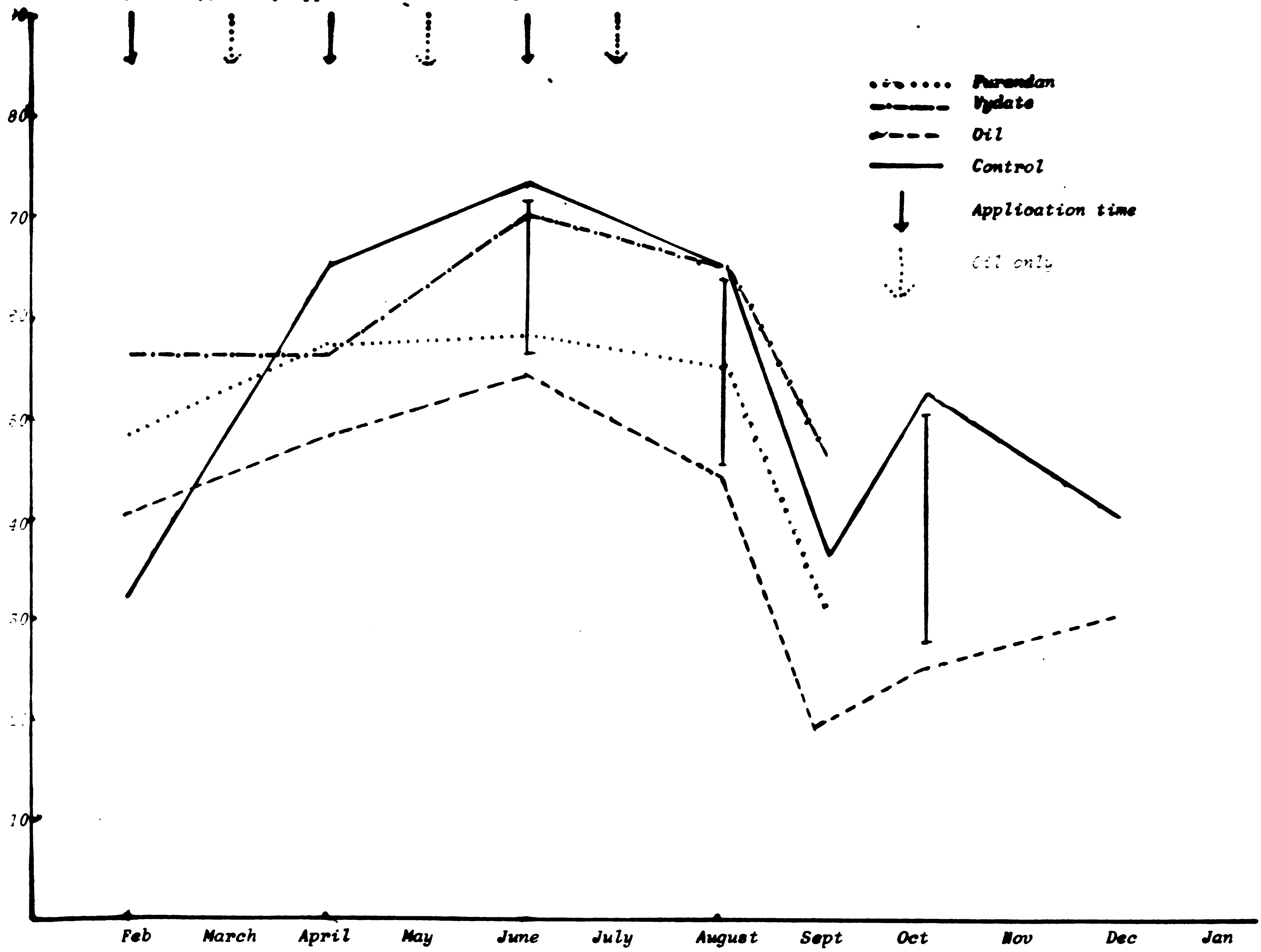


Figure 10: Effect of soil applied systemic chemicals on coconut mite damage at Grace

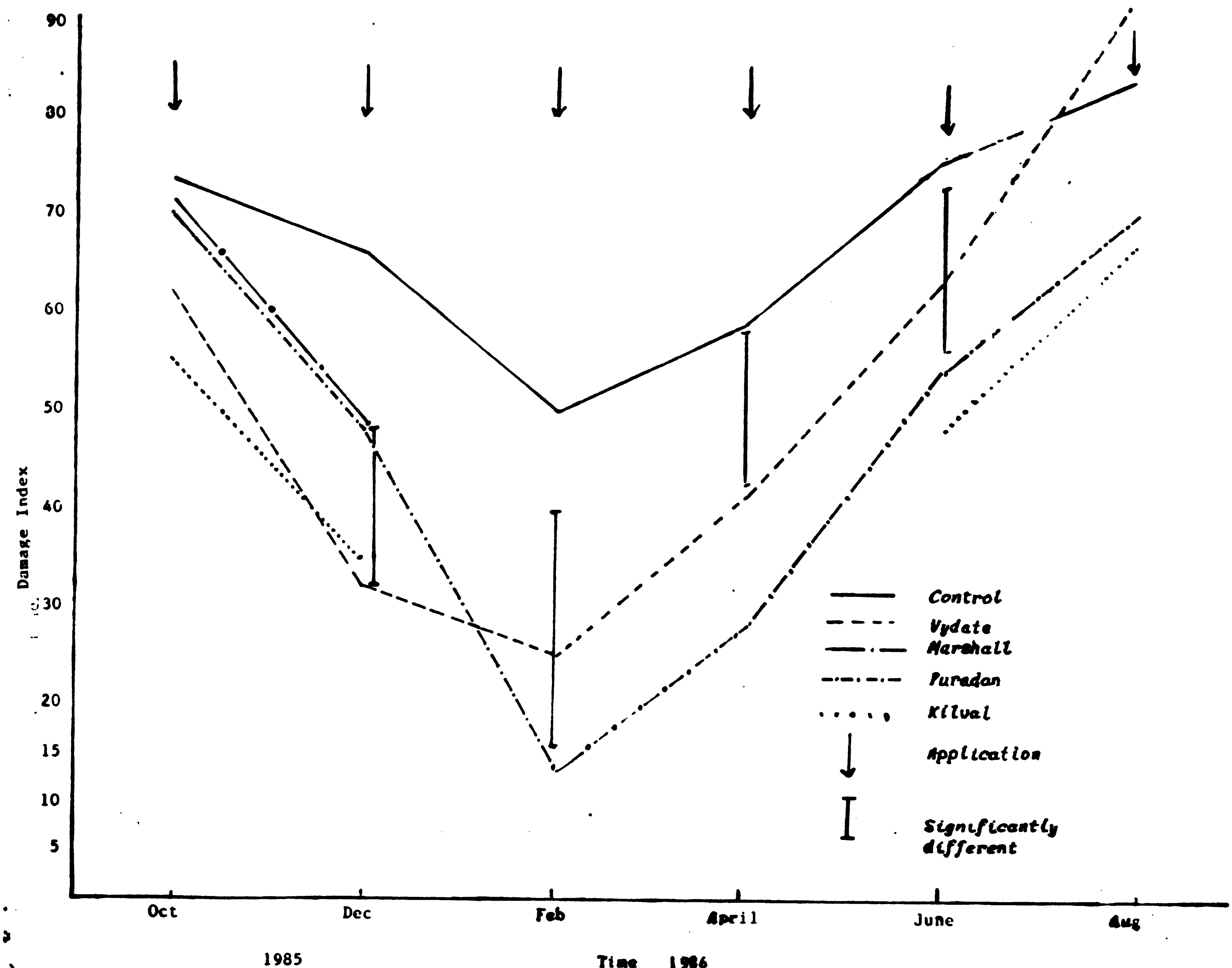


Fig. 11- Effect of soil applied systemic chemicals on coconut mite damage at Belle Vue

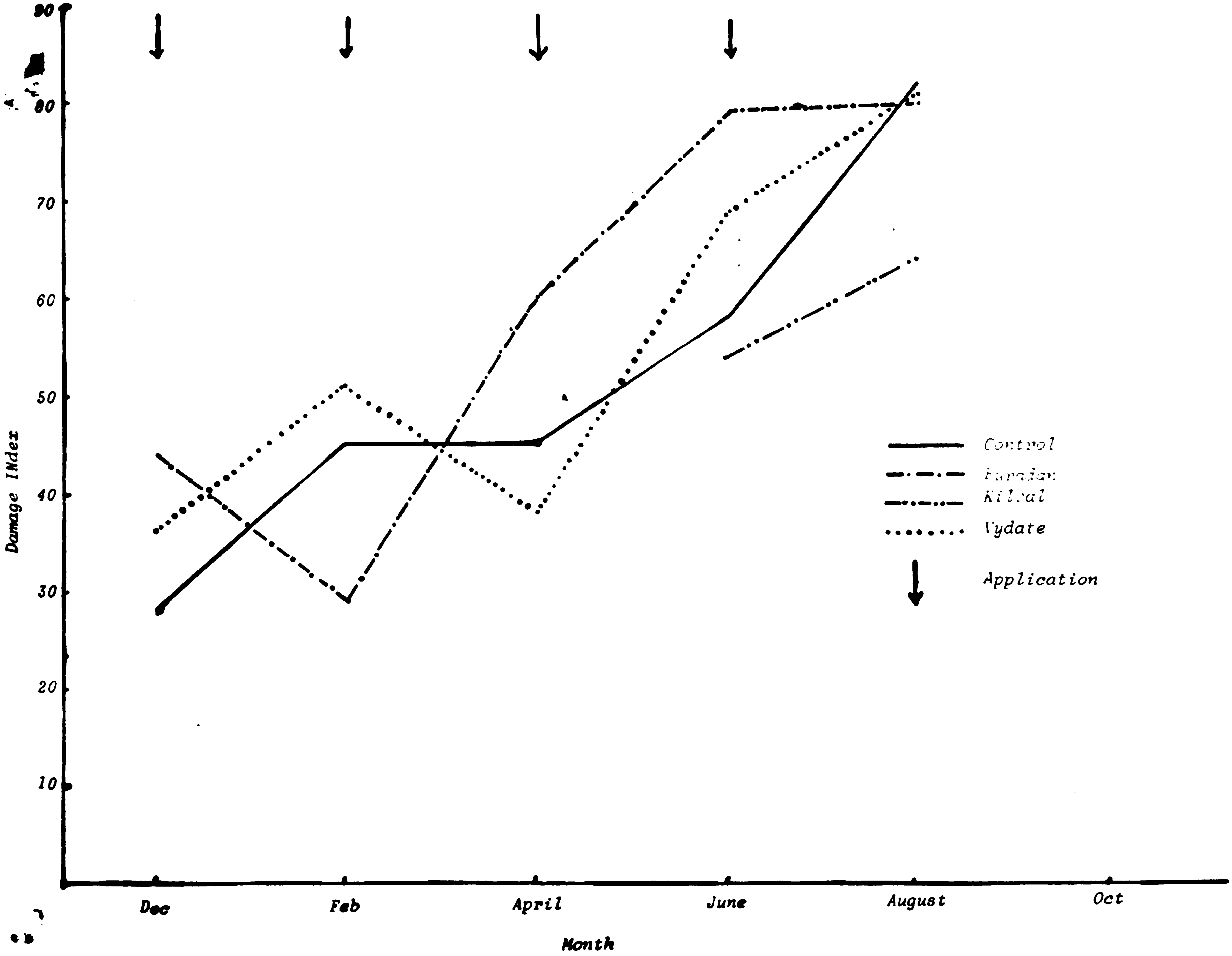
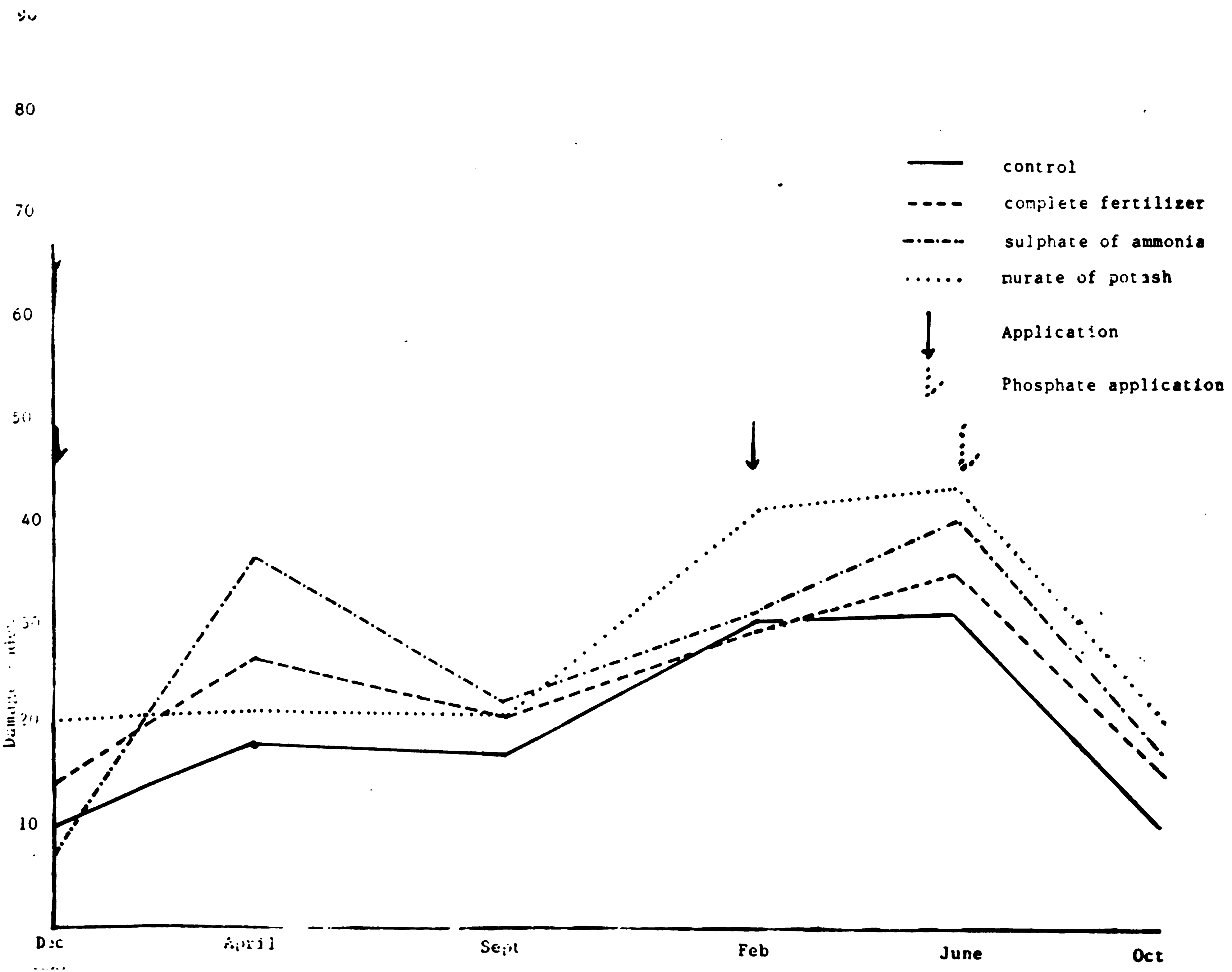
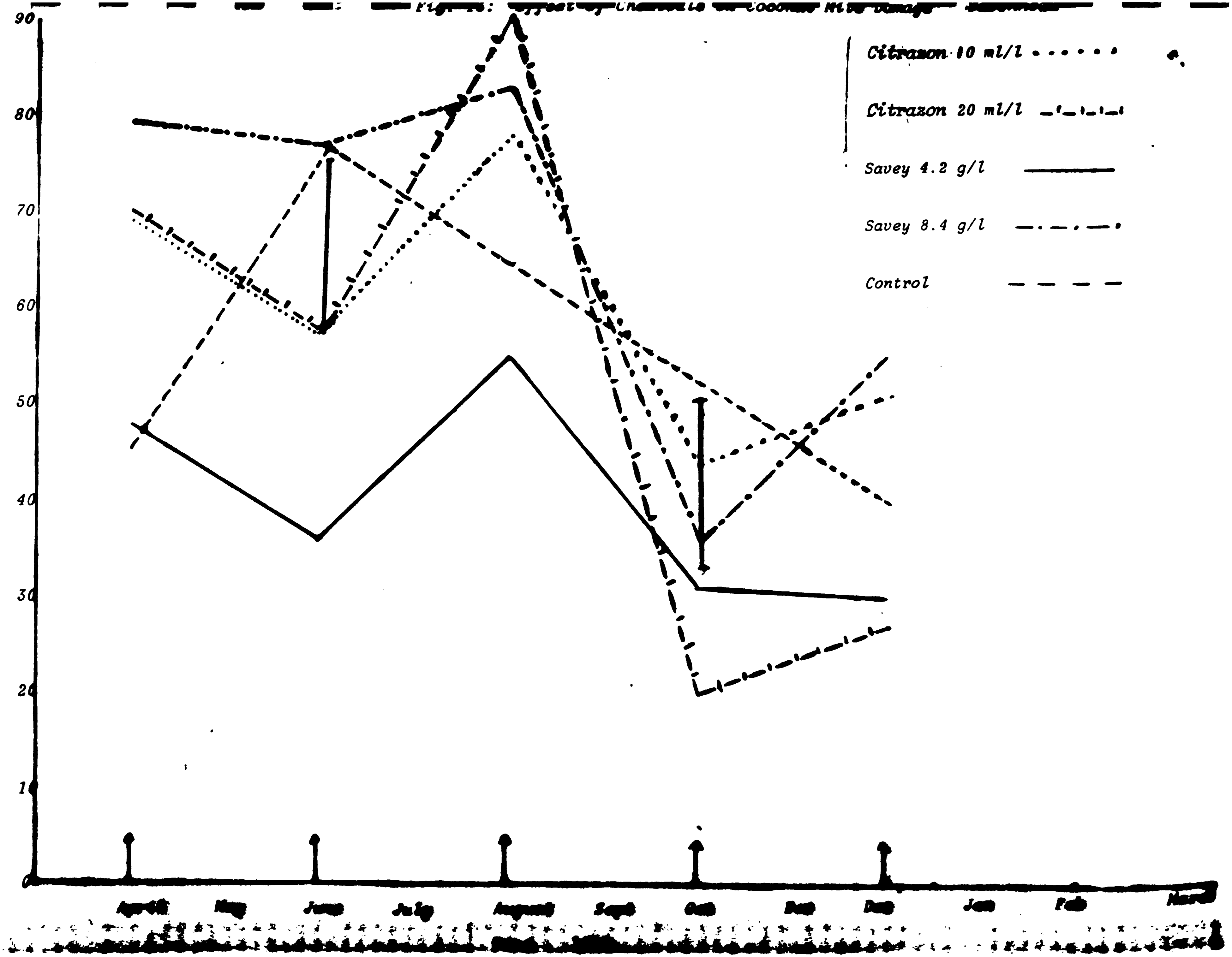


Figure 12: Effect of different fertilizers on coconut mite damage





Citrazon 10 ml/l
Citrazon 20 ml/l
Savey 4.2 g/l
Savey 8.4 g/l
Control
90
80
70
60
50
40
30
20
10
0
April
May
June
July
August
Sept
Oct
Nov
Dec
Jan
Feb
March

Fig. [illegible]: Effect of Chemicals on Coconut Mite Damage