ECONOMIC IMPACT OF LEPROSIS IN BRAZIL

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Abstract

Citrus leprosis is one of the main virus diseases of Brazilian citriculture. The disease and its vector are present almost in all Brazilian citrus producing areas, especially in São Paulo State, the greatest national citrus producer. Citrus leprosis damage is characterized by local lesions on fruits, leaves, and twigs or small branches, which directly reduce production and the economic life span of the citrus tree. In favorable years, during long period of water stress, significant yield lost from 20 to 100% can be achieved in groves without control of *Citrus leprosis virus* vector, the red flat mite *Brevipalpus phoenicis*. Because of its endemic status and severe potential damages, a frequent and expensive disease management in commercial orchards must be accomplished since the establishment of new citrus planting. Frequent and systematically field scouting is done to detect the vector mite and different mite control threshold levels are used depending on the historical of disease into the grove. Around US$ 70 to 80 million is spent annually to control the vector mite. Nowadays, it can represent 13% of total phytossanitary costs and 6% of total costs of bearing groves. Pruning symptomatic branches and shoots is also a recommended practice to reduce leprosis inoculums' as a complementary strategy of citrus leprosis control.

Introduction

In Brazil, citrus leprosis is reported since 1931. It was firstly found in sweet orange "Bahia" (*Citrus sinensis* L. Osbeck), in Sorocaba, São Paulo State (Bitancourt, 1934). With the increased fruit transportation from the farms to juice processing plants throughout the São Paulo State during citrus industry expansion in the 60's, citrus leprosis was widely spread and became a very important disease (Rossetti et al., 1997). Nowadays, in São Paulo State, citrus leprosis occurs in every citrus producing region, been more severe in the North, Northwest and Center. In South and Southeast of the state, in more recent citrus boundaries, there is the presence of the *Brevipalpus* mite, but with low leprosis incidence. Citrus leprosis surveys carried out by Fundecitrus in 2004 and 2005, estimated that around 50% of sweet orange trees showed at east one leprosis lesion, being around 20% in new shoots and fruit.

Even though, citrus leprosis occurs mainly in São Paulo because of the concentration of the Brazilian citriculture in this state, the disease was detected in every Brazilian macro-regions where the disease surveys were performed (Figure 1) (Bastianel et al., *accepted paper*). In Brazil, citrus is grown in 22 of 27 states, being 99% of the total of sweet oranges production originated from states of São Paulo, Bahia, Sergipe, Minas Gerais, Paraná, Rio Grande do Sul, Santa Catarina, Goiás and Rio de Janeiro. In all of them citrus leprosis is present.

Citrus leprosis is a severe viral disease, caused by the *Citrus leprosis virus* (CiLV), transmitted by the Tenuipalpidae mites of genus *Brevipalpus*, that causes a decrease in production and reduces the economic life span of a citrus orchard due to significant mortality of new wood growth, reduction in tree canopy development, premature leaf and fruit drop where the mite vector is not controlled (Figure 2). The mite by itself does not affect production significantly.

Historically, citrus leprosis epidemics occur in cycles in Brazil because of weather and/or economics factors. Years with long water stress period are the most favorable ones for *Brevipalpus* multiplication and consequently CiLV spread (Oliveira, 1986; Oliveira 1995). Additionally, when citrus prices are high, growers control the mites more carefully and, when

prices fall, chemical treatments for mites and other pests and pathogens are neglected and the incidence of citrus leprosis increases (Rodrigues et al., 2003).

Observations made in the State of São Paulo indicated that when inoculum is present in an area and mitecides are not applied, usually two to three years are needed to allow the complete spread of leprosis throughout an orchard and to make yield damage perceptible. Despite the disease incidence and severity progress rates are not considered high compared to other citrus diseases, citrus leprosis is a polyetic disease, increasing the amount of lesioned tissues year after year and always starting a new season with higher initial inoculum (Czermainski et al. 2007).

Estimated yield losses up to 100% from prematurely dropped fruit have been recorded in Brazil for different sweet orange cultivars (Nantes & Atique, 1993; Rodrigues et al., 2000). Damage increases significantly with the inclusion of unmarketable fruits, those are not accepted by packinghouse or juice plant (Figure 3) (Rodrigues et al., 2003). Fruits with lesions have low commercial value, especially for the fresh market. There is a significant positive relationship between the number of fruits with lesions and number of lesions per fruit. These variables are both negative related to fruit weight. However, other quality variables such as Brix, acidity and Brix/acidity ratio are not significantly influenced by the number of lesions on the fruit (Chiavegato et al., 1982; Rodrigues et al., 2000).

Recent studies showed that spatial distribution of leprosis symptomatic trees and *Brevipalpus* mite are not completely related (Bassanezi & Laranjeira, 2007). The probability of a tree becomes infected is higher when neighbor trees are symptomatic than when the tree has the mite presence (Franciscon et al., 2008), and the reduction in yields is more related to the disease incidence and severity than to the abundance of the vector (Bassanezi, *unpublished data*). Usually, leprosis mite population is low and not well distributed into the grove that makes mite sampling not accurate and precise. Even those, empiric thresholds of mite infestation are used for mite control decision making. Field scouting are usually done every 10 to 14 days, systematically inspecting 1 to 2% of trees and looking at 3 to 5 internal fruit or shoots for leprosis mites. Often, in groves with leprosis symptoms incidence or with history of disease incidence, mite infestation up to 10% in inspected fruit or shoots is allowed before chemical control (Gravena, 2005). However, some growers with risk aversion have much lower or no tolerance to the presence of leprosis mite and start to control leprosis vector with much less mite infestation even without incidence of leprosis symptomatic trees in the grove. Besides risk aversion and leprosis historical, other factors are responsible for the adopted mite infestation threshold level such as the mite sampling method and the capacity time-response for spray.

In São Paulo State, using specific mitecides for *B. phoenicis* with long residual effect, an average of one to two mitecide sprays per year is necessary to keep leprosis vector mite infestation in a very low level. With more general mitecides, such as sulfur lime, that has low residual effect, more than 10 sprays are needed, which makes the use of these general mitecides less economic (Pattaro, 2007). Around US$ 70 to 80 million is spent annually to control the vector mite. Before huanglongbing (HLB) report in São Paulo State in 2004, the costs with mitecides represented 37% of total phytossanitary costs and 12% of total costs of bearing groves. Nowadays, with the increasing on insecticide sprays to control HLB vector, the Asian psyllid *Diaphorina citri*, the costs of mitecides represent 13% of total phytossanitary costs and 6% of total costs of bearing groves. Usually, mitecide control are done at high volume sprays (> 4000 liters per hectare), but recent research on spraying technology of mitecides allowed a reduction of the spray volume up to 2000 liters per hectare without difference in product deposit and coverage and mite control efficiency (Ramos et al., 2007a; Ramos et al., 2007b).

Since *Citrus leprosis virus* is not systemic and causes only local lesions, pruning of symptomatic branches and shoots is also a recommended practice to reduce leprosis inoculums'. Only the accomplishment of frequent removal of all affected shoots and fruits without control of leprosis vector can keep the disease incidence very low, but the cost of that practice is positively related to citrus leprosis incidence, being not profitable in highly diseased and mite infested groves. The

complete yield recovery of a high severely diseased tree can take as long as two years after drastic pruning and strict mite control, what could be not profitable compared with mite control applied or not with low and intermediate level of pruning (Pattaro, 2006). Better economics results were achieved when intermediate pruning was carried out in complement to vector mite control.

Conclusions

Together with citrus huanglongbing, citrus variegated chlorosis, citrus canker and citrus sudden death, leprosis still at the top five most important citrus diseases in Brazil. Since, citrus leprosis and its mite vector are endemic in the major citrus producer Brazilian regions; the disease has a deserved major attention, especially in Sao Paulo State. The disease management is often necessary to avoid serious damages on fruit yield and on new shoots that can compromise future yields, being the citrus leprosis management costs considered almost a fixed cost. Basically, the management of citrus leprosis is based on reduction of mite vector population and, in some cases, on complementary reduction of virus inoculum by pruning affected braches. Effective results on citrus leprosis control have been achieved with available mitecide products in a strict mite control program. However, mite scouting and mitecide sprays still represent considerable cost factors of citrus production. Improvements on mitecide spraying technology to increase mitecide efficiency and reduce spray volume, as well as researches on mite sampling systems and the use of global position system to allowed local mitecide applications, on field monitoring mite resistance to mitecide to indicate the appropriate product to spray, and on detection of viruliferous mites incidence by RT-PCR to better adjust the making decision threshold of mite infestation are coming up to make citrus leprosis management less expensive and more effective.

Reference Cited

Bassanezi, R.B., F.F. Laranjeira. 2007. Spatial patterns of leprosis and its mite vector in commercial citrus groves in Brazil. Plant Pathology 56:97-106.

Bastianel, M., V. M. Novelli, E. W. Kitajima, G. W. Muller, R. B. Bassanezi, J. Freitas-Astúa. Citrus leprosis: Disease distribution in over a century of existence. Plant Disease (accepted).

Bitancourt, A. A. 1934. Relação das doenças e fungos parasitas observados na secção de Fitopatologia durante os anos de 1931 e 1932. Arquivos do Instituto Biológico 5:185-196.

Chiavegato, L. G., M. M. Mischan, M. A. Silva. 1982. Prejuízos e transmissibilidade de sintomas de leprose pelo ácaro *Brevipalpus phoenicis* (Geijskes, 1939) (Acari: tenuipalpidae) em citros. Científica 10:265-271.

Czermainski, A. B. C., R. B. Bassanezi, F. F. Laranjeira, L. Amorim. 2007. Dinâmica temporal da população do ácaro *Brevipalpus phoenicis* e da leprose dos citros sob condições naturais de epidemia. Fitopatologia Brasileira 32:295-303.

Franciscon, L., P. J. Ribeiro Junior, E. T. Krainski, R. B. Bassanezi, A. B. C. Czermainski. 2008. Modelo autologístico espaço-temporal com aplicação à análise de padrões espaciais da leprose-dos-citros. Pesquisa Agropecuária Brasileira 43:1677-1682.

Gravena, S. 2005. Manual Prático de Manejo Ecológico de Pragas dos Citros. Gravena, Jaboticabal, 372p.

Nantes, J. F. D., C. C. Atique. 1993. Relação entre leprose e queda de frutos em citros. In: CONGRESSO BRASILEIRO DE ENTOMOLOGIA, 14. Anais. Piracicaba. p.181.

Oliveira, C. A. L. 1986. Flutuação populacional e medidas de controle do ácaro da leprose *Brevipalpus phoenicis* (Geijskes, 1939) em citros. Laranja 7:1-31.

Oliveira, C. A. L. 1995. Aspectos ecológicos do *Brevipalpus phoenicis*. In: Oliveira, C. A. L., L. C. Donadio (ed.) Leprose dos Citros. Jaboticabal, FUNEP. p.37-48.

Pattaro, F. C. 2006. Aspectos técnicos e econômicos da poda e do controle químico no manejo da leprose dos citros. Jaboticabal, FCAV/Unesp (Tese de Doutorado).

Ramos, H. H., K. Yanai, I. M. Corrêa, R. B. Bassanezi, L. C. Garcia. 2007a. Caracteísticas da pulverização em citros em função do volume de calda aplicado com turbopulverizador. Engenharia Agrícola 27:56-65.

Ramos, H. H., K. Yanai, D. de Araújo, D. S. R. da Rocha, M. B. Spósito, R. B. Bassanezi. 2007b. Estado da arte na tecnologia de aplicação em frutíferas - volume de aplicação e diâmetro de gotas. Summa Phytopathologica 33:S110-S112.

Rodrigues, J. C. V., N. L. Nogueira, G. W. Müller, M. A. Machado. 2000. Yield damage associated with citrus leprosis on sweet orange. Proc. Intl. Soc. Citriculture 2:1055-1059.

Rodrigues, J. C. V., E. W. Kitajima, C. C. Childers, C. M. Chagas. 2003. Citrus leprosis virus vectored by *Brevipalpus phoenicis* (Acari: Tenuipalpidae) on citrus in Brazil. Experimental and Applied Acarology 30:161-179.

Rossetti, V., A. Colariccio, C. M. Chagas, M. E. Sato, A. Raga. 1997. Leprose dos citros. Boletim Técnico do Instituto Biológico 6:5-27.

Fig. 1 – Brazilian states with citrus leprosis reports (SP = São Paulo, MG = Minas Gerais, RJ = Rio de Janeiro, ES = Espítito Santo, PR = Paraná, SC = Santa Catarina, RS = Rio Grande do Sul, BA = Bahia, SE = Sergipe, CE = Ceará, PI = Piauí, TO = Tocantins, PA= Pará, AM = Amazonas, AC = Acre, MT = Mato Grosso, MS = Mato Grosso do Sul, GO = Goiás, DF = Distrito Federal).

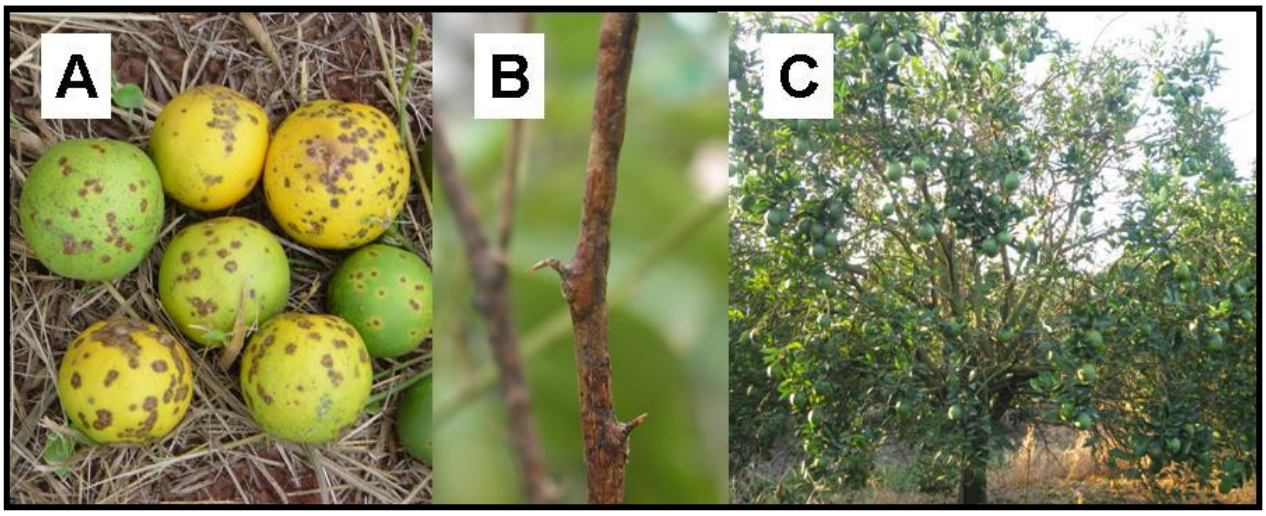

Fig. 2 – Damages caused by citrus leprosis on sweet orange. A – Lesions on fruit and early fruit drop. B – Stem dieback. C – Canopy reduction and defoliation.

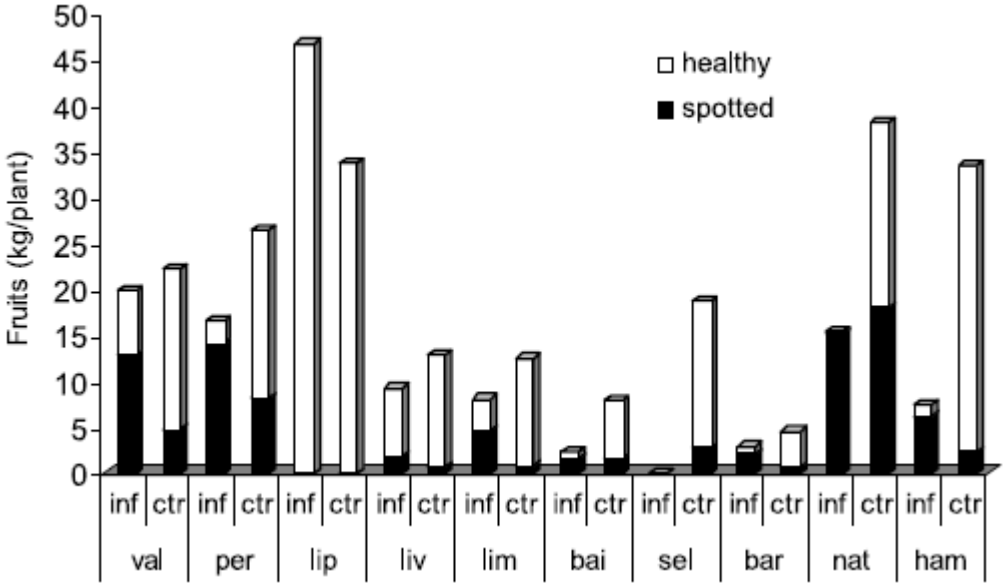

Fig. 3 - Comparative fruit production of different citrus cultivars (val=Valencia, per=Pera, lip=Lima da Persia, liv=Lima verde, lim=Lima, bai=Bahia, sel=Seleta, bar=Barao, nat=Natal and ham=Hamlin) that were 4 years old and averaged six plants per treatment. Trees (inf) at 18 months age were infested with viruliferous mites. Control non-infested trees (ctr) remained under multiple mitecide sprays each year in Piracicaba, São Paulo State (Rodrigues et al., 2003).