Synopsis of Strategies to Reduce Populations of Citrus Psylla, *Trioza erytreae*, and the Spread of Greening

**ABSTRACT**

Measures to control citrus psylla or to prevent the build-up of large populations and the spread of greening are discussed. The most important of these are: restricting citrus growing to hot, low-lying regions of the country; strict chemical control of vectors in nurseries; planting orchards with one cultivar of the same age; and planting only cultivars with flushing periods that coincide in the same area. The need for further research is also discussed.

**KEYWORDS**

*Trioza*, citrus fruits, disease control.

---

Recommandations pour réduire les populations de psylle des agrumes et le développement du greening.

**RÉSUMÉ**

Des mesures pour contrôler et pour éviter l'accroissement des populations des psylles des agrumes sont recensées. Le développement de la maladie du "greening" est ensuite examinée. Les principales recommandations sont : limiter la plantation des agrumes aux régions chaudes et peu humides du pays, effectuer un contrôle chimique strict des vecteurs dans les pépinières, aménager des vergers avec des arbres d'un même cultivar et du même âge et planter, dans une même zone, des cultivars ayant des poussées végétatives saisonnières qui coïncident. La nécessité de réaliser des travaux de recherches complémentaires est aussi discutée.

**MOTS CLÉS**

*Trioza*, agrume, contrôle de maladies.

---

Recomendaciones para reducir las poblaciones de psylle en los cítricos y el avance de "greening".

**RESUMEN**

Se presentan medidas para controlar la psylle de los cítricos y para evitar el desarrollo de las poblaciones de este insecto. El avance de la enfermedad de "greening" es analizada. Las principales recomendaciones son : limitar las plantaciones de cítricos a regiones calientes y poco húmedas, controlar estrictamente los vectores en los viveros, establecer huertos con árboles de una misma edad y efectuar plantaciones en zonas donde coincidan la brotación vegetativa y el periodo estacional. La necesidad de efectuar trabajos de investigación complementarios es también discutida.

**PALABRAS CLAVES**

*Trioza*, frutas cítricas, control de enfermedades.
The presence of citrus psylla, *Trioza erytreae* (Del Guercio) (Hemiptera: Triozidae), was first reported in southern Africa by *Loosbury* (1897). *Van der Merwe* (1923, 1941) considered this insect to be a minor pest of citrus nursery trees and occasionally of new flushes in citrus orchards. The status of citrus psylla was raised to that of a major pest in 1965 when McLean and Obierholzer (1965) demonstrated that *T. erytreae* adults are vectors for greening disease of citrus in South Africa. Two short review papers on citrus psylla have appeared, one by Van den Berg and Nel (1981) and the other by Aubert (1987), and recently two comprehensive reviews were published by Otake (1990) and Van den Berg (1990a). The present synopsis endeavours to give practical suggestions for reducing psylla populations and containing the spread of greening disease, aspects that have not been dealt with in sufficient detail in previous publications.

measures to reduce citrus psylla populations and the spread of greening disease

1. The psylla problem can be largely avoided by restricting citrus growing to hot, low-lying regions of the country where high temperatures combined with low humidities restrict psylla breeding (Moran, 1968; Aubert, 1985).

2. Certain citrus trees are either less attractive to adult psylla or less suited for nymphal development than others (Van den Berg et al., 1991a). Apparently “resistant” trees should be tested to verify these observations and, if found to be resistant, they should be propagated and used in breeding programmes.

3. The selection and breeding of greening-tolerant citrus cultivars could offer an alternative method for control of this disease (De Lange et al., 1984).

4. Each flush cycle should be reduced to as short a period as possible (Cating, 1969a; Van den Berg, 1986). This can be achieved by tree selection, application of growth retardants (Van den Berg, unpublished data) or with an irrigation regime to encourage winter tree dormancy and well-defined flushes in summer (Cating, 1969a). The latter method has been evaluated on four citrus cultivars, but it was only successful on lemons where, despite the suppression of new growth for about 17 weeks, there was no significant loss of yield (Van den Berg, 1986).

5. In order to restrict psylla breeding to a minimum period in a particular area, only cultivars with flushing periods that coincide should be planted (Van den Berg, 1986). Valencia and grapefruit can be grown in the same area, but any combination of citrus cultivars with lemons or to a lesser extent with navels, will probably result in more severe psylla infestations due to extended breeding opportunities. The highest risk cultivar combination in one area would most likely be lemons and navels (Van den Berg, 1986). It should also be borne in mind that orchards have to be at least 1.5 km apart before they can be regarded as isolated from each other (Van den Berg and Deacon, 1988).

6. Pest control measures vary with tree age and cultivars (Van den Berg, 1982). It is therefore recommended that each orchard be planted with a single cultivar. Planting of young trees between older trees is not recommended but, when practised, the younger trees should be treated more often for psylla than the older trees since flushing is prolonged in young trees (Van den Berg, 1982).

7. Pruning of trees to restrict size, stimulates new growth and is not recommended in areas which are subject to psylla infestations (Van den Berg, 1987). If pruning is unavoidable, due to inadequate spacing, pruning should be timed to ensure that the ensuing new growth coincides with the main flush in spring.

8. Skirting of trees for ant control may also stimulate new growth and should be implemented at the same time as pruning (Van den Berg, 1982; 1987).
9. The spread of greening and its vectors can be limited through sound nursery practices (Schwarz, 1967; Kotze, 1982; Kotze, 1985; Aubert, 1988) and by enforcing existing legislation that prohibits the transfer of citrus propagation material from Transvaal, Natal or Orange Free State to Cape Province (R.S.A. Act 36, 1983).

10. Greening disease can only be contained if infected plant material is eradicated in the orchards (Schwarz, 1967; Greer and Schwarz, 1970; Kotze, 1982). Infected branches should be sawn off flush with the main stem during June and July (Van den Berg, 1982; Van Vuuren, 1983; Buttendag, 1986; Van den Berg, 1987) and any further developing shoots should be removed.

11. Neglected and dying citrus trees can serve as a source of greening disease inoculum and should either be removed or undergo the same psylla control programme as well-managed orchards (Van den Berg and Verbeek, 1985).

12. The recommendation of Aubert (1988) that new orchards should be established as far as possible from indigenous rutaceous host plants is well founded. Since False Horsewood trees can also be infected with greening (Van den Berg et al., 1992), this recommendation takes on even greater importance. Eradication of indigenous host plants from the vicinity of orchards is therefore advised (Van der Meerwe, 1923; Van den Berg et al., 1992).

13. Adult citrus psylla have been observed in feeding positions on plants which are unsuitable for nymphal development. Furthermore, psylla can "overnight" on other non-host plants (Van den Berg and Deacon, 1989). Other plant species can therefore be symptomless carriers of greening disease. Such plants should be identified and removed from the vicinity of orchards.

14. Citrus psylla populations appear to be regulated by more than just an availability of young developing leaves and high temperatures combined with low relative humidities (termed saturation deficit index) (Van den Berg et al., 1991a). Other factors should therefore be investigated to control or predict psylla outbreaks.

15. Several citrus groves in the Cape were found to have trees infected with greening disease. These trees originated from Transvaal nurseries (Schwarz, 1967). Furthermore, citrus psylla from Stellenbosch is capable of transmitting greening disease (Van den Berg et al., 1987b). Spread of the disease thus appears to be inevitable, and it is still unclear why this has not occurred in these areas, further studies are needed to elucidate this question.

16. Indigenous parasitoids (Catling, 1969b) and predators (Catling, 1970; Van den Berg et al., 1987a), clearly suppress populations of citrus psylla, but they are unable to reduce numbers to economically acceptable levels. Introduction of the parasitoid Tamarixia raiowae Burks (Hym.: Eulophidae) and the predatory anthocorids, Antilocoris antevolens White, A. melanocephalus Reuter and A. melanurus (F.), has been recommended (Van den Berg, 1984) and requires investigation.

17. It is important to inspect orchards for citrus psylla outbreaks, preferably weekly, especially when they flush (Van der Kooy et al., 1986; Van den Berg, 1990b), or to use a monitoring method (Samways et al., 1986; Van den Berg et al., 1991b). Populations can be monitored with a yellow sticky trap placed in the northernmost row, one in the southernmost row and one in the middle row of a citrus orchard. This will provide a standardized and reliable monitoring method (Van den Berg et al., 1991b). Young trees, especially lemon, develop new growth over long periods and should be inspected thoroughly (Catling, 1969a; Van den Berg, 1990b).

18. In young trees, citrus psylla are often only present in the northern rows of an orchard, especially if these are close to windbreaks. Chemical control could therefore be confined to these trees. During winter, the same strategy can be followed with older trees, but some edge rows may also be infested (Van den Berg et al., 1991b).
19. Preventive chemical control can be applied before the start of the major spring flush cycle in order to reduce psylla numbers before build up later in the season (Cattlin, 1969). A female needs up to four matings to be able to fertilize her full egg capacity, and some females have to mate within a month before laying fertile eggs in spring. At low population densities, some females may therefore lay infertile eggs throughout her lifespan or part of it (Van den Berg et al., 1991c). This would be a further advantage derived from keeping populations at low levels, especially during winter.

20. Since host searching is conducted shortly before sunset (Van den Berg and Deacon, 1989) and citrus psylla usually remain on the same tree for several hours (Van den Berg et al., 1990), fast acting, contact and systemic insecticides are recommended for their control. Although these may not prevent the spread of greening to an orchard, they will probably kill adult psylla on the first tree on which they alight, thus reducing spread of the disease.

21. Observations indicate that adult citrus psylla are almost exclusively confined to young leaves and branches (Van den Berg et al., 1990). It is also known that nymphs can only survive on young tender flush (Van den Merwe, 1923; Moran and Blowers, 1967). For these reasons, foliar chemical sprays against this pest need only be applied as light cover sprays. This confirms the recommendations of Bedford (1985). The cost of the insecticide applied as a light cover spray is half that of a full cover spray (Bedford, 1985) and therefore represents a substantial saving.

22. Chemicals with long residual action applied to control pests such as citrus thrips, Scirtothrips aurantii Faure, and American bollworm, Heliothis armigera (Hüb.), will also reduce the psylla population. The control of citrus psylla, citrus thrips and American bollworm should be integrated as an entity, especially during spring (Van den Berg et al., 1985). A single contact insecticide can replace bait for thrips and one or two contact insecticides for psylla and American bollworm larvae. Control could therefore be more cost-effective.

23. Psylla can also be controlled by applying undiluted monocrotophos to the bark of citrus trees. If applied in the recommended dosage, this chemical is not phytotoxic towards various rootstocks and Valencia trees (Butendag and Bronkhorst, 1984, 1986; Butendag, 1986). This control method is effective and relatively cheap.

acknowledgements

The author wishes to extend his thanks to Prof P.H. Hewitt for constructive criticism and to Mrs M. Maritz for typing the manuscript. This paper forms part of a dissertation submitted to the University of the Orange Free State, Bloemfontein, South Africa in fulfilment of a Ph.D. degree.

refereces


Trioza erytreae Del Guercio and Diaphorina citri Kuwayama (Homoptera: Psyllidae), the two vectors of citrus greening disease: Biological aspects and possible control strategies. Fruits 42 (3), 149-162.


Vergroeningsieke van sitrus: verskeie beheermethodes van die vektor Triozia erytreae (Del Guercio) met Azodrin (monokrotfos) en 'n ondersoek na onderdrukking van vergroeningsieke-vrugsimptome met staminspuitings. Pietermaritzburg (South Africa): University of Natal, Ph.D. (Agric.) thesis, 265 p.


Further aspects of trunk treatment of citrus with insecticides: phytotoxicity, side effects on incidental pests, and development of application apparatus. Citrus and Subtropical Fruit Journal, 604, 7-10.


CATLING H.D., 1969b.

CATLING H.D., 1969c.


Greening a menace to our citrus industry. South African Citrus Journal, 437, 3-7.

Vergroening by sitrus - Tyd vir 'n oplossing word min. Citrus and Subtropical Fruit Journal, 585, 8.


LOUNSBURY C.P., 1897.


MORAN V.C., 1968.


Hoe om die sitrusvlooi te beperk. Information Bulletin, Citrus and Subtropical Fruit Research Institute, Nelspruit, South Africa, 120, 6-7.
Introduction of natural enemies against citrus psylla, Triozoa erytraeae (Del Guercio) (Hemiptera: Triozidae). Citrus and Subtropical Fruit Journal, 612, 8-11.

Effects of citrus cultivars and reduced irrigation on availability of new growth for citrus psylla breeding. Fruits, 41 (10), 597-604.

Hoe om citrusbladwolke te beperk. Information Bulletin. Citrus and Subtropical Fruit Research Institute, Nelspruit, South Africa, 184, 5.


Dispersal of the citrus psylla, Triozoa erytraeae (Hemiptera: Triozidae), in the absence of its host plants. Phytophylactica, 20, 361-368.

Flight activities of the citrus psylla, Triozoa erytraeae (Hemiptera: Triozidae). Phytophylactica, 21, 391-399.

Predators of the citrus psylla, Triozoa erytraeae (Hemiptera: Triozidae), in the Lowveld and Rustenburg areas of Transvaal. Phytophylactica, 19, 285-289.


Dispersal within and between citrus orchards and native hosts, and nymphal mortality of citrus psylla, Triozoa erytraeae (Hemiptera: Triozidae). Agriculture, Ecosystems and Environment, 31, 297-309.


A review of research work on the citrus psylla, Triozoa erytraeae (Del Guercio). Subtropicalia, 2 (6), 11-15.

Neglected and dry-land navel trees as a source for the breeding of citrus psylla, Triozoa erytraeae (Del Guercio) (Hemiptera: Triozidae). Subtropicalia, 6 (12), 12-15.


Cross-breeding and greening disease transmission of different populations of the citrus psylla, Triozoa erytraeae (Hemiptera: Triozidae). Phytophylactica, 19, 353-354.

Situspleegverkenning op Zebediela. Citrus and Subtropical Fruit Journal, 628, 57.

VAN DER MERWE C.P., 1923.

VAN DER MERWE C.P., 1941.

VAN VUUREN S.P., 1983.