VALIDATION OF AN IMMIGRATION INDEX FOR THE APPLE JUMPING LOUSE CACOPSYLLA MELANONEURA IN TRENTINO

VALIDAZIONE DI UN INDICE DI IMMIGRAZIONE DELLA PSILLA DEL MELO CACOPSYLLA MELANONEURA *IN TRENTINO*

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Abstract
The "apple proliferation" disease is an economically important threat for the European apple production and its control relies on the use of insecticides against the vector, *Cacopsylla melanoneura*. This insect spends a limited period in the apple orchards (late winter - spring, with relevant differences in the years). For this reason a successful control strategy consists in predicting the immigration (from the wood into the orchards) process of the species. In particular, are key points the first appearance in the orchards and the peak of immigration. In 2012 we proposed an Immigration index based on the week average of maximum temperatures and number of hours above a threshold temperature of 9.5°C. Since January 2011 to March 2015 this index has been validated in the field in Valsugana Valley (Trentino). The index proved a strong reliability with high accuracy in predicting both appearance and peak of immigration. It will be employed as supporting tool for the control of *C. melanoneura* from 2016.

Keywords
Temperature threshold, Apple Proliferation, psylla, overwintering
Parole chiave
Soglia termica, Scopazzi del melo, psilla, svernamento

Introduction

The apple proliferation disease is currently considered one of the main threat of the European apple production, with increasing incidence and progressive loss of production that can be stopped only if measures of control are promptly adopted (Kunze, 1989). These are the extirpation of the infected plants and the chemical treatment against the vector. The latter is a jumping louse insect, *Cacopsylla melanoneura* (Hemiptera: Psyllidae), whose life cycle is divided between apple orchard and forest environment. In particular the "apple" period is between late winter and spring, with high variability according to the years. In cold seasons, for example, the first detection of the species has been reported from March whereas in mild winters the species was found from January. This because the migration, or rather the immigration into the orchards, seems to be driven by climatic parameters and in particular temperature. The immigration process is scalar in that the population does not move massively in one or few episodes but gradually colonizes the orchards. For this reason, it looks crucial to identify the start time of the immigration and to attribute a quantitative weight to the movements in order to foresee the peak of immigration. All this knowledge is basic to the control strategy planning so much as to avoid an uncorrected and untimely use of insecticides and thus to reduce the number of treatments (Baldessari *et al*., 2010). In 2012 we elaborated and published (Tedeschi *et al*., 2012) a candidate immigration index (Ii), based on historical data (insect samplings and meteorological parameters from 2006 to 2010 in Borgo Valsugana, Trentino, Italy) that finally produced the following formula:

$$Ii = [(T_{7n} - T_{th}) + dd_n]$$

being T_{7n} the average of maximal temperatures of the 7 days preceding any sampling date and T_{th} the thermal threshold (9.5°C). dd_n is the number of hours above the threshold per week. The next step has been the validation of the index starting from 2011 to 2015, on several localities in Valsugana where the apple proliferation incidence is currently the highest in the region (10-20% of infected plants in some areas). Here we present the results at the end of the validation period.

Materials and Methods

Insect sampling. Field surveys were carried out between January – April from 2011 to 2015 in a treated three hectare apple orchard (cv Golden delicious) of the Fondazione E.Mach in the Trento province (BV: Borgo Valsugana, 419 m a.s.l.). In the period 2011-2013 adults were collected every 7 days, by means of beating method: for each replication plot, 25 branches (50x10 cm in length) were considered and every branch was shaken two times above a beating tray (diameter 7 cm, 60x40 cm of cloth). The collected adults were counted and identified in the laboratory after morphological examining female and male terminalia (Ossiannilsson,1992).
Index validation. The insect population dynamics were associated to the index variations. Our main aim was to assess whether a positive value of the index corresponded

to a movement of immigration into the apple orchard. Consequently, our hypothesis was that the first insect appearance/capture is to be associated to a certain index threshold.

Results and Discussion

Table 1 shows the correspondence between 3 candidate index thresholds (-1, 0 and 1) and the first insect record in the orchard. We found a very good consistence between the threshold value of -1 and the first field detection. In all seasons 2011-2013 and in 2015 the index threshold of -1 was an efficient predictor (perfect accuracy in the sampling date). In 2014 there was a short period of three days (25-27th January) when the index dwelled between -1 and 1, but this was not associated to any capture. However, the -1 threshold was passed again on 12th February, just one day before the first record in the field. This could be explained either because a very low population is also hard to detect with the beating method and consequently a no-capture does not imply the real absence of the insect, or the necessity to make some adjustment to the index according to the date. In practice, it could be necessary to give progressively more weight to the weeks of sampling in a way that, for example, late weeks of February can reach the threshold value of immigration, given the same temperature conditions, more easily than those of January. Alternative option is the study of a parameter that accounts on the cumulative Index.

Tab.1 - from 2011 to 2015 the first record of C. melanoneura *adults ranged from early to late February. In the left columns are reported the dates when the index values of -1, 0 and 1 were first reached. As for 2014, it is also reported the second time when the index reached the values of -1 and 0.*

Tab.1 - dal 2011 al 2015 la prima cattura di adulti di c. melanoneura *ha oscillato tra la gli inizi e la fine di febbraio. Nelle colonne di sinistra sono riportate le date in cui l'indice ha raggiunto, rispettivamente, i valori di -1, 0 e 1. Nel 2014 sono riportate anche le date in cui l'indice ha superato per la seconda volta i valori di -1 e 0.*

Year	*1st record*	*Index -1*	*Index 0*	*Index 1*
2011	*7-feb*	*4-feb*	*5-feb*	*6-feb*
2012	*20-feb*	*20-feb*	*22-feb*	*24-feb*
2013	*11-feb*	*6-feb*	*19-feb*	*19-feb*
2014	*13-feb*	*25-jan/ 12 feb*	*26-jan/ - 14 feb*	*18-feb*
2015	*19-feb*	*12-feb*	*13-feb*	*17-feb*

Conclusions

In conclusion, we assessed the validity of the proposed index and we found a significant correspondence between the threshold -1 and the first migratory moves of *C. melanoneura* from the forest into the apple orchard. For the moment we validated only one site in Valsugana however, we are currently collecting data (samplings) from the Technical Service of Fondazione Mach coming from other 10 sites to further validate the index in a larger apple growing area of Valsugana.

Thanks to these data, we could further improve the index also to ascertain whether it is feasible to make a quantitative prediction of the *C. melanoneura* migration. Such a tool would be extremely useful in the context of pest management and, consequently, decision of insecticide applications.

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