Apricot susceptibility to blossom brown rot (*Monilinia* spp.) and leaf rust (*Tranzschelia* spp.) under low-input production system

C-E. Parveaud[1], J-M. Broquaire[2], V. Mercier[3], C. Gomez[1], L. Brun[3], G. Clauzel[3], A. Guillermin[3], J-M. Audergon[4]

Abstract

Disease-susceptibility of apricot cultivars is a key-stone towards low-input production systems. Among the main diseases, the susceptibility to Monilinia *spp. and leaf rust of apricot cultivars are economically important but rarely assessed. A 5-years study in two sites was conducted to assess the susceptibilities to* Monilinia *spp. and leaf rust of 16 apricot cultivars under natural conditions (no inoculation). No fungicide and insecticide were applied during the experiment. In Torreilles site, no significant* Monilinia *spp. was observed. In Gotheron site, the percentage of shoots necrosed by* Monilinia *spp. ranged from 13% to 100% during 2010-2011. A Genotype x Environment interaction was observed for* Monilinia *spp. damages. Concurrently a high variability to leaf rust was observed in both sites. The ranking of cultivars susceptibility to leaf rust was similar between both sites.*

Keywords: Apricot, cultivar, susceptibility, *Tranzschelia* spp., *Monilinia* spp.

Introduction

Production regularity in organic apricot orchards is highly constrained by blossom brown rot caused by *Monilinia* spp. infections on flowers. When the climatic conditions for *Monilinia* spp. infections are gathered during bloom, the development of this disease induces flowers decay and, in some cases, shoots necroses. Apricot leaf rust is caused by *Tranzschelia pruni-spinosae* or *Tranzschelia discolour*. This disease provokes brown leaves spots on the lower side of leaves and colour fading spots on the upper side of leaves. Rust development can induce premature defoliation, which is detrimental to tree vigour and production regularity. Copper-based treatments are partially efficient against the control of *Monilinia* spp. and leaf rust, but their negative environmental impact should be considered. In order to help growers in the choice of low disease-susceptible cultivars, we have assessed the susceptibilities to *Monilinia* spp. and leaf rust of 16 apricot cultivars observed during 5 years in two sites.

Material and Methods

In 2006, 16 and 12 apricot cultivars were respectively planted in Gotheron experimental station (Saint-Marcel-les-Valence, Drôme, France) and Sica Centrex station (Torreilles, Pyrénées-Orientales, France). 9 cultivars were planted in both sites. In each site, 20 trees per cultivars were planted on *Prunus* rootstock (GF305 in Gotheron, Myrobalan in Torreilles) at a 4 x 4m distance randomly-located in the plot (Mercier *et al.*, 2008). No fungicide and insecticide were applied during the study period (2003-2010). Fertilization and weed control were managed according to conventional agriculture practices.

[1] GRAB, Research Group for Organic Farming, France, 26320 Saint-Marcel-les-Valence, claudeeric.parveaud@grab.fr

[2] SICA Centrex, Chemin du Mas Faivre, 66440 Torreilles, France, jm.broquaire@centrex66.com

[3] INRA, National Institute for Agricultural Research, UERI Gotheron, France, 26320 Saint-Marcel-les-Valence, mercier@avignon.inra.fr

[4] INRA, National Institute for Agricultural Research, UGAFL, Avignon, France, audergon@avignon.inra.fr

Shoots infected by *Monilinia* spp. were removed after the observations. The percentage of shoot necrosed by *Monilinia* spp. infections was assessed 100 days after bloom. The severity of leaf rust damages was assessed by one score ranking from 0 (no symptom) to 5 (81 to 100% of leaves infected or fallen). Statistical analyses were computed using Statgraphics plus 5.1 software (Statgraphics plus 5.1, Manugistics, Rockville, MD, USA).

Results

In Torreilles site, no significant *Monilinia* spp. damage was observed because of dry climatic conditions during bloom (results not shown). In Gotheron site, the climatic conditions in 2007, 2008 and 2009 were favourable to *Monilinia* spp. development for some of the cultivars only (table 1). Conversely, the climatic conditions in 2010 and 2011 were favourable to *Monilinia* spp. development for all the cultivars, which allows a reliable ranking of cultivars' susceptibility. A high variability in *Monilinia* spp. susceptibility was observed: the percentage of shoots necrosed ranged from 13% to 100% (table 1). Bakour was the less susceptible cultivar and Bergarouge® Avirine, Candide and Frisson were the more susceptible ones. The probability for cultivars to be exposed to *Monilinia* spp. infection during bloom varied according to years. The increase of damages severity between 2010 and 2011 could be explained by the climatic conditions more favourable to *Monilinia* spp. development in 2011. Because shoots infected by *Monilinia* spp. were pruned out after assessment, a cumulative effect of the *Monilinia* spp. inoculums might not occurred.

Table 1: Mean percentage of shoot necrosed by *Monilinia* spp. in Gotheron site. Light grey cell indicates that the humectation period was less than 4 hours during bloom; dark grey cell indicates no humectation during bloom. (a): adjusted means after ANOVA. Values followed by different letters are significantly different (P<0.05) according to Newman-Keuls test.

Cultivars	**2007**	**2008**	**2009**	**2010**	**2011**	**Mean 2010-2011** [a]
Bakour (2137)	-	6	0	3	23	13 A
Goldrich (2184)	36	9	8	9	48	28 B
TomCot® (2669) Toyaco	22	12	11	19	40	30 B
Malice® (2241) Avikot	3	22	7	14	54	33 B
Polonais (1352)	48	18	2	33	65	48 C
Hargrand (1814)	4	18	9	31	72	50 C
A4034	-	15	4	45	72	58 CD
Early Blush® (2938) Rutbhart	-	25	16	40	83	60 CD
Canino (1343)	-	30	16	52	74	63 CD
Vertige (3845)	6	30	28	53	84	68 D
Orangered® (2892) Bhart	1	17	20	53	87	70 D
Bergeron (660)	2	32	7	68	70	72 D
Tardif deTain (2490)	1	31	16	65	78	72 D
Bergarouge® (2914) Avirine	15	28	40	85	89	89 E
Candide (4025)	-	21	19	93	95	96 E
Frisson (2821)	1	36	31	91	95	100 E

Leaf rust damages were observed in 2008 and 2009 in Gotheron site and in 2008, 2009 and 2010 in Torreilles site (table 2). A high variability to leaf rust was observed in both sites: mean scores range from 1.11 to 4.39 in Gotheron site and from 2.25 to 4.89 in Torreilles site. The ranking of cultivars susceptibility to leaf rust is similar between both sites.

Table 3: Mean severity score of leaf rust damages observed during 2008-2009 in Gotheron site and 2008-2010 in Torreilles site. Score scale: 0 = no symptom; 1 = 1-20% infected or fallen leaves 2 = 21-40%; 3 = 41-60%; 4 = 61-80% and 5 = 81-100%. Values are adjusted means after ANOVA. Values in the same column followed by different letters are significantly different ($P<0.05$) according to Newman-Keuls test.

Cultivars	Gotheron	Torreilles
Hargrand (1814)	1.11 A	2.25 B
Orangered® Bhart (2892)	1.35 AB	1.43 A
Early Blush® Ruthbart (2928)	1.58 B	2.59 BC
Vertige (3845)	2.00 C	2.80 C
Bergarouge® Avirine (2914)	2.05 CD	2.48 BC
Tom Cot® Toyaco (2669)	2.75 FG	3.79 D
Frisson (2821)	3.06 GH	3.78 D
Tardif de Tain (2490)	3.47 I	4.52 E
Bergeron (660)	4.39 J	4.89 F

Discussion

Most of the common commercial cultivars assessed in this study (such as Bergeron) have an intermediate to high susceptibility to both diseases. A high susceptibility of Bergeron cultivar was also demonstrated in Hungary (Holb *et al.*, 2006). Some studies have investigated the susceptibility of apricot cultivars thanks to artificial infections of *Monilia laxa* (e.g. Trandafirescu & Teodorescu, 2006). However, studies conducted under natural conditions are still rare.

There is a need to further identify low disease-susceptible cultivars:

- to help growers in their choice of apricot cultivars. Because cultivars rarely combine low susceptibilities to all diseases, the cultivar choice will be motivated according to the most severe diseases observed in their production area.
- to provide reliable scientific data for breeding programs. One of the biggest challenge of apricot breeding concerns disease resistance (Bassi and Audergon, 2006). Genotype x Environment interaction makes the assessment of cultivars susceptibility a hard task.

The effect of the design (e.g. block *vs.* random) and the management (e.g. no disease control *vs.* disease control) of experimental plots on susceptibility assessment needs to be carefully considered.

Acknowledgements

The authors wish to thank the technical and the temporary staff of INRA Gotheron and SICA Centrex for orchard maintenance and data gathering. This study was supported by the French Ministry of Agriculture thanks to three MAAP/CTPS programs (2006-2008, 2008-2010 and 2010-2012).

References

Bassi, D. & Audergon, J-M. 2006. Apricot breeding: update and perspectives. *Acta Horticulturae* **701**: 279-284. XII International Symposium on Apricot Culture and Decline.

Holb, I.J., Drén, G., Szabo Z., Rackso, J., Thurzo, S. and Nyeki, J. 2006. Brown rot blossom blight and fruit rot incidences of apricot in two different geographical regions in Hungary. *Acta Horticulturae* **717**: 123-128. XIII International Symposium on Apricot Breeding and Culture.

Mercier, V., Gomez, C., Warlop, F., Clauzel, G., Brun, L., Broquaire, J-M., Gilles, F., Audergon, J-M. 2008. Gamme variétale d'abricotiers : évaluation de la sensibilité au monilia. Arboriculture Fruitière n°626-627, pp20-23.

Trandafirescu, M. & Teodorescu, G. 2006. Apricot breeding: update and perspectives. *Acta Horticulturae* **701**: 371-375. XII International Symposium on Apricot Culture and Decline.