Cite as: Betz, D., Haag, N. (2026). Single-row netting of plums: A method to control plum moth, plum sawfly and leaf-curling plum aphid. *Proceedings of the 22nd International Conference on Organic Fruit-Growing*, Filderstadt 2026.02.23-25. Ed. FOEKO e.V. 2026: 258-261

Single-row netting of plums: A method to control plum moth, plum sawfly and leaf-curling plum aphid

D. Betz[1] and N. Haag[1]

Abstract

A single-row netting system of plums was tested from 2021 until 2025 to control major pests of plums, i.e. the plum moth, Grapholita funebrana Treitscheke*, the sawflies Hoplocampa flava* L. and *Hoplocampa minuta* Christ and the *leaf-curling plum aphid, Brachycaudus helichrysi* Kaltenbach*. For this reason, closing of nets at different times during the season, namely at blooming, before the second generation of the plum moth and in early September before the migration of the leaf-curling plum aphid, was tested. Fruit infestation of the plum moth could be reduced in 2022 from 12 % in uncovered control plots to below 2 % in covered plots. For leaf-curling plum aphids the number of individuals in the following spring could be minimized to 4 per 6 m branch sample in covered plots compared to 182 in the control. The exclusion of the sawflies resulted in lower fruit infestation, but remains challenging as the egg laying phase coincides with the pollination period.*

Keywords: Exclusion netting; *Grapholita funebrana; Hoplocampa minuta; Hoplocampa flava; Brachycaudus helichrysi*

Introduction

Although the investment costs are high, exclusion netting systems have become an effective and sustainable method for controlling insect pests such as *Drosophila suzukii* Matsumura in berries and cherries (Augel *et al*. 2020), and the tortricids *Grapholita molesta* Busck in nectarines and *Cydia pomonella* L. in apples (Candian *et al.* 2021; Tasin *et al.* 2008; Alaphilippe *et al.* 2016; Kelderer *et al.* 2018). In organic production of plums, existing strategies are not very efficient in controlling the predominant insect pests. For *Grapholita funebrana* Treitscheke there is no effective tool in Germany except for mating disruption, but this fails in small and fragmented orchards common in South Germany. Thus, in years with high population densities, the damage and economic losses are high. The control of the tenthredinids *Hoplocampa flava* L. and *Hoplocampa minuta* Christ will become challenging in future due to the loss of registration of Quassia extracts in the EU. For the aphid *Brachycaudus helichrysi* Kaltenbach several applications are required for a successful management. In this study, the protection potential of a single-row exclusion net system against three insect pests (*G. funebrana, H. flava, H. minuta, B. helichrysi*) of plums at different phenological and developmental stages of plant and insects, respectively, was tested.

Material and Methods

From 2021 – 2024, row nets were tested in plantations of the plum varieties 'Hanita', 'Mirabelle Nancy', 'Toptaste', 'Tophit' and 'Gäugold' planted in 2017. All plum trees of the trial orchards are cultivated and pruned as narrow fruit walls (UFO and Drapeau). The nets (supplier “BayWa AG”) with mesh size of max. 1,3 x 1,3 mm were closed below the branches at the lower wire (see Figure 1). Neighboring uncovered trees served as control plots, resulting in 5 covered and 5 uncovered plots, each with 8 - 11 trees. In addition, 5 - 8 trees of the variety 'Presenta' were protected in the same way, while corresponding control plots

[1] Landwirtschaftliches Technologiezentrum Augustenberg (LTZ), DE-76227 Karlsruhe, doris.betz@ltz.bwl.de

remained without nets. In 2025 we furthermore recorded sawfly infestations in another neighboring trial with the variety 'Presenta'. Here we covered 4 trees with exclusion nets (as mentioned above) and 4 were kept uncovered as control.

Figure 1: Row net covering plum trees, cultivated as narrow fruit wall

The nets were closed and opened each year at different times (see table 1) depending mainly on pest pressure (*G. funebrana*) and plant development.

Table 1: Times for closing the net-plots against plum sawfly and plum moth.

Trial year	Closing/ opening of nets
2021	closed at 1 April; opened at 28 April; closed at 15 July until harvest
2022	closed at 14 April until harvest
2023	closed at 3 July until harvest; closed again at beginning of September
2024	Closed at beginning of September (aphids only)
2025	closed at 11 April until July (sawfly only)

G. funebrana: 300 fruits per plot were randomly picked at harvest time for assessment of infestation by *G. funebrana*. In the laboratory, they were opened and the number of infested fruits with larvae or larval feces was counted. At the same time, the fallen fruits were collected and examined for plum moth infestation. In addition, the weekly flight was recorded using pheromone traps (“Bio Pherotrap ® Trichterfalle”, Temmen GmbH).

H. minuta, H. flava: in 2021, we recorded sawfly infestations in the “5 plum variety setup” where nets were closed at the first blooming on 1 April. On 19 May, 100 fruits per plot were examined for the characteristic drill holes. On 9 May 2025, a minimum of 211 fruits in each plot were checked for the characteristic drill holes in the neighboring trial. Nets had been closed from 11 April 2025 after full blooming at BBCH 65-67 until July. Concurrently, the flight of the sawfly was monitored with white Rebell® sticky traps.

B. helichrysi: For exclusion of *B. helichrysi* the nets were closed at the beginning of September in 2023 and 2024 when the aphids return to the winter host. In 2 net-covered and 2 uncovered plots with 5 - 8 trees each, 60 young branches of 10 cm length per plot were cut in the following February. They were kept at 4°C in storage until examination for eggs, nymphs and adults of aphids using a stereomicroscope. In addition, the number of buds per branch were counted.

Results

Since nets were closed and opened each year at different times, a comparison of results between years was not possible.

G. funebrana: Until the closing of the nets on 15 July of 2021 the moth flight was moderate with a maximum of 10 moths per trap and week. Fruit infestation at harvest was also low with 2 % in the control and no distinct differences to netted plots. In 2022, nets were closed from post bloom until harvest. The moth flight was higher in the first phase until 1 July with a maximum of 22 moths per trap and week and a peak on 21 July with 67 moths in one trap. Correspondingly, with 12% the infestation was high in the control. In the net plots the infestation was less than 2 % (see Figure 2). Since in 2023 the flight monitoring showed only a small number of moths, the nets closed on 3 July. The flight peak occured on 13 July with a maximum of 26 moths in one trap. Despite low flight and infestation levels, a clear difference was observed between the control and the netting (see Figure 2). The results of the fallen fruits were similar with 15 % in control and 2,5 % in the net treatment.

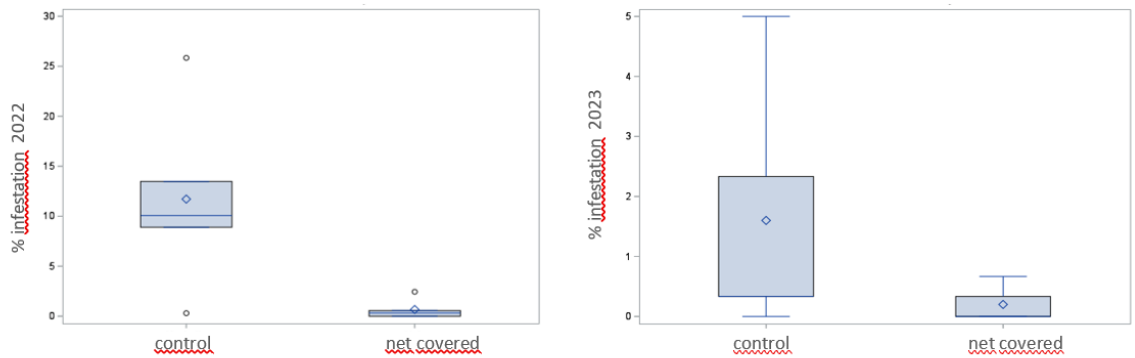

Figure 2: mean fruit infestation (%) of *G. funebrana* at harvest 2022 und 2023.

H. minuta, H. flava: In 2021, the first sawflies were caught in the monitoring traps on 6 April; hence, the nets were closed before the first adults emerged. A clear reduction in infestation could be achieved (see Figure 3).

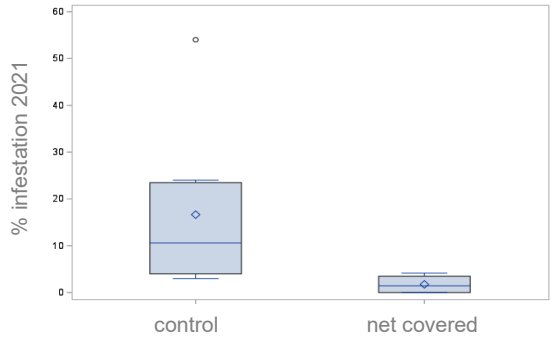

Figure 3: mean fruit infestation of plum sawflies (%) on 19 May 2021 (when nets were closed with first blooming)

B. helichrysi: Results of 2024 are shown in table 2. Mean values were 0.2 aphid per bud in the control and 0,005 in the net-covered plots the exclusion. In 2025, no aphids were recovered.

Table 2: numbers of individuals of *B. helichrysi* and total numbers per bud (mean values per 6 m branch samples per plot, cutted 29 February 2024).

	eggs	adults	nymphs	Total *B. helichrysi*/ bud
Net	0	2	2	0,005
Control	2	34	146	0,2

Discussion: The application of row nets showed an efficient protection against *G. funebrana* and *B. helichrysi*. Most crucial will be the timing of closing the nets. In particular, sawflies cannot be excluded without risking an exclusion of the pollinators leading to pronounced harvest losses. In 2021 when the net was closed at the first blooming, the harvest declined considerably, most probably due to exclusion of pollinators (data not shown). This is because the flies hatch from the soil before or with the beginning of plum blooming. Their flight peak and egg laying occur during post bloom, as also observed in our monitoring, with highest catches on the sticky traps at BBCH 67-69 on 'Presenta' and 'Toptaste'. Hence, to exclude egg laying the nets have to be closed latest at full bloom, thereby excluding pollinators. To identify the optimal window for closing the net by taking into consideration the specific floral phenology of a variety, will be our research aim during the next years. It was shown that, the row net system offers advantages over covering the entire orchard, since single varieties can be closed according to their blooming phenology and the occurrence of plum sawflies. Alternatively, the release of pollinators within the nets used for apples by Normandeau Bonneau *et al.* (2020) should be investigated. However, this will result in increasing costs in an already cost-intensive production system. There were no noticeably fruit quality losses during the trial years (data not shown). However, the quality and other impacts of row netting, e.g. on beneficials or secondary pests, need to be researched.

Acknowledgements

Many thanks to the fruit production team under direction of Hermann Meschenmoser. Thanks also to Dr. Karin Hartung for statistical analysis and to all the many helpers!

References

Alaphilippe, A., Capowiez, Y., Severac, G., Simon, S. Saudreau, M., Caruso S., S & Vergnani, S. (2016). Codling moth exclusion netting: An overview of French and Italian experience. IOBC/WPRS Bull. 112: 31-35.

Augel, C., Boehnke, B., Wichura, A. Lindstaedt, J., Wiebusch, J.-H., Engel A., Benz, S., Saltzmann, J., Eberhardt, G., Vogt, H., Koeppler, K. (2020). Demonstration project „Exclusion netting for managing Spotted Wing Drosophila in fruit crops“– Results 2017-2019. Proceedings of the 19th International Conference on Organic Fruit-Growing from February 17th to 19th, 2020, University of Hohenheim, Germany (ed. Fördergemeinschaft Ökologischer Obstbau e.V., Weinsberg, Germany), pp. 166-169.

Normandeau Bonneau, M., Samson-Robert, O., Fournier, V., Chouinard, G. (2021). Commercial bumble bee (Bombus impatiens) hives under exclusion netting systems for apple pollination in orchards. Renewable Agriculture and Food Systems 36, 234–244.

Candian V., Pansa, M.G., Santoro, K., Spadaro, D., Briano, R., Peano, C., Tavella, L., Tedeschi, R. (2021). First multi-target application of exclusion net in nectarine orchards: Effectiveness against pests and impact on beneficial arthropods, postharvest rots and fruit quality. Insects 12(3): 210.

Tasin, M., Demaria, D. Ryne, C., Cesano, A., Galliano, A., Anfora, G., Ioriatti, C., Alma, A. (2008). Effect of anti-hail nets on Cydia pomonella behaviour in apple orchards. Entomologia Experimentalis et Applicata 129, 1: 32-36.

Kelderer, M., Casera, C., Lardschneider, E. & Telfser J. (2018). Field trials in apple orchards with different covering methods to reduce plant protection and yield losses due to pests and diseases. Proceedings of the 18th International Conference on Organic Fruit-Growing from February 19th to 21st, 2018, University of Hohenheim, Germany (ed. Fördergemeinschaft Ökologischer Obstbau e.V., Weinsberg, Germany), pp. 64-70.