Cite as: Buchleither, S., Bohr, A., Späth, S., Meyer, M., Haug, P., König, C. (2022).Susceptibility of scab resistant varieties to apple scab, sooty blotch and Marssonina coronaria. *Proceedings of the 20th International Conference on Organic Fruit-Growing*, online 2022.02.21-23. Ed. FOEKO e.V. 2022: 70-73

Susceptibility of scab resistant varieties to apple scab, sooty blotch and *Marssonina coronaria*

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Abstract

To evaluate the susceptibility of new scab resistant or robust varieties to apple scab, sooty blotch and Marssonina coronaria, several new varieties have been evaluated between 2017 and 2021 in an organically managed orchard in Lake Constance Area without any fungicide input. Within this five-year period, several varieties remained without any scab symptoms on leaves and fruits. The commonly planted variety "Topaz" showed the highest scab infestation of all the resistant varieties in each year. Contrary to apple scab, no variety showed resistance or at least sufficient robustness against sooty blotch and Marssonina coronaria in this trial.

Keywords: Apple scab, sooty blotch, *Marssonina coronaria*, resistant varieties

Introduction

The use of resistant or robust varieties is one of the keys for the successful control of apple scab as well as for the reduction of plant protection input, especially in organic farming. In the last 20 years, the rate of varieties with resistance or robustness against apple scab increased up to currently 60% on organically managed farms in Lake Constance Area. The most important vf (Rvi6)-resistant varieties are "Topaz" and "Santana", but in the last years also new varieties like "Natyra", "Deljonca" and "Freya" have been frequently planted on organically managed farms. Parallel to this development, infestation with apple scab on vf (Rvi6)-resistant apple varieties has widely been observed in the Lake Constance Area since 2013, but especially in the year 2021. Particularly "Topaz" was noticed to show severe scab symptoms under reduced plant protection management. Due to high amounts of precipitation during summer, also sooty blotch and *Marssonina coronaria* are playing an important role in this region, especially in organic fruit production. To evaluate the susceptibility of new scab resistant or robust varieties to several diseases in an early stage, Förderverein Ökologischer Obstbau (Föko e.V.) initiated and coordinated the plantation of an on-farm variety testing orchard in Lake Constance Area. In this orchard varieties remained without any fungicide input during the years 2017-2021. Under these conditions, first estimations on resistance or robustness of newly bred varieties can be generated within a short time period and rated in relation to susceptible varieties like "Elstar" and "Jonagold".

Material and Methods

In this organically managed orchard, a number of 3 x 3 trees per variety was planted by randomised dispersal on the rootstock M9. In this orchard all varieties remained without any fungicide input during the entire period of the trial. Since 2017 the evaluation of infestation with apple scab, sooty blotch and *Marssonina coronaria* has been conducted in cooperation between FÖKO e.V. and KOB within a Project funded by the Ministry of rural affairs and consumer protection of Baden-Württemberg. A 0-9-scale adapted from Lateur and Populer (1994) was used to annually assess scab infestation after primary scab season. In this scale

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1 means “no visual symptoms” and 9 “tree completely affected”. Yearly assessment of the infestation level caused by sooty blotch has been done in the middle of September using a scale from 0 (no symptoms) to 5 (more than 50% of fruit surface covered with symptoms). Additionally, infestation with *Marssonina coronaria* has been evaluated yearly at the end of October using a scale from 0 (no visual symptoms) to 9 (nearly no leaves left).

Results

Figure 1 shows the level of apple scab infestation on the leaves for the five-year period between 2017 and 2021. In this figure red bars represent the average value of the years 2017 till 2021. Black bars illustrate the infestation level of the year 2021, which was the year with the highest infection pressure due to above-average occurence of rain events between May and August. The very high infestation levels in 2021 on the scab susceptible varieties “Elstar” and “Jonagold” underline the high infestation pressure of this year. Despite the complete absence of fungicide plant protection input, several apple varieties remained without any scab lesions on the leaves during the entire five-year period. Especially the new varieties „ACW 18419“, and „ACW 18522“, the variety “Admiral” with polygenetic resistance, and the traditional variety „Seestermüher Zitronenapfel“, as well as the varieties „Discovery“ and „Allegro“ remained without scab symptoms in every year. But also varieties with vf (Rvi6)- resistance which have already been planted on several organically managed farms in Germany like „Deljonca“ and „Freya“ remained free of scab on the leaves in every year. The varieties „Natyra“, „Galiwa“, „Ladina“ as well as the new variety „CIV 76“ showed only low infestation levels on a few leaves on single trees over the years as well as in 2021. In this trial, the most commonly planted vf-(Rvi6)-resistant variety “Topaz” showed rather disappointing results. Compared to other scab resistant varieties, “Topaz” showed higher leaf infestation levels in each year, particularly in 2021. However, especially in the year 2021 with high infection pressure, scab infestation on “Topaz” was still considerably reduced compared to “Elstar” and “Jonagold”.

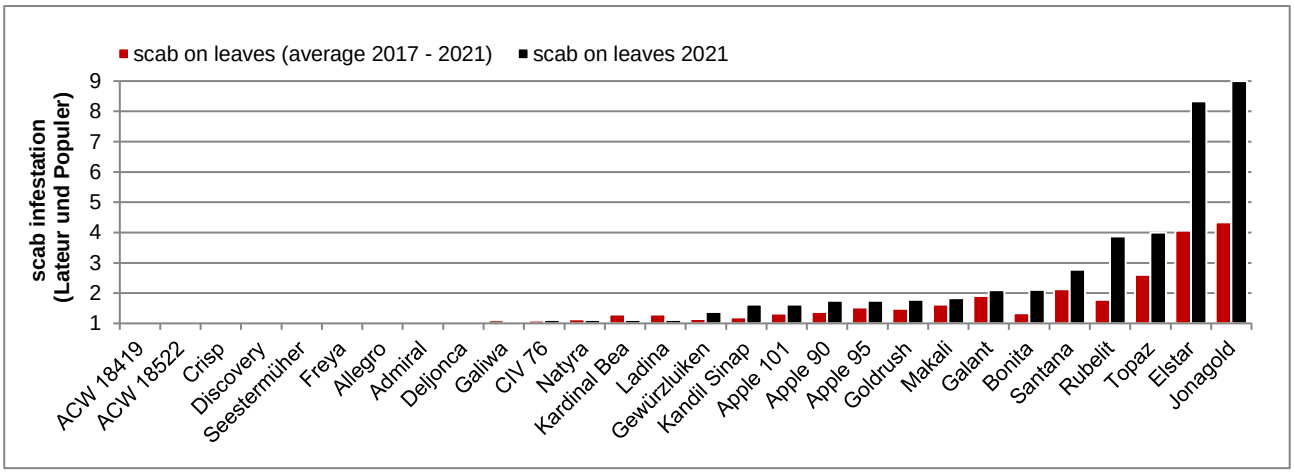

Fig. 1: Average infestation level (scab on leaves) of the years 2017-2021 (red) and infestation level in 2021 (black) in an untreated orchard in Lake Constance Area

In figure 2 the results of fruit-scab evaluation are shown in addition to leaf-scab for the year 2021. It is remarkable, that for some varieties infestation levels differ between leaves and fruits. For example, on the varieties “Allegro” and “Galiwa” scab on fruits appeared, but in contrast no scab symptoms on leaves were detected. Higher infestation levels on fruits compared to leaves were also found for the varieties “Goldrush“, „Bonita“ and „Santana“. Contrary results were detected for „Rubelit“ and „Topaz“, where higher infestation level on

the leaves occurred while scab on fruits remained moderate. Only the susceptible varieties „Elstar“ and „Jonagold“ showed high scab infestation both on leaves and fruits.

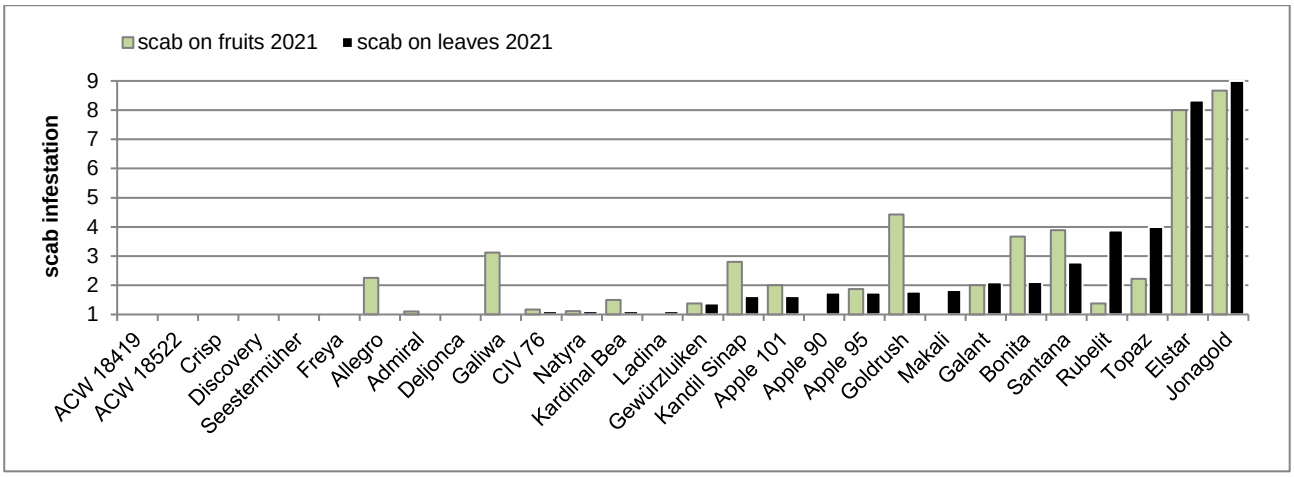

Fig 2.: Apple scab on leaves and fruits in 2021 in an untreated orchard in Lake Constance Area

Figure 3 depicts infestation with sooty blotch from 2018 – 2021. In 2017, assessment of sooty blotch was not possible due to high losses caused by frost. Grey bars represent average infestation in the years 2018 -2021, black bars illustrate the infestation in 2021. Similar to apple scab, a considerably increased infestation of sooty blotch occurred in the year 2021. The majority of the tested varieties showed high infestation levels in this year. In contrast to apple scab, no variety expressed resistance or at least sufficient robustness against sooty blotch in this trial. Only “Deljonca” showed moderate infestation levels in 2021.

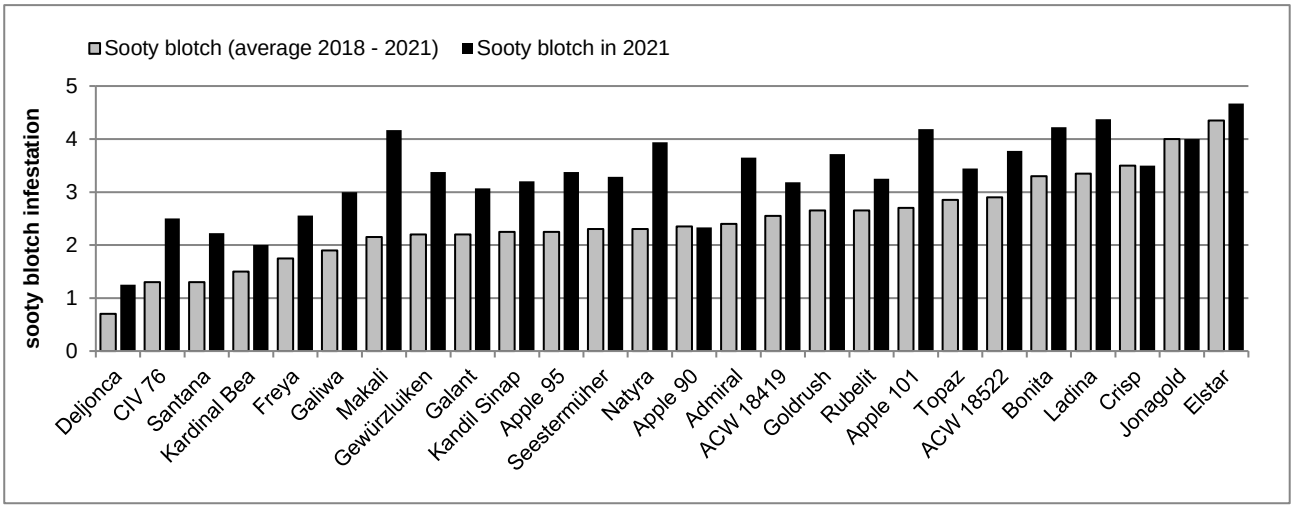

Fig. 3: Average infestation with sooty blotch of the years 2018 – 2021 (grey) and infestation in 2021 (black) in an untreated orchard in Lake Constance Area.

Results of the assessment of *Marssonina coronaria* are shown in figure 4. For the varieties Elstar“, „Bonita“, „Rubelit“ and „Jonagold“ only data of the years 2020 and 2021 are available. This has to be considered for the interpretation of the results. In line with apple scab and sooty blotch, highest *Marssonina coronaria* infestation levels were found in 2021. Most of the tested varieties showed very high and not acceptable infestation with *Marssonina coronaria* in this year. Highest levels of infestation were found on the varieties „Crisp“, „Ladina“, „Freya“, „Admiral“, „Bonita“, „Makali“, „Topaz“ and both ACW-varieties. Slightly reduced infestation could only be found on four varieties. Only one nowadays high-scale marketable variety (“Elstar”) belongs to this group, together with the old, traditional

varieties „Seestermüher Zitronenapfel“, „Kardinal Bea“ and „Kandil Sinap“. In contrast to apple scab, none of the tested varieties showed adequate robustness or resistance against *Marssonina coronaria* in this trial.

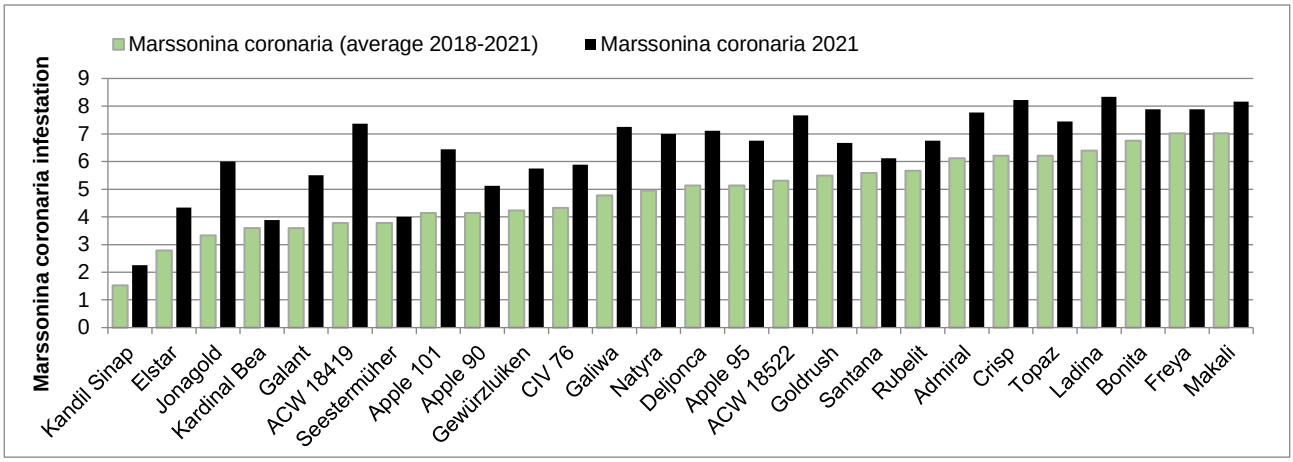

Fig. 4: Average infestation with *Marssonina coronaria* of the years 2018 – 2021 (green) and infestation in 2021 (black) in an untreated orchard in Lake Constance Area

Discussion

Concerning apple scab, promising results for several new resistant varieties were achieved. Within the five years of this trial, several varieties showed solid resistance against apple scab even without any fungicide input under favouring conditions for scab infections of Lake Constance Area. For these varieties it can be expected that an appreciable reduction of fungicide plant protection input for the control of apple scab can be achieved without any negative effect. Unfortunately, none of the tested varieties expressed adequate robustness or resistance against sooty blotch and *Marssonina coronaria*. These results underline the importance of considering the resistance or robustness against sooty blotch and *Marssonina coronaria* along with apple scab resistance in the evaluation of new varieties.

Acknowledgements

We would like to thank the Ministry of Food, Rural Affairs and Consumer Protection of Baden-Württemberg for funding this project, as well as E. Karrer for implementation and management of this orchard.

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