

Study on the use of food traps to evaluate the efficacy of mating disruption against *Lobesia botrana* in Douro Demarcated Region



A. Pinto^a, J. Salvação^b, A. Ferreira^c, M. Nóbrega^d, A. Nave^{c,e}, C. Carlos^{c,e}, D. Gomes^f, B. Bagnoli^g, A. Lucchi^h, L. Torres^e, F. Gonçalves^{e*}

^aAgronomy Department, University of Trás-os-Montes and Alto Douro, Quinta de Prados, 5001-801 Vila Real, Portugal;

^bDepartment of Forestry Sciences and Landscape Architecture, University of Trás-os-Montes and Alto Douro, Quinta de Prados, 5001-801 Vila Real, Portugal;

^cAssociation for the Development of Viticulture in the Douro Region, Science and Technology Park of Vila Real – Régia Douro Park. 5000-033 Vila Real, Portugal;

^dSogevinus Fine Wines S.A., Av. Diogo Leite, 344, 4400-111 - Vila Nova de Gaia, Portugal;

^eCentre for the Research and Technology of Agro-Environmental and Biological Sciences, University of Trás-os-Montes and Alto Douro, 5001-801 Vila Real, Portugal;

^fQuinta do Vallado Sociedade Agrícola LDA., Vilarinho dos Freires, 5050-364 Peso da Régua, Portugal;

^gDepartment for innovation in biological, agro-food and forest systems, University of Tuscia, Viterbo, Italy;

^hDepartment of Agriculture, Food and Environment, University of Pisa, Pisa, Italy

* mariafg@utad.pt

INTRODUCTION This study aimed at evaluating the usefulness of food traps, using wine as bait, in Douro Demarcated Region (DDR) vineyards, to: i) monitor the second and third flights of *Lobesia botrana* in plots under mating disruption (MD); (ii) study the impact of non-crop habitats and/or neighboring non-MD vineyard plots in the occurrence of the insect in the MD vineyards; (iii) examine the mating status of *L. botrana* females.

These traps are hypothesized to be more advantageous, for the study aims, than the based on pheromone traps and male captures, given that they are not affected by the pheromone cloud and also capture females, which is useful for fertility studies.

RESULTS The total number of *L. botrana* adults captured was 109 in Vallado and 32 in S. Luiz. The number of captures during the 2nd flight was very low (5 in Vallado and 12 in S. Luiz), presumably because the use of borax that may have interfered with the volatile emission of the bait. In the 3rd flight, in both farms, the number of females captured was higher than that of the males (Table 1), being the sex-ratio (F/M) female biased (2.6 in Vallado and 1.8 in S. Luiz). Both sexes were captured in higher number in non-MD vineyard plots than in MD vineyards (Table 1). In S. Luiz, no catches were obtained in MD vineyards, possibly as a result of the reduced pest pressure, considering that MD has been applied there since 2001 and has covered almost all of the vineyard for several years. In this farm all the females captured in both neighboring non-MD vineyards and non-crop habitats, were mated.

In Vallado, the high number of captures obtained in the MD vineyard border (Figure 5, table 1), suggests the migration of adults, particularly mated females (Figure 6) to MD plots from non-MD vineyard plots.

Significant correlations were found in the buffers 100 to 250 m: captures (total, females and males) were positively correlated with the percentage of olive groves ($0.619 < r < 0.887$, $p < 0.05$); total and females captures were also positively correlated with the percentage of other crops ($0.648 < r < 0.865$, $p < 0.05$); negative correlations ($-0.765 < r < -0.666$, $p < 0.05$) between both total and female captures and the percentage of woodlands and scrublands were also found.

In both farms it is admissible that the presence of water line streams near or inside the MD plot also had contributed to the increase in the insect population, by promoting better survival conditions (Figure 5).

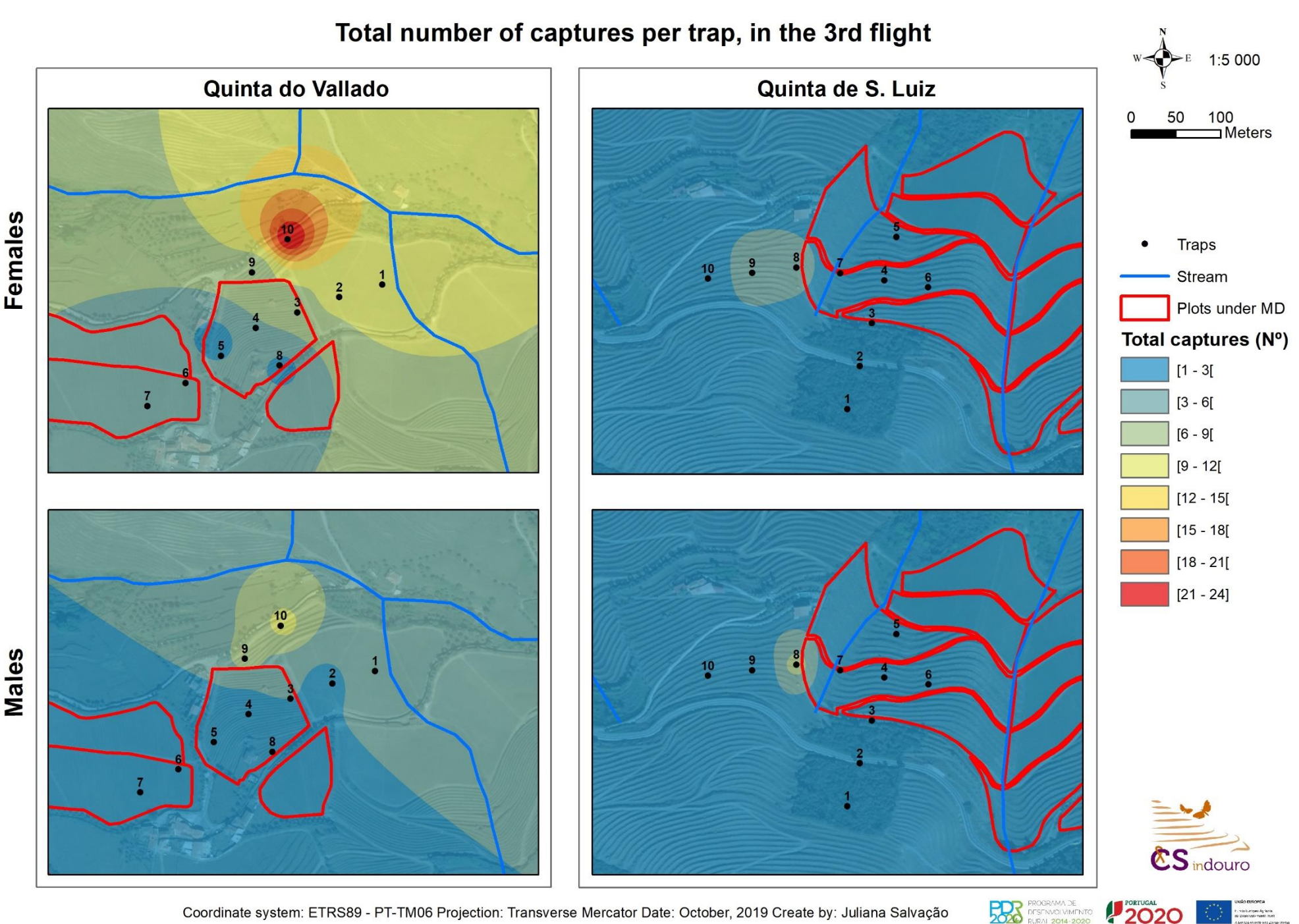


Figure 5 IDW results for the total number of captures of females and males *Lobesia botrana* in the 3rd flight (For Vallado: traps in MD vineyard (4, 5, 6, 7, 8); traps in MD vineyard border (3); traps in non-MD vineyard (1,2,9,10). For S. Luiz: traps in MD vineyard (4, 5, 6); traps in MD vineyard border (3, 7); traps in non-MD vineyard (8,9,10); traps in non-crop habitats (1,2)).



Figure 1 Adult of *Lobesia botrana*



Figure 2 Trap type DROSOSAN used in the assays. Large holes (1 cm Ø) were open in the side nets.

METHODOLOGY Field work was carried out in two wine farms from DDR: Vallado (in Baixo Corgo sub-region) and S. Luiz (in Cima Corgo sub-region). MD dispensers, loaded with 300 mg of pheromone, were installed in the experimental MD vineyards, in the beginning of March, at a dose of 400 dispensers/ha. In Vallado the experimental MD vineyard was surrounded by a non-MD vineyard, while in S. Luiz, it was surrounded by a woodland and a non-MD vineyard. During the study period, Vallado vineyards were sprayed once against *S. titanus*. In S. Luiz the non-MD vineyard was sprayed against 3rd generation of *L. botrana*.

Food traps (Figure 2) were installed in mid-May of 2019 in both MD vineyard and neighboring non-MD vineyards and non-crop habitats, and separated from each other by about 50 m. Traps were filled with a water-alcoholic solution of 50% red wine, and were checked at each 3-4 days until the end of September. Till July 15th, 5% of borax were also added to allow insect conservation. Adults of *L. botrana* were counted, separated by sex (Figure 3) and females were dissected to check their mating status (Figure 4).

A full spatial distribution based on total captures of both sexes in traps, and on the percentage of mated females was performed through geostatistical method Inverse Distance Weighting (IDW) in order to obtain a general frame of *L. botrana* presence at a spatial level. Analysis was performed in ArcGIS 10x., using Spatial Analyst Extension, with Geostatistical Analyst Wizard (statistical analysis were only done for the 3rd flight data, due to the low number of adults captured in the 2nd flight in both study sites).

The land-use types in buffers (50, 100, 150, 200 and 250 m) around each trap were mapped, categorized and accounted for (area in ha and %) using ArcGIS 10x. For the analysis, four categories were considered: (i) vineyards; (ii) woodlands and scrublands combined; (iii) olive groves; (iv) perennial and temporary crops combined and hereafter named other crops. Spearman's rank correlations were used to examine correlations between the total captures of *L. botrana* in the 3rd flight in each trap and land-use types around each trap, at different buffers. For greater robustness, data from the two farms were analyzed together.

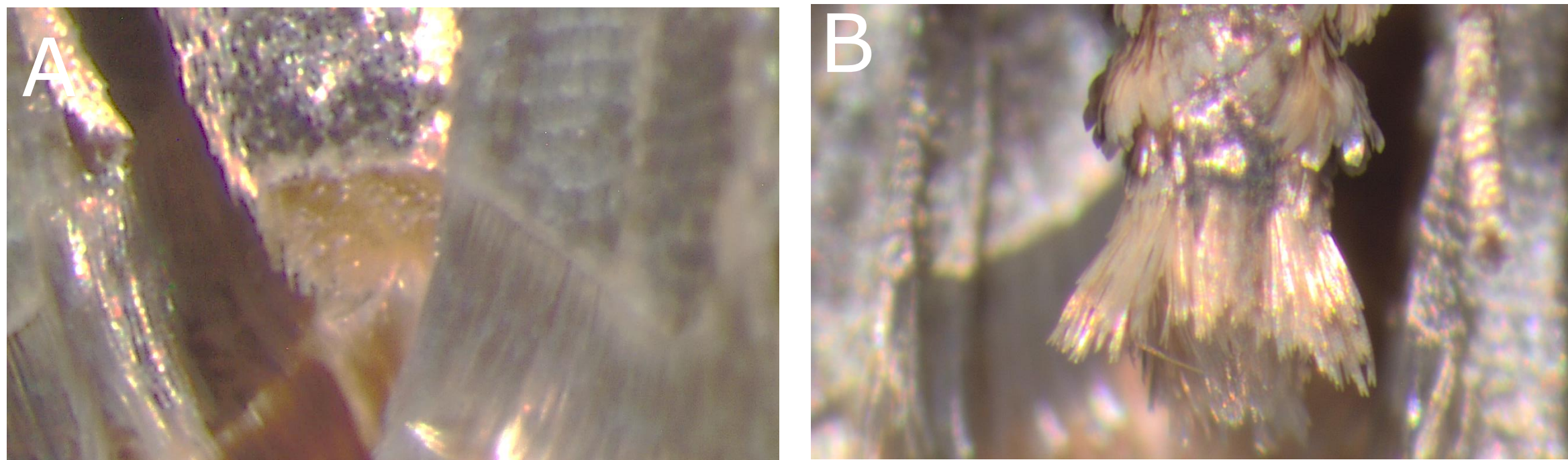


Figure 3 End of abdomen of *Lobesia botrana*: females (A) and males (B)

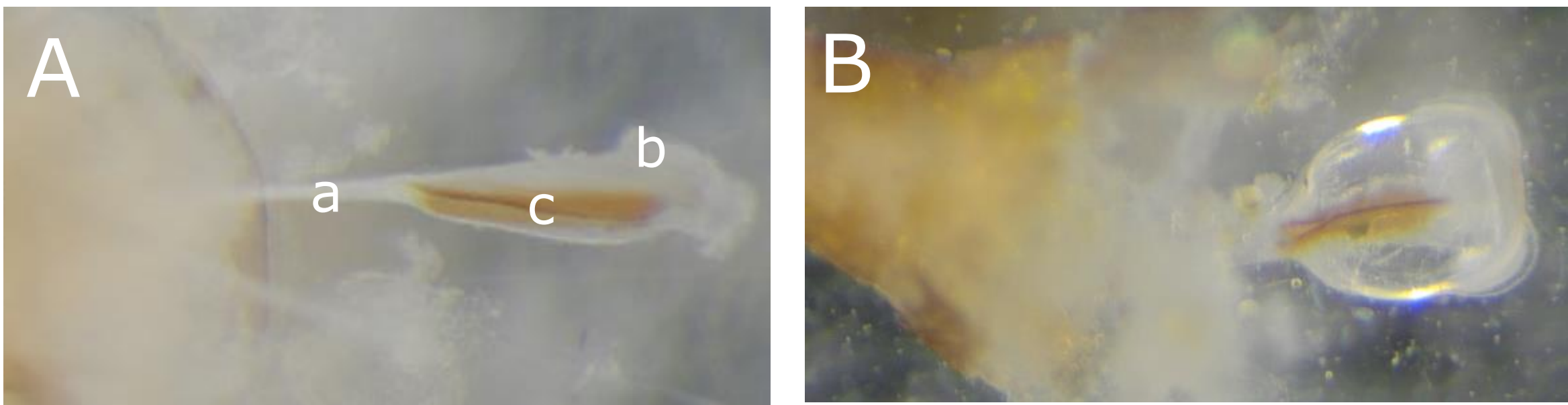


Figure 4 Female genitalia of *Lobesia botrana* characterized by a long, slender *ductus bursae* (a) that is undifferentiated from the *corpus bursae* (b) and an elongate *signum* (c): virgin (A) and mated (B).

Table 1 Total captures of males and females of *Lobesia botrana*, per trap, and percentage of mated females, in the surveyed locations (inside and in the borders of MD vineyards, non-MD vineyards, and non-crop habitats).

		Vineyard			Non-crop habitat
		Under MD	Border	Non-MD	
Males	Vallado	0,6±0,4	3	6,0±1,7	
	S. Luiz	0,0	0,0	2,3±2,3	0,0
Females	Vallado	3,6±0,9	5,0	13,3±3,7	
	S. Luiz	0,0	0,0	3,0±1,0	1,0±0,0
% Mated Females	Vallado	95,0	83,3	97,9	
	S. Luiz	-	-	100,0	100,0

CONCLUSION The obtained results are expected to contribute for the improvement of MD strategy against *L. botrana* in DDR, namely in the optimization of the density application of MD dispensers in the plots. Moreover, the use of food traps allows to assess the female mating status inside MD plots and the identification of possible sources of migration of mated females to the vineyards under MD.