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Evaluation of infestation by *Lobesia botrana* (Dennis et Schiffermüller) (Lepidoptera, Tortricidae) and its relation to territorial differences and cultivar susceptibility

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Abstract: A three year study (2008-2010) was carried out in two organically managed vineyards in western Sicily to verify both the influence of different cultivars and microclimatic conditions on grape moth infestation and on mould infections of grapes. Observations were done on two autochthonous cultivars (Inzolia and Catarratto) and four international ones (Chardonnay, Cabernet Sauvignon, Syrah and Merlot). Results showed a different degree of infested grapes among the different cultivars in both farms but also a different level of infestation between the two farms for the same cultivar. Chardonnay was the most infested cultivar by the grape moth larvae, while Merlot was the less infested one. *Botrytis cinerea* was almost absent on the majority of the cultivars, while the sour bunch rot was always present. This disease was sometimes present on all infested grapes. On the other hand, *Aspergillus* was present at very low levels on the majority of the cultivars.

Key words: *L. botrana*, cultivar, sour bunch rot, *Botrytis*, *Aspergillus*, Sicily

Introduction

Lobesia botrana (Denis et Schiffermüller) is considered the key pest in most of wine producer European countries. It is also present in Russia, in some Middle Eastern countries, in Japan and in some African countries (Tremblay, 1993). It has been recently introduced in California (Varela, 2009) and its introduction in Australia is feared.

Many factors affect the trend of the grape moth infestation and indirect damages caused by moulds. One of them is related to the bunch density of cultivated varieties: those with dense bunches suffer more damage than those with loose bunches (Moleas, 1995). According to Moleas (1995) and Cravedi (1995), damages are limited in precocious cultivars because of conditions adverse to fungi development. As a matter of fact, the fungi and bacterial infections through injuries caused by *L. botrana* larvae are to be considered the main economic damage of grapes, more than the losses caused by their trophic activity (Maison & Pargade, 1967; Savopoulou-Soultani & Tzanakakis, 1988).

The present work aims at contributing to the knowledge of relationships among grape moth-moulds-cultivars in an organic management scenario, where no chemicals were used for *L. botrana* control and no fungicides were applied in summertime after June against microbial adversities.

Material and methods

Observations were carried out in two organically managed vineyards in province of Trapani (Sicily, Italy). Nine varieties (Trebbiano, Inzolia, Muller Thurgau, Chardonnay, Cabernet,

Syrah, Merlot, Tannat and Catarratto) are present in the Funaro farm (39 hectares, 37°46'22.79"N 12°43'14.08"E, 134m a.s.l.), and seven (Inzolia, Muller Thurgau, Cabernet sauvignon, Cabernet franc, Syrah, Merlot and Catarratto) in the Vesco farm (65 hectares, 37°55'58.64"N 13°02'20.69"E, 267m a.s.l.). The traditional vertical trellis with pruned system (Guyot) is adopted for Cv Inzolia and Catarratto and the cordon trained one for the remaining cultivars.

During 2008 and 2009, observations were carried out taking into consideration two white grape varieties (Chardonnay and Inzolia) and two red grape varieties (Syrah and Merlot) in the Funaro farm. Samplings were weekly done on two bunches/plant; 240 plants were taken into account per variety. The presence of larvae on bunches or injuries caused by larvae as well as the presence of moulds on those bunches were recorded.

In 2010, the Chardonnay and Syrah cultivars were replaced by the autochthonous white grape variety Catarratto and the international red grape variety Cabernet Sauvignon to compare infestation and damages detected in the two farms on the same cultivars.

Table 1. Brix degrees registered in the different cultivars in the two farms

			"Funaro" farm			
	Chardonnay	Inzolia	Catarratto	Syrah	Cabernet Sauvignon	Merlot
2008	15.9° *23 Jul*	16.4° *11 Aug*		16.0° *11 Aug*		16.9° *11 Aug*
2009	15.2° *17 Jul*	15.5° *4 Sep*		15.1° *27 Aug*		16.0° *7 Aug*
2010	--	15.8° *12 Aug*	15,4° *1 Sep*		16,3° *3 Sep*	16.5° *3 Aug*
			"Vesco" farm			
2010	--	16.2° *23 Aug*	16.5° *31 Aug*	--	15.5° *24 Jul*	15.8° *28 Jul*

From July to harvest time, sugar contents in berries were weekly recorded as Brix degree. Grape moth infestation was considered dangerous after about 16°Brix was reached, as absence of moulds was observed below this value beside a moderate bunch infestation by grape moth (Tsolakis *et al*., 2008. Table 1 reports Brix degrees and the dates when these values were detected.

Temperature and relative humidity were recorded by digital thermohygrographs.

Proportions of damaged bunches were transformed using an arcsine-square-root equation prior to the analysis of Variance. Means were separated by the Newman-Keuls test and/or Tukey test. The software “Statistica” was used for analyses (StatSoft Inc., 2008).

Results and discussion

Figure 1 reports the mean infestation of bunches on each cultivar after the sugar contents in berries exceed 16°Brix. Infestation rate was statistically different in the four considered

cultivars ($F_{(7;\ 4074)}$ = 14,80; p = 0,00). Chardonnay was the most infested cultivar in both years and no statistical differences were registered for the same cultivar between the years of observations.

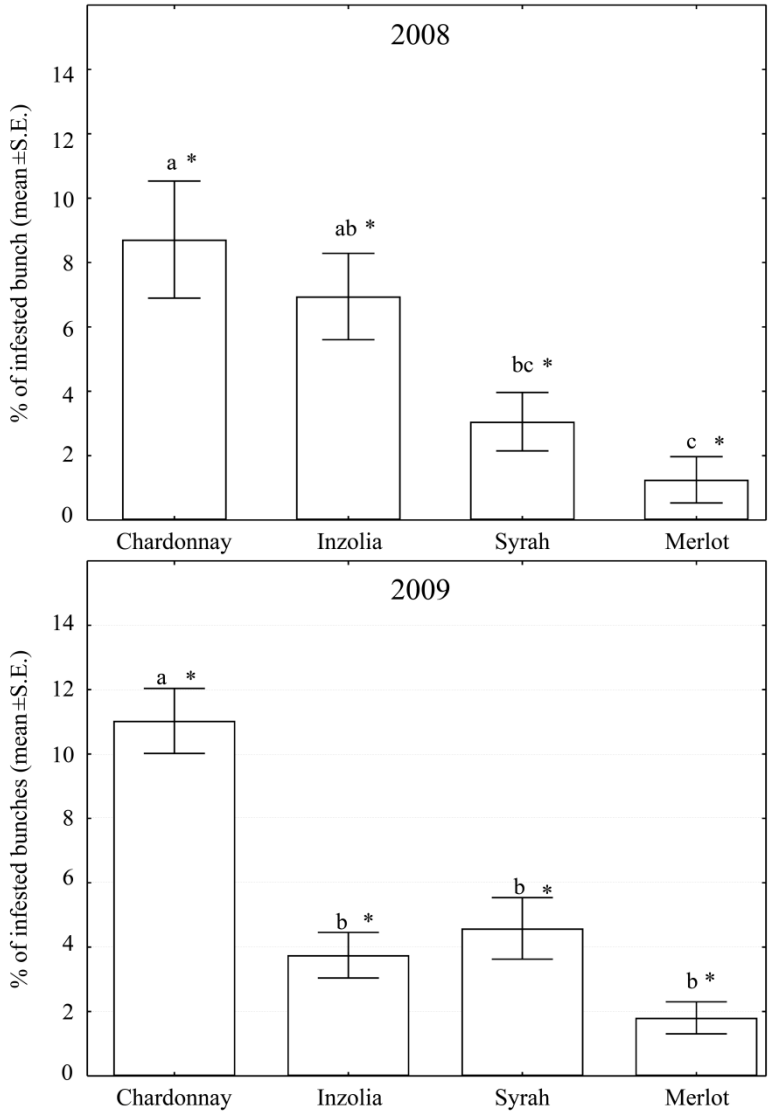

Figure 1. Infestation of bunches by *L. botrana* during 2008 and 2009 in the considered cultivars in the farm Funaro. Different letters denote significant differences among cultivars. Different number of asterisks denotes significant differences between the two years for the same cultivar. Anova followed by Newman-Keuls test was performed on the data; $p < 0.05$.

As far as the susceptibility of Chardonnay is concerned, it could be related to precocity of this cultivar more than to a real major attractivity. As a matter of fact, Chardonnay ripens in Sicily at the end of July, at least two weeks before the other considered cultivars, and it is attacked mainly by the second generation of grape moth, while the remaining cultivars suffer from the presence of the larvae of the third generation.

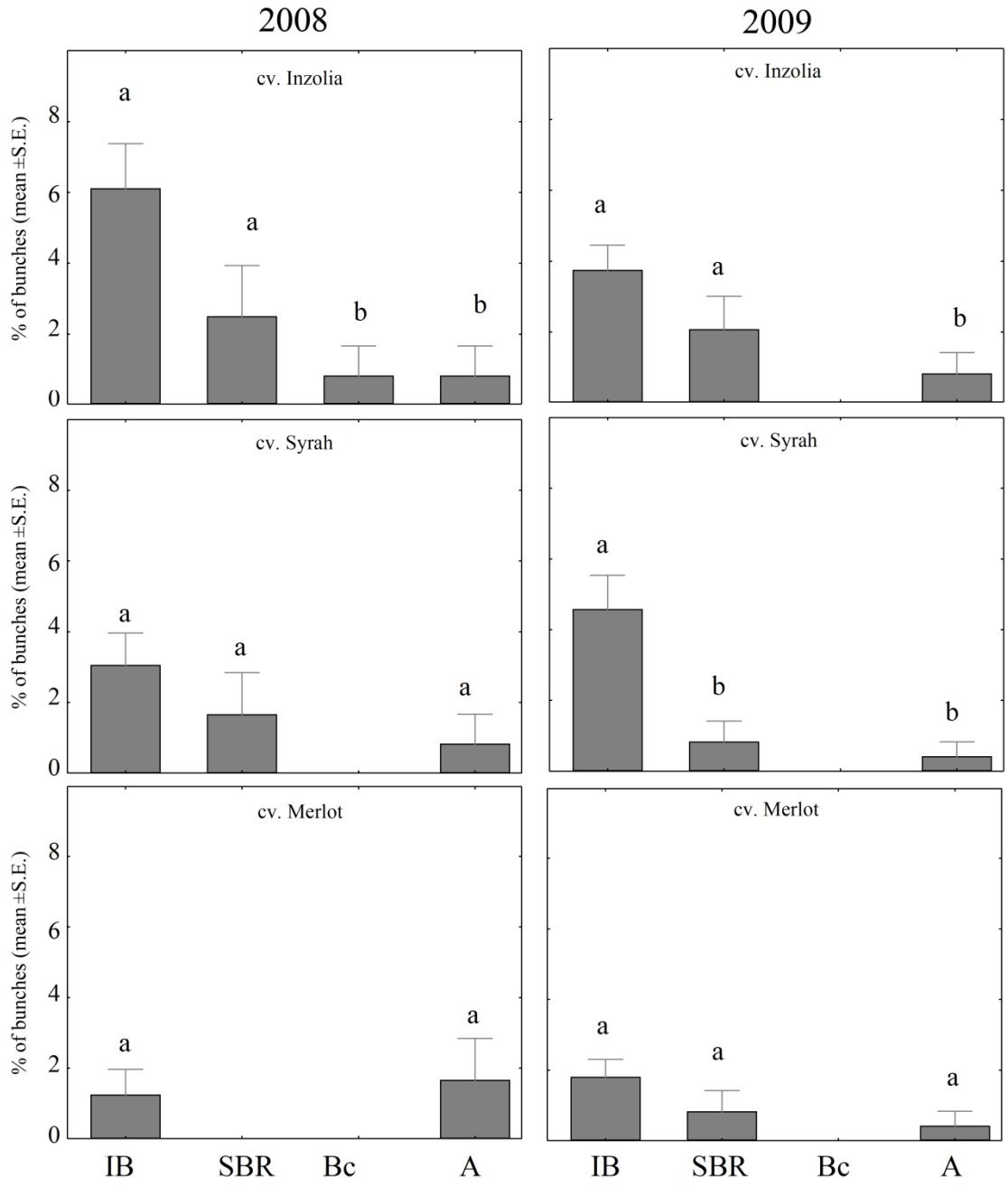

Figure 2. Infestation of bunches by *L. botrana* larvae and damaged bunches by moulds during 2008 and 2009 in the considered cultivars in the farm Funaro. Different letters denote significant differences among cultivars. Anova followed by Newman-Keuls test was performed on the data; $p < 0.05$. IB, Infested bunches; SBR, sour bunch rot; Bc, *Botrytis cinerea*; A, *Aspergillus* spp.

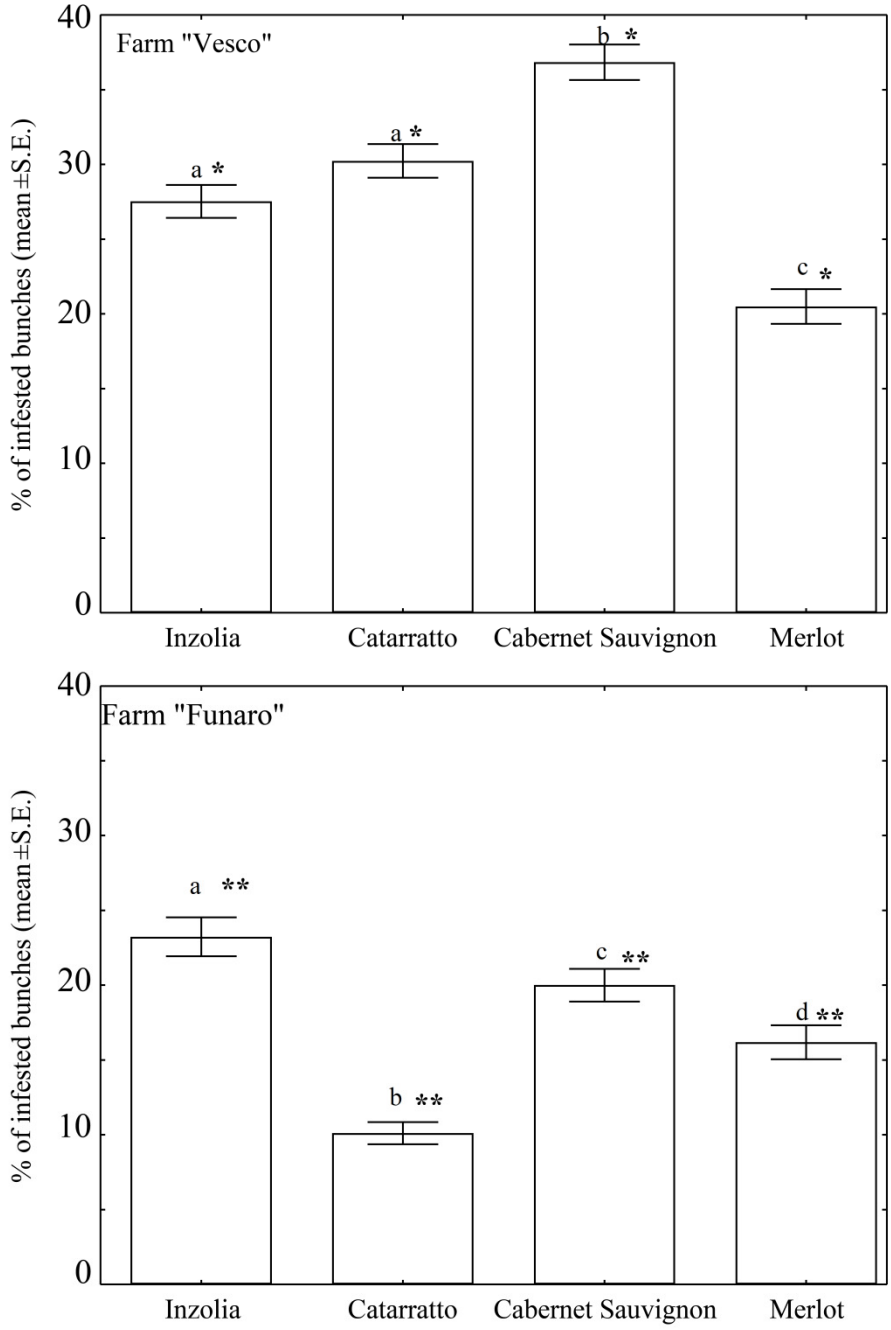

Figure 3. Infestation of bunches by *L. botrana* larvae during 2010 in the two farms. Different letters denote significant differences among cultivars for the same farm. Different number of asterisks denotes significant differences between the two farms for the same cultivar. Anova followed by Newman-Keuls test was performed on the data; $p < 0.05$.

On the other hand, climatic conditions are more favourable for the grape moth during July than during August, when quite the "scirocco"[*] wind, deleterious to the species, often blows.

[*] Scirocco is a strong and warm wind blowing from Africa to Sicily. It lasts 2-3 days, bringing temperatures up to 35°C and relative humidity below 25%.

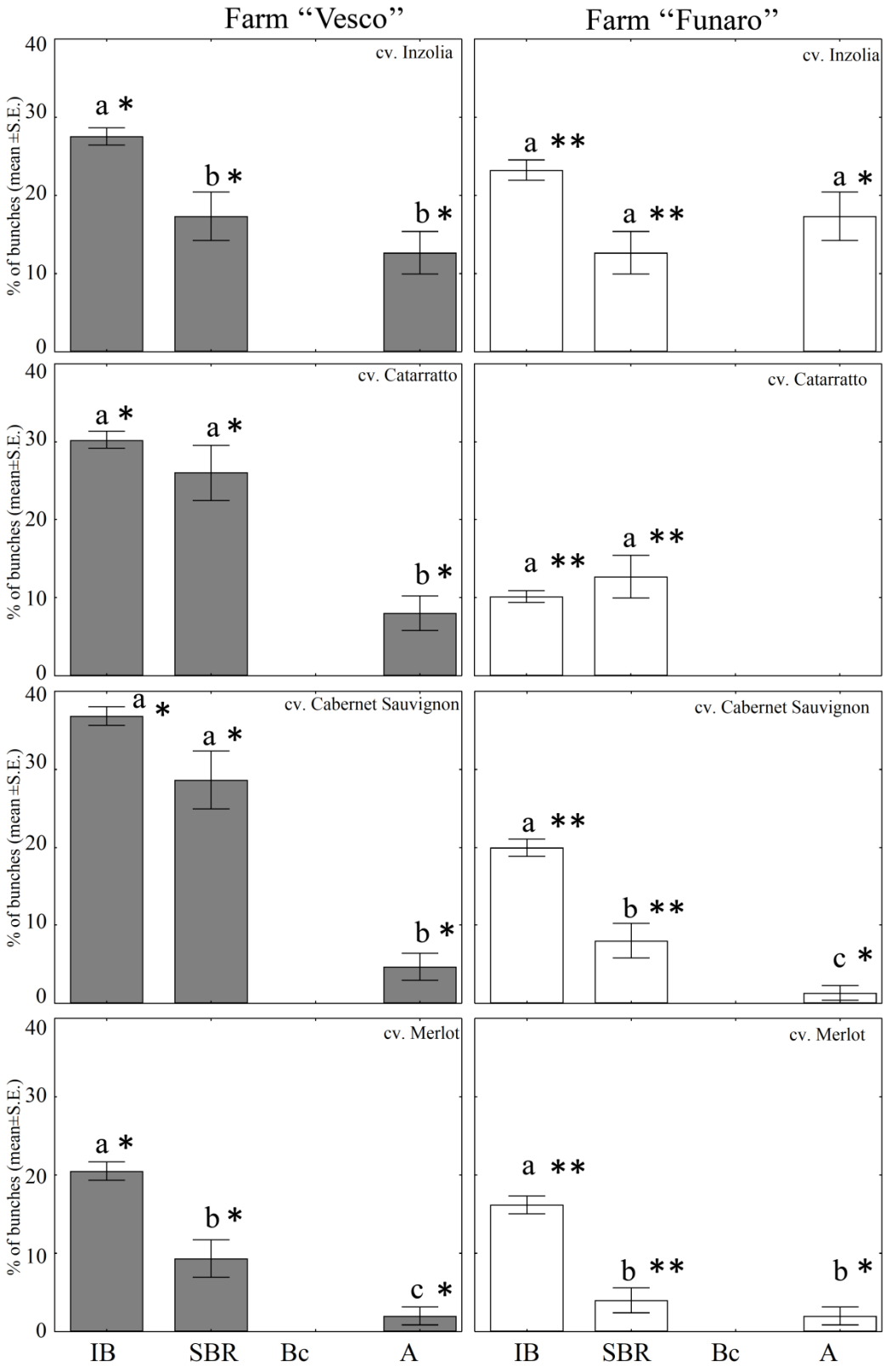

Figure 4. Infestation of bunches by *L. botrana* larvae and damaged bunches by moulds in the two farms during 2010. Different letters denotes significant differences between infested and damaged bunch by moulds. Anova followed by Newman-Keuls test was performed on the data; $p < 0.05$. IB, Infested bunches; SBR, sour bunch rot; Bc, *Botrytis cinerea*; A, *Aspergillus* spp.

In both years, the percentage of bunches of Cv Inzolia damaged by grey mould and *Aspergillus* was statistically lower than those attacked by *L. botrana* larvae ($F_{(3;716)}$ = 3.95; p = 0.008 and $F_{(3;1436)}$ = 4,81; p = 0.002 for 2008 and 2009, respectively), while no statistical differences were found for number of bunches infected by sour bunch rot (p = 0.26) (Fig. 2). All the bunches of Syrah attacked by grape moth were infected by sour bunch rot and *Aspergillus* in 2008 ($F_{(1;716)}$ = 1,84; p = 0.13), while the the infection was statistically lower in 2009 ($F_{(3;1196)}$ = 8,45; $p < 0.01$).

On Merlot, damaged berries by larvae trophic activity were infected by *Aspergillus* in both years ($F_{(1;\ 358)}$ = 0,1; p = 0.75), while sour bunch rot was detected only in 2009 (Fig. 2). It should be mentioned that grey mould was detected on Inzolia only in 2008 (Fig. 2), while only few bunches infected by sour bunch rot (2 and 6 for 2008 and 2009, respectively) were found on Chardonnay.

During 2010, the infestation rate in the "Vesco" farm was different in the four considered cultivars ($F_{(3;\ 6145)}$ = 31,49; p = 0.00) (Fig. 3). Cabernet Sauvignon was the most infested one (37%) while the less infested was Merlot (20%). Intermediate values were registered for the two white autochthonous cultivars (Fig. 3). Differences among the considered cultivars were also found in the "Funaro" farm ($F_{(3;\ 5096)}$ = 32,04; p = 0.00), where the most infested one was Inzolia and the least infested was the cultivar Catarratto. Comparing the infestation rate between the two farms, a higher infestation is evident in the "Vesco" farm for all the considered cultivars ($F_{(7;\ 11241)}$ = 63,63; p = 0.00).

No bunches affected by grey mould were found in both farms, while sour bunch rot was present on all the cultivars (Fig. 4). In the "Vesco" farm, the percentage of Inzolia and Merlot bunches infected by sour bunch rot and *Aspergillus* were statistically lower than those infested by *L. botrana* larvae; on Catarratto and Cabernet Sauvignon, all infested bunches showed symptoms of sour bunch rot. Similar results were obtained in the "Funaro" farm for Inzolia, Catarratto and Merlot, while on Cabernet Sauvignon the percentage of bunches damaged by sour bunch rot was significantly lower (Fig. 4).

No differences were found between the two farms as far as the presence of *Aspergillus* is concerned (F = 1,11; p = 0.37) (except for Cv Catarratto on which no *Aspergillus* were found), while the percentage of bunches damaged by sour bunch rot were significantly lower in the "Funaro" farm (Fig. 4).

Our data indicate that grape moth trophic activity is the main factor influencing infections by moulds, but not the only one. The negative influence of low relative humidity values towards *B. cinerea* is known (Cozzi *et al*., 2006; Tsolakis *et al*., 2007), but our data indicate that sour bunch rot is not susceptible to this factor. On the other hand, *Aspergillus* spp. seems positively influenced by low relative humidity values, as also showed by Serra *et al.* (2006).

According to data collected we cannot confirm a cultivar susceptibility to grape moth infestations and mould infections, as this susceptibility changes in different farms in the same territory. On the other hand, our data suggest that careful surveys on different cultivars present in a farm have to be carried out, as the intervention threshold can significantly vary at farm level.

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