Coffee Rust Epidemic in Brazil

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INTRODUCTION

Coffee is one of the most important crops in Brazil, with almost 2.5 million hectares of growing fields, being the major world producer. This area is divided in arabica and robusta coffee, being with the arabica (*Coffea arabica* L.) the higher qualities of drink and the higher market value. On the other hand, this specie is more suscetible to diseases, being the coffee rust (CR) (*Hemileia vastatrix*) the most important and impactant one. Yield losses can be as high as 50% (Zambolim et al., 2005) on non-treated fields, and due to the biennial phenology of the crop two producing years are affected.

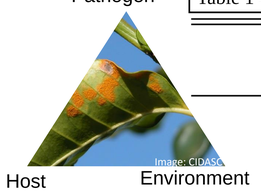


Table 1 – The biennial phenological cycle of coffee. Source: Brunsell et al., 2013.

First phenological year												Second phenological year											
First phase							Second phase					Third phase				Fourth phase			Fifth phase			Sixth phase	
Vegetative and vegetative bud formation							Induction, growth, and dormancy of floral buds					Flowering; pin-heads and fruits expand				Formation of full fruit			Maturation of fruit			Rest and branch senescence	
Long days—7 months							Short days—evapotranspiration = 350 mm					Evapotranspiration = 700 mm											
Water restriction affects buds and following-year production										Small leaves		Water restriction—light bean				Water restriction—spell bean size			Water restriction—good quality				
Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Vegetative stage										Rest		Reproductive stages										Pruning	

Source: Adapted from Camargo and Camargo, 2001.

Brazilian production is estimated to reach 48.9 million of bags on 2016, after two years of low production due to a rainfall lack on grower regions. Southeast region of the country is the most important, with 93% of all arabica coffee produced on the country, and Minas Gerais is responsible for 69.5% of this amount (IBGE, 2016). The aim of the study is to clarify AUDPC, the epidemic start and the months with the highest progress, using leaves incidence data, understanding important differences to the better management of CR.

MATERIAL AND METHODS

The 16-year analysis of coffee rust epidemic was carried with experimental data obtained from trials conducted at Varginha (Minas Gerais state), Brazil. These fields of 4,000 trees ha-[1] were differentiated according to high (HL) or low load (LL) of fruits, an important factor influencing CR development. These trials are conducted since 1998 on a Procafé Foundation farm with monthly leaves rust incidence evaluation. Leaves with symptoms were accounted on plots with high and low load of fruits to provide an incidence value.

Figure 1 – Coffee rust symptoms and field trials on the evaluated area.

Area Under Disease Progress Curve (AUDPC) was used to compare the differences between HL and LL plots, calculated as: $A_k = \sum_{i=1}^{N_i-1} \frac{(y_i + y_{i+1})}{2}(t_{i+1} - t_i)$ (Madden et al., 2007).

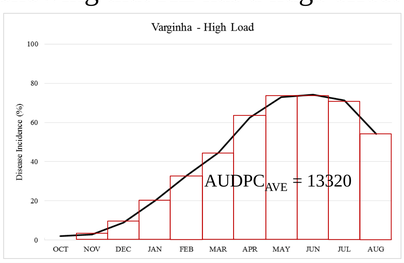
RESULTS

Load is important on coffee rust pathosystem because of the relationship between carbohydrates, defense mechanisms and grain filling. In HL years instead of directing the carbohydrates to defense mechanisms the plant use this energy to grain filling process.

The CR epidemic begins in November in both fruit loads. In HL the disease is more harmful, showing a monthly crescent progress (Figura 2) (red arrow) with a peak in July, usually with more than 80% of leaves infected on non-treated plots.

On the other hand, LL fields show almost flat progress (Figure 2) (orange arrow), maintaining incidence between 15 and 25% until May, with incidence higher than this in eight of 16 years in June, the characteristic end of epidemic in these cases. The maximum disease progress in HL is from March to April, with an average increase of 18%, against an average of 11%. In LL the maximum disease progress occured in the same period, but with an increase of 6%, while the average is 4%.

The AUDPC of HL years is 144% higher than LL years (Figure 4) showing that HL has a huge effect on the CR-coffee pathosystem.



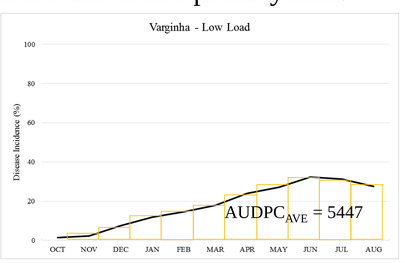


Figure 4 – Average incidence progress curve of CR on HL and LL.

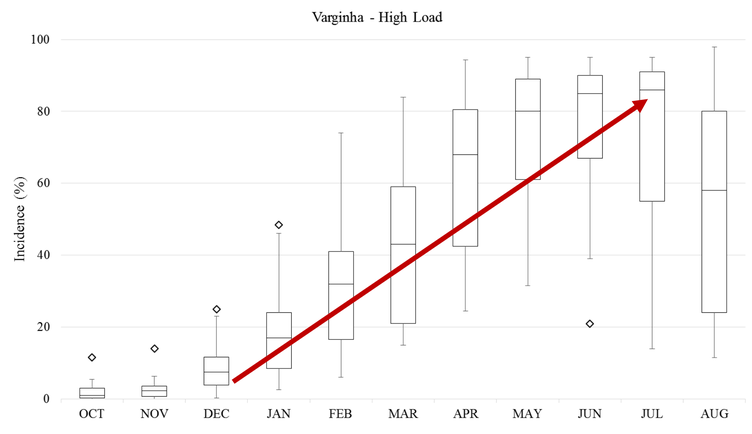


Figure 2 – Box-plot of 16 years coffee rust progress on HL plots at Varginha, MG, BR.

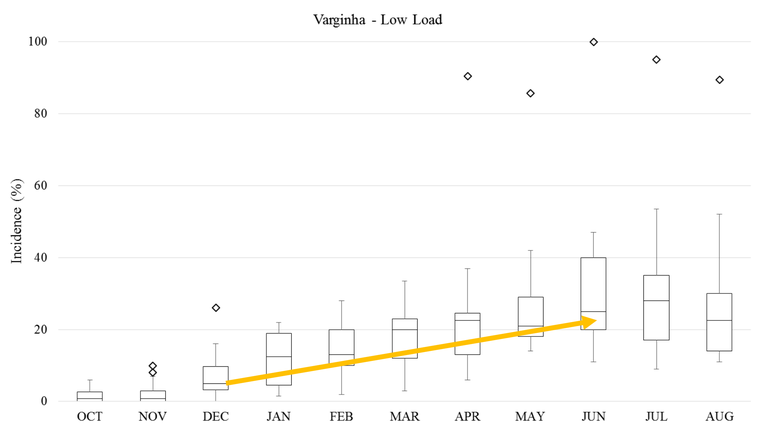


Figure 3 – Box-plot of 16 years coffee rust progress on LL plots at Varginha, MG, BR.

These differences between HL and LL are essentials on the disease management. In LL years the lowers levels of the disease shows an easier control, practically without control loss possibilities. In HL years the epidemic is longer, demanding more care with the crop. For this aim, more sprays are required to cover a longer period of favorability. As this favorability is variable forecast systems (FS) were developed for HL and LL. The FS becomes useful mainly in HL years because of inefficient control situations – late disease peaks, early disease progress, longer favorability than fungicides residual. As a result of this analysis, the HL system is under evaluation on coffee fields on Brazil, aiming to indicate the spraying dates to keep rust under control until the end of the growing season.

Acknowledgements

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