Effects of Citrus cultivars and reduced irrigation on availability of new growth for Citrus psylla breeding.

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INFLUENCE DES CULTIVARS D'AGRUMES
ET D'UNE IRRIGATION REDUITE SUR LA DISPONIBILITE
DE NOUVELLES POUSSES POUR LA MULTIPLICATION
DU PSYLLE DES AGRUMES.

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RESUME - En rapport avec les émissions foliaires la séquence des agrumes sur lesquels le psylle, *Trioza erytreae* (Del Guercio) peut se développer au cours de l'année est : Navel, Valencia, pomelo et, enfin, citronnier ; ce dernier peut abriter durant l'été des populations de psylles plus fortes que dans le cas des trois autres espèces.
Sur citronniers de 5 ans l'arrêt de l'irrigation en hiver durant 12 semaines entraîne une émission foliaire très limitée durant 17 semaines et une réduction importante des populations du psylle ; cette absence d'apport d'eau, de faible incidence sur la récolte, est recommandée pour les régimes où les citronniers sont plantés seuls ; elle ne l'est pas pour les Navel, Valencia et pomelo dans la région de Nelspruit. Citronniers et Navel ne doivent pas être plantés les uns près des autres ; Valencia et pomelo semblent pouvoir se combiner.

INTRODUCTION

The citrus psylla, *Trioza erytreae* (Del Guercio), is of major economic importance due to the adult being the vector of the organism which causes greening disease of Citrus in South Africa (Mc Clean and Oberholzer, 1965; Moll and Martin, 1973). According to Anon. (1967) the Citrus psylla occurs throughout the eastern parts of Africa, the Islands of St. Helena, Mauritius and Madagascar and according to Aubert (1984) also on Reunion Island. Sections of the tree affected by greening bear abnormal fruit, and eventually severe tree decline takes place. Consequently farmers from certain areas have been forced to curtail Citrus production (Moll, Van Vuuren and Milne, 1980; Van den Berg and Nel, 1981).

The fact that immature stages of Citrus psylla can only develop on young leaves, was first mentioned by Van der Merwe (1923), and latter by other workers.

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Thus, population fluctuations of the Citrus psylla are closely correlated with the growth cycles of the Citrus trees. When conditions become adverse, the Citrus psylla can show considerable powers of dispersal and great ability to locate new flush points (Samways, 1984).

Under favourable temperature conditions Citrus may be forced to form new growth at almost any time by manipulating the water supply (Webber, 1943). According to Hefer (1963), the formation of new growth is delayed by insufficient soil moisture. On the other hand, irrigation during the winter may stimulate the formation of leaves and thus precipitate psylla outbreaks (Catling, 1970). This led to speculations that withholding irrigation during winter can significantly lower psylla populations.

Citrus branches affected by greening tend to form new growth out of cycle with unaffected branches (Catling, 1970) so that Citrus trees with greening are more favourable host plants than healthy trees.

Catling (1969) found that the formation of new growth differed considerably in two Tzaneen Citrus orchards. At Letaba, where warm and dry conditions prevail, no new growth was present on mid-season cultivars for approximately 3 months during winter, while a Valencia orchard at Forest Hill, which is relatively cool and moist, produced new growth cycles throughout the year.

The objective of this study was to determine how the growth cycles of different Citrus cultivars influence Citrus psylla populations. In the trials, the premise was that all new growth could serve as breeding sites for the Citrus psylla.

MATERIALS AND METHODS

The production of new growth by different Citrus cultivars where irrigation was withheld for certain periods was determined on the CSFRI and Friedenheim experimental farms at Nelspruit. For this purpose, the following cultivars were used: Bahianinha navels, Olinda Valencia, and Marsh grapefruit, all on Troyer Citrange rootstocks and Eureka lemons on Volkameriana rootstocks. These orchards were all 5-year - old when the experiment commenced in 1982, and some of the trees were affected by greening to a small extent.

For each cultivar, three rows of 14 trees were chosen at random. The following treatments were applied to single rows:

Treatment 1 (Control): Irrigated every 14 days, according to a crop factor of 0,75.

Treatment 2: Irrigated as the previous row, except from 13 May 1982 up to and including 22 July 1982 when no water was supplied. On 5 August 1982 the irrigation deficit was replenished and normal irrigation resumed.

Treatment 3: Normal irrigation was provided as in treatment 1, except from 10 June 1982 to 19 August 1982 when irrigation was withheld. On 2 September 1982 the irrigation deficit was replenished and normal irrigation resumed.

The presence of new growth on these trees was determined as follows:

For each cultivar, the first ten trees were used in each treatment. A metal frame of 300 x 300 mm was held at a height of about 1.5 m against the canopy of a tree. All new growth points with young tender leaves less than 25 mm long, and considered young enough for psylla breeding, were counted. This process was repeated for each quadrant of all the marked trees. The counts were made weekly from 22 April 1982 to 23 April 1983.

The same three rows of lemons were used as in the irrigation-flush study to determine the influence of withholding irrigation on their yield. During the following year, the same periods of withholding irrigation were repeated, one calendar day earlier, to treatments 2 and 3 as before.

Fruit from each of the 10 trees in the treated rows were picked separately and weighed for each tree on 25 May 1983; 8 November 1983 and 9 February 1984.

RESULTS

1. Production of new growth by different Citrus cultivars regularly irrigated.

A comparison of the growth cycles of the control trees used in the irrigation trials, namely navels, Valencias, grapefruit and lemons, is made in Fig. 1. The average weekly temperatures, as provided by Agrometeorology at the CSFRI, Nelspruit, are also provided.

From Fig. 1, the following deductions are made :

1.1. Bahianinha navels on Troyer Citrange.

No distinct dormant period was present with 5-year-old navel trees. The first new flush of the season started at the beginning of June, followed by the main flush from mid July to the end of September. A large amount of flush was therefore present for a period of about 3 months. Except for three separate counts with no new growth points during summer, new growth was present throughout the year.

1.2. Olinda Valencia on Troyer Citrange.

The first and biggest flush during the year started at the end of July and lasted till the end of September. No new growth points were present for 7 weeks, from mid October to the end of November.

1.3. Marsh grapefruit on Troyer Citrange.

The growth cycle of grapefruit is much the same as that of Valencias. Their dormant period of 9 weeks is a little longer, from the end of September to the end of November.

1.4. Eureka lemons on Volkameriana.

For a period of 10 weeks, from mid April to the end of June, there were no new growth points on the lemon trees. Lemons flushed continuously from the beginning of August till the end of December.

2. The influence of withholding irrigation for certain periods on the production of new growth.

2.1. Navels.

The production of new growth by navels which were

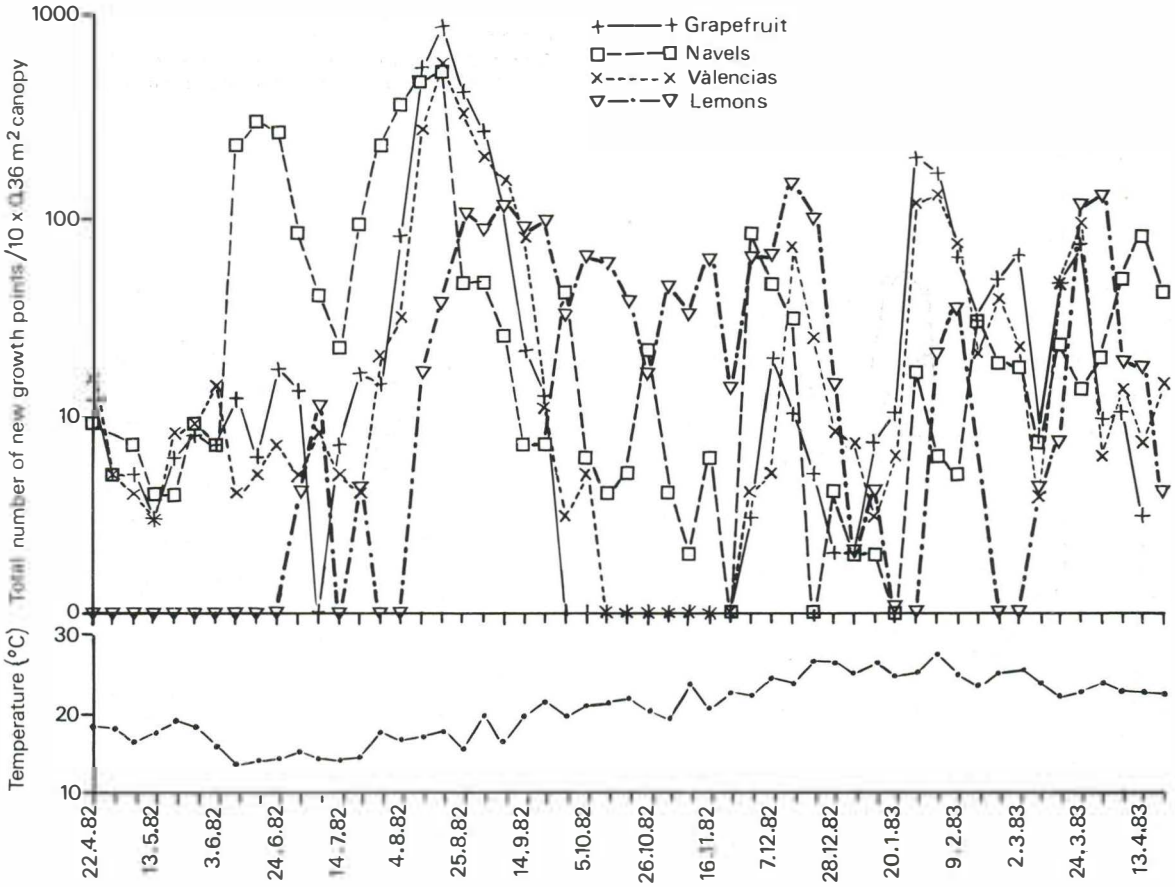

Figure 1 - A COMPARISON OF THE GROWTH CYCLES OF FOUR **CITRUS** CULTIVARS AND WITH WEEKLY AVERAGE TEMPERATURES.

irrigated regularly, is compared to others where irrigation was withheld for certain periods (Fig. 2). The presence of new leaves on both treatments where irrigation was withheld, declined to zero for only 1 week in the middle of July (Fig. 2). Although it rained on 25 and 26 July 1982, the trees had already started flushing on these dates.

2.2. Valencias.

In Fig. 3, a comparison is made between irrigated trees and others where irrigation was withheld for periods.

During the periods where irrigation was withheld, the production of new growth on Valencia trees decreased to zero for short periods (Fig. 3). The rain at the end of July possibly shortened some of these periods. During this time, new growth was always present on trees regularly irrigated. On the trees where irrigation was withheld earlier, small numbers of new growth points occurred during the period mid October to the end of November. This period was slightly longer on the former two treatments than on the control trees.

2.3. Grapefruit.

The production of new growth on trees irrigated throughout the year and others where irrigation was withheld for periods, is illustrated in Fig. 4. The influence of withholding irrigation on new growth, is much the same in grapefruit (Fig. 4) as for Valencias.

2.4. Lemons.

A comparison is made of the new growth of lemons irrigated throughout the year and others where irrigation was withheld (Fig. 5).

Trees that were regularly irrigated had no new growth for 13 of the 17 weeks from 22 April 1982 to 12 August 1982 (Fig. 5). During the same period, trees where irrigation was withheld for different periods had no new growth for 15 weeks and very few new growth for the other 2 weeks.

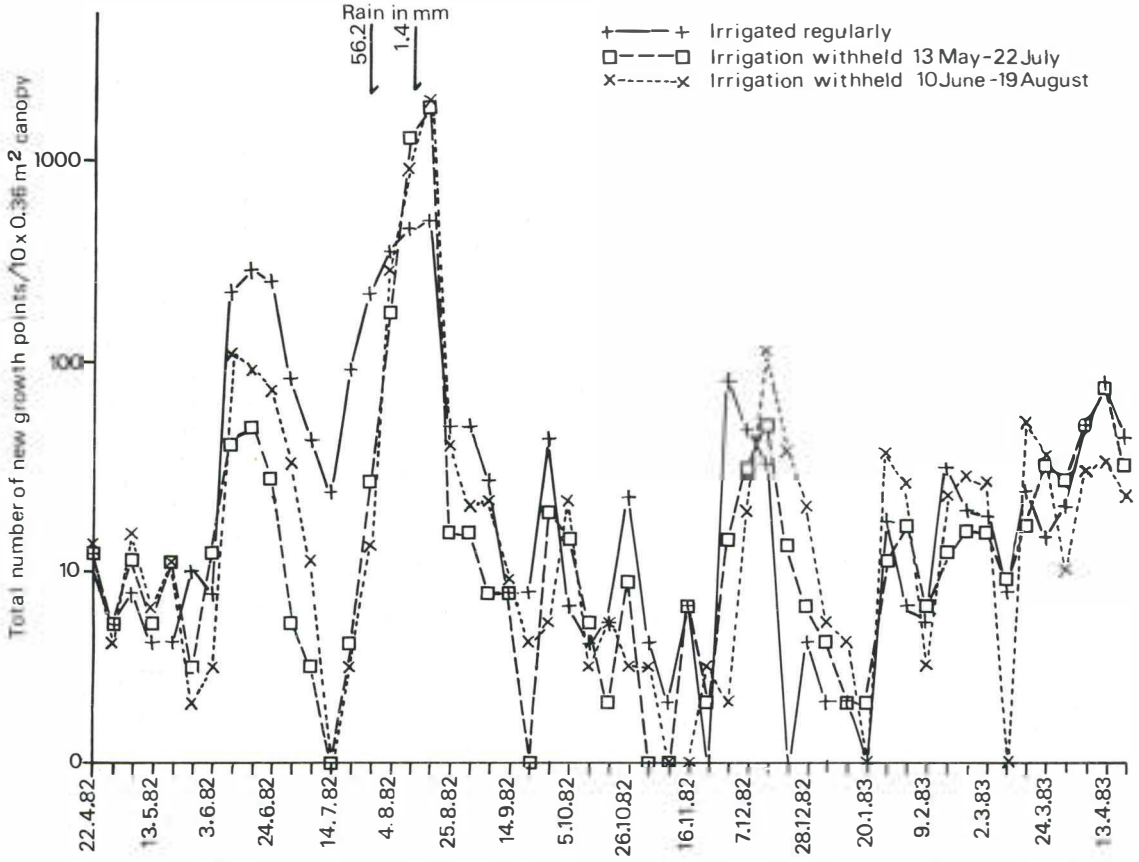

Figure 2 - A COMPARISON OF THE NEW GROWTH POINTS OF **NAVELS**, REGULARLY IRRIGATED AND THOSE WHERE IRRIGATION WAS WITHHELD FOR PERIODS.

TABLE 1 - Total mass of fruit produced by each of ten 6-year-old lemon trees where irrigation was provided regularly or withheld for periods.

	Total mass of fruit per tree in kg		
	Treatment 1 Irrigated regularly	Treatment 2 Irrig. withheld 12 May 1983-4 August 1983	Treatment 3 Irrig.withheld 9 Jun 1983-1 September 1983
mean	82,0	81,9	80,7
Standard error	+ 12,99	+ 10,86	+ 10,28
L.S.D. = 40,15 at P = 0,05			

3. The influence of withholding irrigation on the yield of lemons.

A comparison of the total mass of fruit produced by each of ten 6-year-old lemon trees where irrigation was provided regularly and where it was withheld for periods, are provided in Table 1.

A large variation occurred between the total mass of fruit produced by the individual trees within the treatments. In comparison to the control (treatment 1), the withholding of irrigation from 12 May 1983 to 4 August 1983 (treatment 2), and from 9 June 1983 to 1 September 1983 (treatment 3), had little effect on the average mass of fruit produced by lemon trees (Table 1) and the means do not differ significantly at the 5% level.

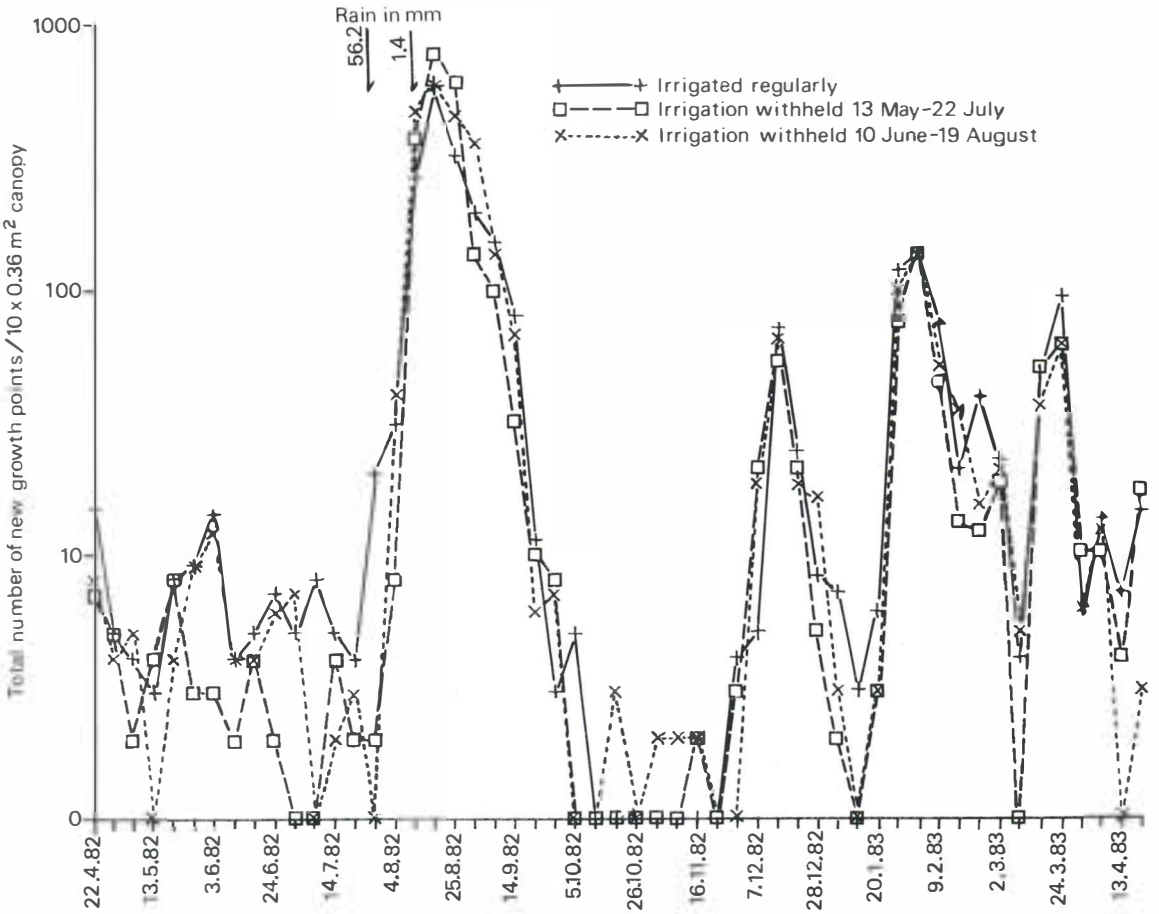

Figure 3 - A COMPARISON OF THE NEW GROWTH POINTS OF **VALENCIAS**, REGULARLY IRRIGATED AND THOSE WHERE IRRIGATION WAS WITHHELD FOR PERIODS.

DISCUSSION AND CONCLUSIONS

During these trials it was found that 5-year-old navels flush about 2 weeks earlier than Valencias of the same age. This agrees more or less with the report by Hall (1930) that navels flush about 3 weeks earlier than Valencias at Mazoe (Zimbabwe). In contrast, Catling (1969) observed that there was little difference in the timing of the spring growth cycle of these two varieties at Letaba. These differences may possibly be attributed to different rootstocks used or to climatic differences of the area, e.g. rainfall and/or temperature which might influence navels and Valencias differently.

According to Catling (1969), adults of the Citrus psylla usually live between 34 and 50 days and up to as long as 82 days. The longest periods when no new growth was present on the trees, were 1 week for navels, 7 weeks for Valencias, 9 weeks for grapefruit and 10 weeks for lemons. With flush present on navel trees for most of the year, it seems to be the cultivar that can support psylla populations best throughout the year. Valencias and grapefruit were found to be less ideal for this purpose. If planted in isolation, lemons seem to be the cultivar that would hardly be abble to provide breeding sites for psylla throughout the year. However, lemons flush continuously from the beginning of August till the end of December. During a part of this period no new growth was present on Valencias and grapefruit and very few on navels. Furthermore the period August to December is when the psylla population is at its peak (Catling, 1970). For these reasons, lemons will probably be able to support higher populations than the other cultivars during these months, which confirms the statement of Pyle (1979) that lemons can support greater psylla populations than other cultivars.

A large amount of new growth was present on navels for about 3 months from June. Psylla populations can therefore increase very rapidly during winter and spring on this cultivar.

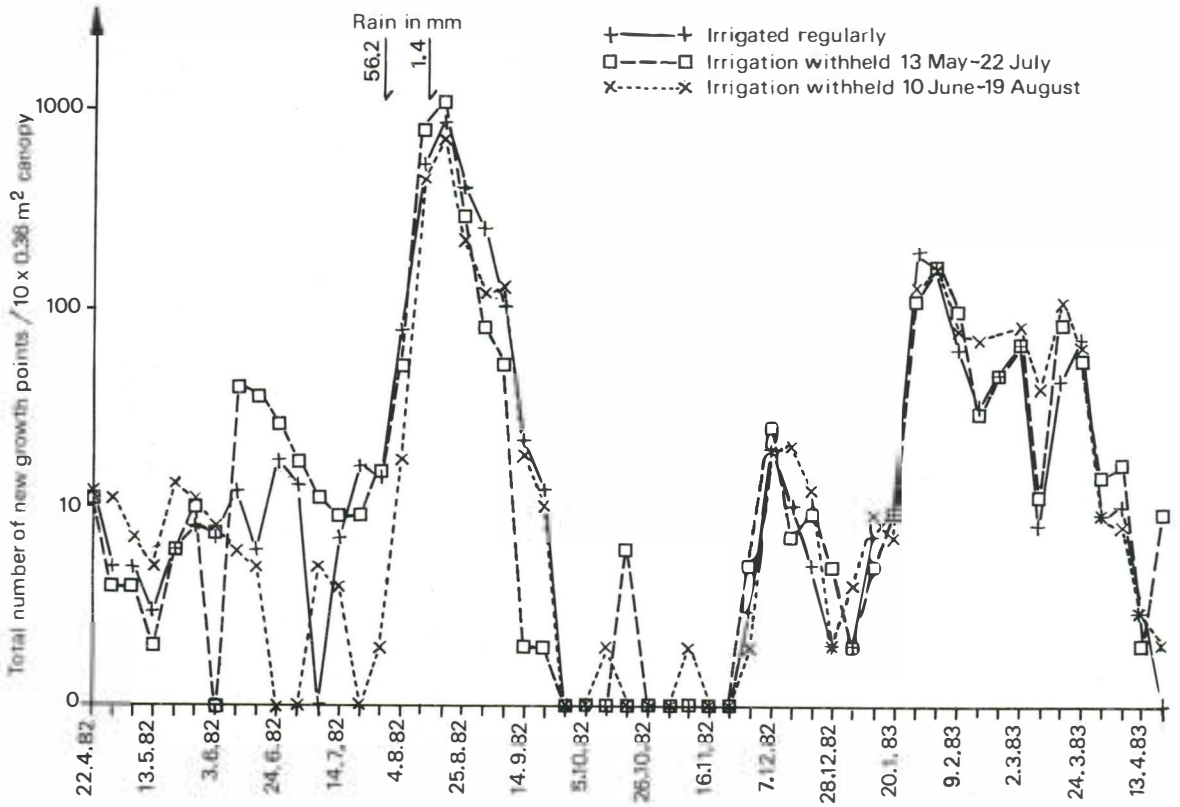

Figure 4 - A COMPARISON OF THE NEW GROWTH POINTS OF **GRAPEFRUIT**, REGULARLY IRRIGATED AND THOSE WHERE IRRIGATION WAS WITHHELD FOR PERIODS.

As the first flush of navels started early in June, the withholding of irrigation which started on 13 May and 10 June, seems to be too late to influence the initiation of this flushing period. The only effect seems to be that the new growth decline to zero for only 1 week on both treatments where irrigation was withheld. This should only have a minor effect on psylla populations and this method to reduce flush is therefore not recommended on navels in the Nelspruit area.

Before the first flush of the season, production of new growth by Valencia trees where irrigation was withheld, dropped to zero for 1 or 2 weeks. As the adult psylla can live much longer than this, these periods can easily be overcome by them and the slightly longer resting periods of the two treatments where irrigation was withheld during October-November, will probably not lead to any difference from the control trees. The withholding of irrigation on Valencias at the mentioned periods will thus not have a significant influence on psylla populations in the Nelspruit area. The situation with grapefruit is much the same i.e. that very little if any benefit will be obtained by withholding irrigation.

Lemon trees that were regularly irrigated had no new growth points for 13 of the 17 weeks during autumn and winter. For the same period, trees where no water was supplied for certain periods had no flush for 15 weeks and very few new growth points for the other 2 weeks. As adults are only able to live up to about 12 weeks (Catling, 1969), this prolonged resting period should have a very important influence on psylla populations. No significant difference in yield occurred with lemon trees treated in this manner.

If planted closer than about 1500 m apart, any combination of Citrus cultivars with lemons and to a lesser extent with navels, seems to be prone to higher psylla populations than in areas with one cultivar only. The worst combination of cultivars in an area is probably lemons and navels. As their dormant periods correspond, the only cultivars of the 4 tested that seem to combine well, are Valencias and grapefruit. The withholding of irrigation for 12 weeks during winter is recommended for isolated lemon orchards.

If greening was to spread to the winter rainfall areas of Southern Africa (such as parts of Patensie, Swellendam and Stellenbosch), the withholding of irrigation for certain periods during the dry period should be investigated as a method of reducing populations on Valencias and lemons.

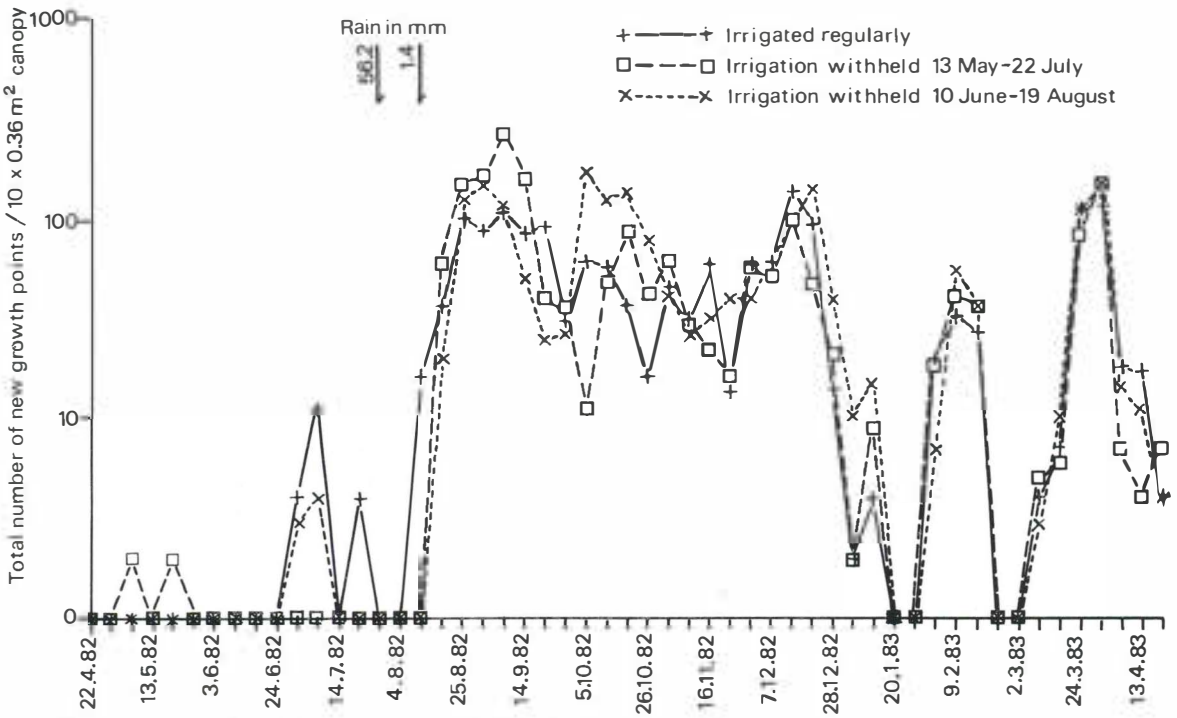

Figure 5 - A COMPARISON OF THE NEW GROWTH POINTS OF **LEMONS**, REGULARLY IRRIGATED AND THOSE WHERE IRRIGATION WAS WITHHELD FOR PERIODS.

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