Trial report 11-2023

Comparison of two different treatment methods on a remontant strawberry crop against spider mites and aphids

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Problem description

At the berry producer "Wieland Beeren", a high number of red spider mites and aphids are repeatedly found on remontant strawberry crops in certain sectors. In some cases, they represent an enormous burden for the strawberry crop. To reduce the pressure on the strawberry crop, a comparative trial was carried out to find out whether the use of an insect-pathogenic fungus, *Metarhizium anisopliae*, in addition to the standard method can achieve an added efficacy. In comparison, the standard treatment will be evaluated in a sector that is also heavily infested.

Materials and method

Over a period from 15 June to 15 September 2023, the efficacy of *Metarhizium anisopliae* compared to the standard treatment was investigated in two different sectors (13 and 14) on remontant strawberry crops under foil tunnels at the Pilgerhof "Wieland Beeren" in Märstetten, Thurgau, Switzerland. In addition to the standard programme, sector 14 was treated with *M. anisopliae* (see image 1).

Image 1: Left: Sector 13 standard treatment, Right: Sector 14 standard treatment with *M. anisopliae*.

As the temperatures in summer sometimes did not permit treatment of *M. anisopliae* (outside temperatures of 30-35 °C), the recommended intervals between the individual *M. anisopliae* sprays could not be realised and a 6th spray had to be omitted. The original recommendation was to spray twice a week with *M. anisopliae* over a period of 3 weeks. Spraying always took place in the evening around 7 pm. The application data can be found in table 1.

Table 1: Overview of spray data, active substances, and concentrations in the two sectors 13 and 14. In sector 13, the standard treatment was assessed, in sector 14 the standard treatment plus the *M. anisopliae* application.

Date [dd.mm.YY]	Standard treatment Sector 13	Metarhizium treatment Sector 14	Concentration
	Applied active substance		
15.06.2023	Fludioxonil Penconazol	Fludioxonil Penconazol	0.050% 0.025%
16.06.2023		*Metarhizium*	20 ml/row
14.07.2023		*Metarhizium*	20 ml/row
15.07.2023	Fludioxonil 2 WS Fluxapyroxad 6.98%, Difenoconazol 4.66%	Fludioxonil 2 WS Fluxapyroxad 6.98%, Difenoconazol 4.66%	0.050% 0.060%
08.08.2023	Spinosad 2 WS Fluxapyroxad 6.98%, Difenoconazol 4.66%	Spinosad 2 WS Fluxapyroxad 6.98%, Difenoconazol 4.66%	0.020% 0.060%
09.08.2023		*Metarhizium*	20 ml/row
04.09.2023		*Metarhizium*	20 ml/row
06.09.2023	2 WS Fluxapyroxad 6.98%, Difenoconazol 4.66%	2 WS Fluxapyroxad 6.98%, Difenoconazol 4.66%	0.060%
08.09.2023		*Metarhizium*	20 ml/row

A total of 6 rows per sector were considered for the study. The two rows adjacent to the respective treatments were declared as a buffer zone and excluded from the assessment. For each test row, 5 leaves were taken from different plants at 5 different locations (see test design, Figure 1) and stored in zip bags in the refrigerator until they were analysed in the laboratory

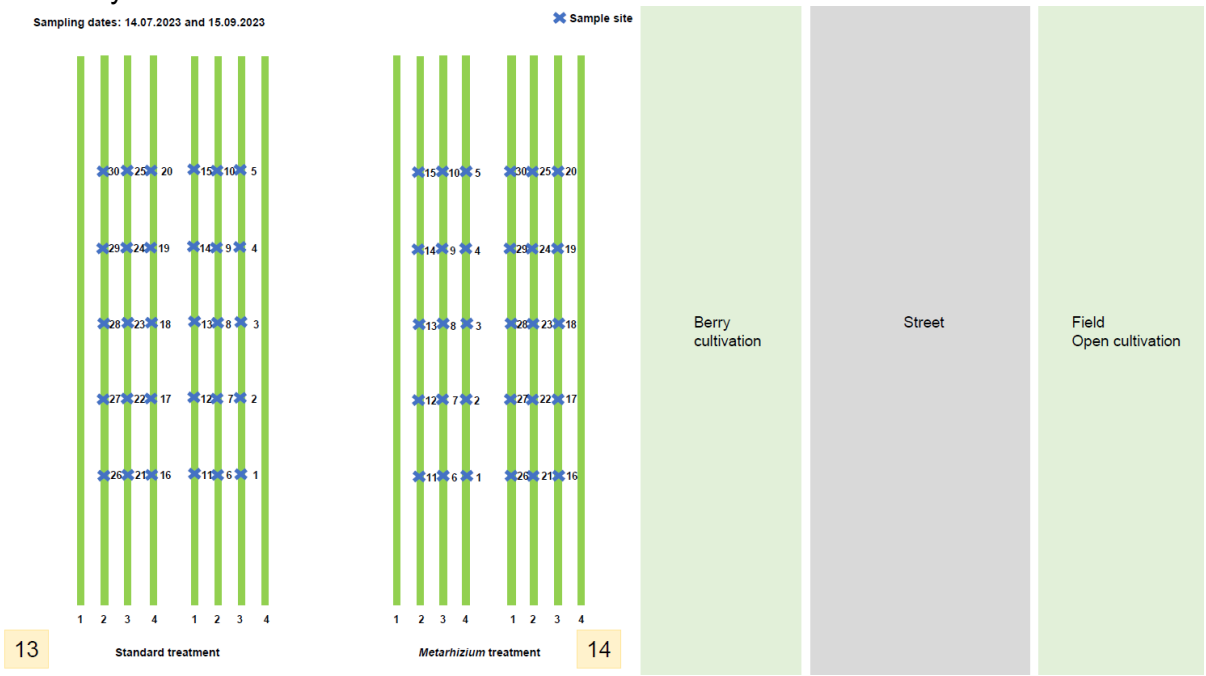

Figure 1: Test design and sampling of the two sectors 13 and 14.

For the assessment, the number of red spider mites and aphids per 5 leaves and sample location was recorded and documented visually by eye and using a microscope. Leaf samples were taken on 14.07.2023 and 15.09.2023. As the first treatment started earlier than

planned, the first sampling was carried out 1 month after the first treatment. No further samples could be taken after completion of the treatments, as the strawberry culture was cleared early, approximately one week after the last sampling.

Statistics

The data was analysed and graphically processed using RStudio 2023.09.0. The Wilcoxon rank sum test was used to compare the absolute totals of red spider mites and aphids, as the data did not correspond to a normal distribution. Significant differences were labelled as follows: p-value < 0.001 = ***, p-value < 0.01 **, p-value < 0.05 *. The higher the number of stars or the smaller the p-value, the more statistically reliable the difference between the compared values is.

Results

Sector 14 generally shows less infestation by eggs, larvae and adults of the red spider mite and aphids after one and three months. Most significant differences can be found on the first sampling day. These significant differences become progressively smaller with the continuation of the treatment, so that on 15 September 2023 only the adult red spider mite population is significantly lower in the *M. anisopliae*-treated plot compared to the standard plot.

Table 2: Sum, mean and standard deviation of the number of eggs/larvae and adult red spider mites and aphids per standard and *Metarhizium* treatment. Significantly different values are marked with *: *** = very high significance, ** = high significance, * = significance.

		Standard treatment		*Metarhizium* treatment	
14.07.2023		Sum	mean ± SD	Sum	mean ± SD
Spider mites	Eggs/Larvae	179 ***	6 ± 15	15 ***	1 ± 1
	Adults	30 **	1 ± 1	10 **	0 ± 1
Aphids	Eggs/Larvae	35*	1 ± 3	0*	0 ± 0
	Adults	0	0 ± 0	0	0 ± 0
		Standard treatment		*Metarhizium* treatment	
15.09.2023		Sum	mean ± SD	Sum	mean ± SD
Spider mites	Eggs/Larvae	367	13 ± 17	257	9 ± 18
	Adults	16 **	1 ± 1	0 **	0 ± 0
Aphids	Eggs/Larvae	52	2 ± 4	16	1 ± 1
	Adults	30	1 ± 2	12	1 ± 1

The most important results are those recorded after the last *M. anisopliae* treatment (15/09/2023, see Figure 2). Therefore, a graphical representation of the data collected on 14 July 2023 was omitted.

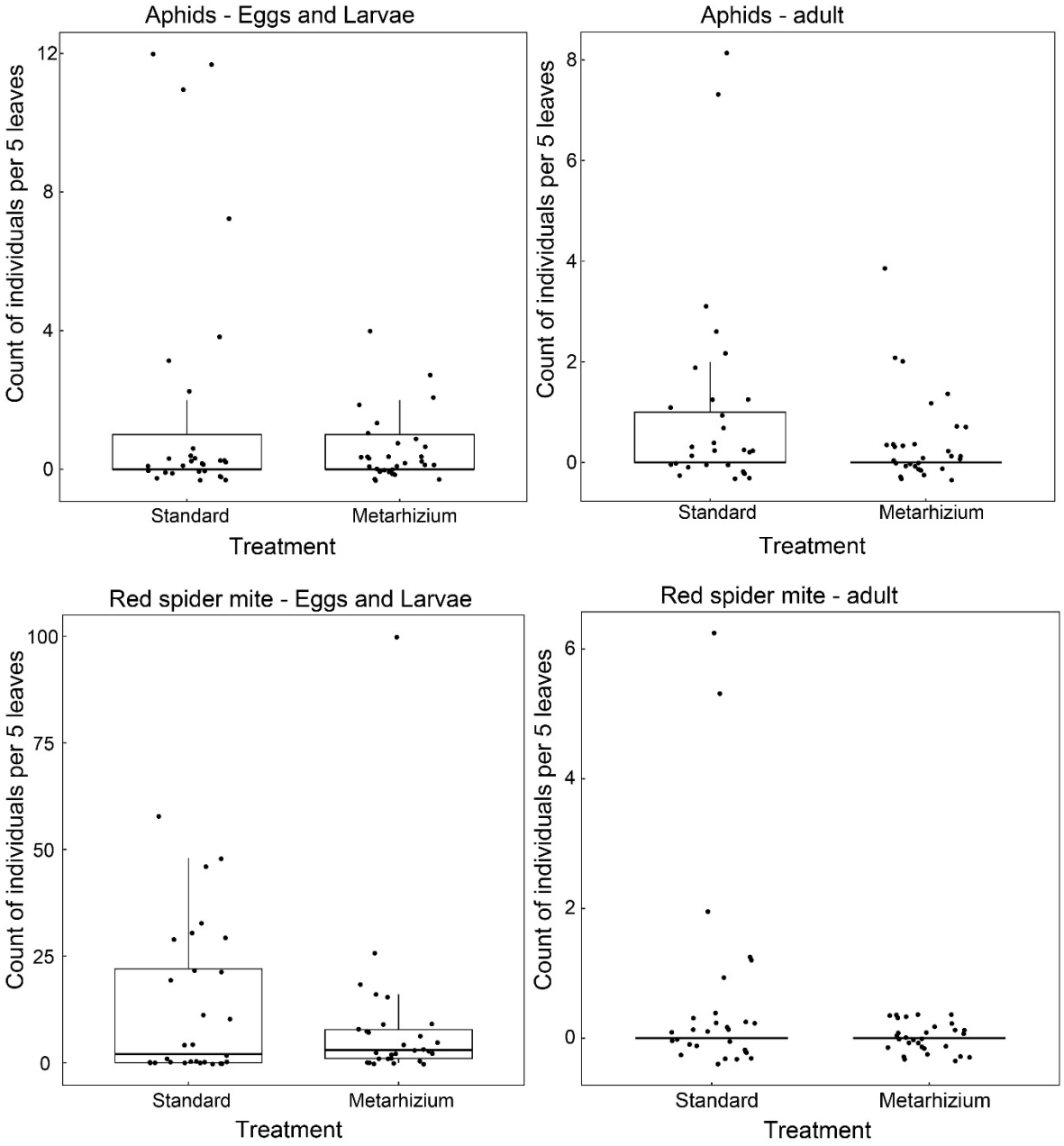

Figure 2: Number of eggs, larvae and adults of aphids (upper figures) and red spider mites (lower figures) found on strawberry leaves of the standard and *Metarhizium* treatment shown as a box plot. Dots show the number of individuals counted per 5 leaves. The thick horizontal line shows the median, the box shows the 25th and 75th percentile, the vertical line the minimum and maximum values. Values outside the box and the minimum and maximum values represent outliers. Visualised results from sampling day 15/09/2023.

Discussion

The results indicate that at least in the adult form of the red spider mite, a significant reduction could be achieved by *M. anisopliae* at the end of the trial. It is unclear whether a single treatment within one month (treatment 15 June and assessment 14 July 2023) could really reduce the populations of eggs, larvae, and adult red spider mites as well as the eggs and larvae of aphids, or whether this reflects the natural population in sectors 13 and 14. As sector 14 is almost directly adjacent to a road, the question arises as to whether the plot generally has fewer pest infestations due to better ventilation. It would therefore be

interesting to swap the two treatments (*Metarhizium* and standard treatment) in sectors 13 and 14 in a future trial. Another adjustment could be a longer observation period of the trial. As *M. anisopliae* needs a certain time to parasitise and kill pests, an additional sampling after the last treatment would certainly be interesting, not one week later, but about 1 to 3 months later. It would also be important to record the initial population before the start of the trial. Nevertheless, despite the high temperatures and low humidity and the resulting more difficult conditions for *M. anisopliae*, the results are very positive.

Conclusion

M. anisopliae was able to achieve a significant reduction in the adult red spider mite population, even though the temperatures and humidity were not optimal for the growth of the fungus. The addition of *M. anisopliae* to the standard applications is therefore recommended.