Weather variables and landscape composition influence blossom and twig blight (Monilinia spp.) damages on apricot in southeastern France

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Abstract

Blossom and twig blight (BTB) caused by Monilinia spp. is a major concern in the production of organic apricot. The aim of this study is to identify factors influencing apricot BTB in field conditions, considering BTB infection risks, surrounding landscape, farming pratices and abundance of mummified fruits. We used linear mixed models to analyse data collected during three consecutive years on a network of 14 apricot orchards located in southeastern France. Results showed that BTB damages are influenced by risks associate with rainfall and leaf wetness at the orchard scale and also by apricot abundance at the landscape scale (1000 m radius).

Keywords: Leaf wetness, *Monilinia laxa*, *Monilinia fructicola*, *Prunus armeniaca*, rainfall.

Introduction

The lack of effective control methods for BTB makes the production of organic apricot sometimes delicate agronomically, and thus economically risky. The understanding of BTB damages on apricot is necessary to develop new control methods. On cherry, the duration of petal wetness and temperature is known to favour the development of blossom blight caused by M. laxa (Tamm et al. 1995). On apricot, Tresson et al. (2020) found that rainfall explain better BTB damages than the duration of wetness. Furthermore, they have developped a climatic Index of cumulated BTB risk based on rainfall and temperature. In stone fruit orchards, twig canker and mummified fruit are the main inoculum sources of Monilinia spp. (Rungjindamai et al., 2014). In landscape, apricot orchards could represent potential reservoirs of inoculum (Plantegenest et al., 2007).

Material and Methods

A network of 14 apricot orchards located in southeastern France was observed during three consecutive years. The network is composed of five organic orchards and 9 conventionnal orchards. The cultivar is Bergeron for 9 orchards and Bergeval (Bergeron X Orangered) for 5 orchards. In each orchard, we monitored the proportion of each bloom stages and BTB damages on 10 untreated trees. Weather conditions and the proportion of apricot area at two scales (100 and 1000 m radius around orchards) were recorded for each orchard. Phenological and weather data were used to calculate infection risks of BTB. Ten infection risks were calculated: one following the method developed by Tresson et al. (2020) based on the abundance and the sensitivity of D, E and F flower stages and on rainfall; three based on abundance of D, E and F flower stages and on rainfall, leaf wetness or relative humidity; three based on abundance of D flower stage and on rainfall, leaf wetness or relative humidity; three based on abundance of F flower stage and on rainfall, leaf wetness or relative humidity. We used linear mixed models (LMM) coupled with multi-model inference approach to test how BTB damages are influenced by infection risks, surrounding landscape, farming

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practices (organic and conventional) and abundance of mummified fruits. Most of the infection risks are highly correlated with each other and so cannot be tested together in a single LMM. We therefore compared seven LMM for the seven types of risks calculated.

Results

Seven types of models (named m1 to m7) were tested (Table 1). They show that pluviometry and leaf wetness could play an important role in apricot BTB. In fact, infection risks based on rainfall or leaf wetness had significant effects on the intensity of BTB damages (m1 to m5). While infection risks based on relative humidity had no significant effect (m6 and m7). When we analysed separately risks associated to phenological stages D and F, only risks associated with F stage had a significant effect (m3 and m5), confirming the high susceptibility during full bloom (F stage). Concerning landscape, only the proportion of apricot at a radius of 1000 m significantly increases BTB damages (6 of 7 models). Farming practices and apricot mummies had not significant effects on damages. To conclude, our results suggest that the control of apricot BTB needs to consider risks associate with rainfall and leaf wetness at the orchard scale and also apricot abundance at the landscape scale.

Table 1 : Estimated parameters for 7 models explaining the intensity of blossom and twig blight damages using different flower infection risks by Monilinia spp., landscape and farming practices. [crossed cells : variable not included in model ; NR : variable not conserved during multimodel inference ; light grey cells : variable conserved during multimodel inference but with non-significant effect / p-value : NS = not significant ; * < 0,05 ; * < 0,01 ; *** < 0,1x10-2 ; **** < 0,1x10-3]

Models	Weather variables used in risk calculation	Infection risks								Proportion of apricot in landscape			Farming Practices (conv)		Mummies	AIC	R2
		Tresson risk		DEF risk		D risk		F risk		100 m	1000 m						
		estim.	R2	estim.	R2	estim.	R2	estim.	R2		estim.	R2	estim.	R2			
m1	rainfall	0,98 ***	0,34							NR	0,68 NS	0,14	-0,10 NS	0,06	NR	120,6	0,55
m2	rainfall			0,81 **	0,29					NR	0,94 *	0,28	NR		NR	122,1	0,50
m3	rainfall					0,241 NS	0,11	0,503 **	0,22	NR	0,86 *	0,27	NR		NR	125,1	0,51
m4	leaf wetness			1,45 ***	0,37					NR	0,77 *	0,31	NR		NR	118,3	0,54
m5	leaf wetness					NR		0,875 **	0,29	NR	0,80 *	0,26	NR		NR	122,7	0,47
m6	relative humidity			0,85 NS	0,05					NR	0,68 *	0,21	-0,38 NS	0,05	NR	130,7	0,40
m7	relative humidity					NR		NR		NR	0,52 *	0,40	-0,64 NS	0,20	NR	132,0	0,61

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