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Short contribution

First results of reducing sooty blotch on apples using specialized brushing technique after harvest

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Abstract

Particularly in years of high precipitation, sooty blotch can infest a high share of apple fruit causing a grayish-black fungal layer and thus blemish at harvest. Therefore, a high amount of fruit cannot be sold as first class table fruit. The area covered by the fungal layer on the fruit surface can be reduced by using specialized brushing technique and the share of marketable fruit can be enhanced, consequently. Between 2023 and 2025, the Kompetenzzentrum Obstbau Bodensee (KOB) conducted together with the organic fruit grower Nikolaus Glocker brushing trials on apple varieties commonly used in organic farming. This study aims to find out up to which degree of infestation apples can be cleaned by brushing and be marketed as first class table fruit afterwards. Furthermore, possible impact of fruit shape on successful cleaning was examined. The 3-year results show, that around 2/3 of apples in category 2 (5-10 % of fruit surface infested) and 1/3 of apples in category 3 (11-25 % of fruit surface infested*) can be marketed as first class table fruit after undergoing the brushing process. A higher infestation level of more than 25% could not be satisfactorily cleaned with the standard brushing process. Also, this trial unveiled that shape of fruit impacts brushing efficacy. These trials were conducted as part of the 'Oekoapfelforward' project, which is funded by the BLE (Federal Agency for Agriculture and Food) as part of the Bundesprogramm Ökologischer Landbau.*

Keywords: sooty blotch, *Peltaster cercophilus*, fly speck, *Schizothyrium pomi*, fruit blemish, brushing

Introduction

The pathogens that cause sooty blotch and fly speck disease colonize the surface of various fruits, including apples, without penetrating the cuticle. In South Germany the most common pathogen of this fungal consortium responsible for a large portion of associated yield loss is *Peltaster cercophilus* (Weber et al., 2016). The infestation manifests as a grayish-black coating on the fruit. This is the fungal mycelium of the pathogens, visible through melanization. Economic damage occurs if infested batches can no longer be marketed as first class table fruit. The fungi only colonize the fruit skin without penetrating deeper cellular layers, therefore in theory they can be brushed off. For this purpose, special brushing machines have been developed and can be integrated into the sorting process. The aim is to remove sooty blotch symptoms from otherwise flawless fruit by mechanical means and thereby increasing the proportion of first class table fruit during s

orting. Using this approach two questions arise and are targeted in this research: Which levels of infestation can be cleaned by brushing? And: Does successful brushing depend on the shape of the fruit, which varies depending on the cultivar?

Material and Methods

The studies were conducted between 2023 and 2025 using the most popular brushing machine model in Lake Constance region manufactured by the Dutch company Burg. The brush unit consists of 24 horizontally arranged brush rollers at the bottom and 6 x 3 brush

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heads attached to the lid, each rotating around its own axis. Generally, the fruit is brushed with light pressure, and the machine settings were kept the same throughout the three years of trial. After the gentle transfer from graters into water, the apples remained in there floating for approximately 60-90 seconds at 6-8 °C water temperature. Subsequently, the fruit were brushed for approximately 60-70 seconds in the brushing unit before being collected again by a conveyor belt. In order to evaluate the brushing success, apples were graded before and after brushing and grouped into different infestation categories. Each infestation category was brushed separately. Table 1 shows the grading scheme. Infestation category 1 corresponds to an infestation of less than 5% of the fruit surface and is considered suitable for first class table use. Categories 2 to 5 show infestation larger than 5% of the fruit surface and therefore, are usually not considered as first class fruit but discarded as cider fruit. This definition of marketable first class fruit is based on requirements of local marketers.

Table 1: Categories for classification of sooty blotch. ✓: suitable as first class fruit, ×: not suitable as first class fruit.

category	infested fruit surface in %	first class fruit
0	without infestation	✓
1	<5	✓
2	5-10	×
3	11-25	×
4	26-50	×
5	>50	×

To examine the successful brushing depending on infestation level the cultivars ‘Topaz’ and ‘Natyra®’ were used for all three years of trial. These two vf (Rvi6)-resistant cultivars are widely cultivated in the Lake Constance region and often show severe symptoms of sooty blotch due to their late harvest date. Here a minimum sample size of 2000 fruit per cultivar was brushed.

To investigate the effectiveness of brushing of different fruit shapes, the spherically shaped cultivar ‘Topaz’ was compared with the cylindrically shaped cultivar ‘Braeburn’. In order to better reflect the specific characteristics of the two cultivars in terms of shape, category 2 (5-10% of infested fruit surface) was further divided into three sub-categories according to the position of the infestation on the fruit surface. This subdivision led to a category 2a “only area surrounding apple stem pit”, 2b “only area not surrounding apple stem pit” and 2ab “area spread on whole fruit” (table 2). For this part of the trial a minimum sample size of 800 fruit per cultivar was brushed.

Table 2: Category 2 – classification of category 2 refined into three subclasses

category	Infested fruit surface between 5 to 10 %
2a	only area surrounding apple stem pit
2b	only area not surrounding apple stem pit
2ab	area spread on whole fruit

Results

Figure 1 shows the relative share of first class table fruit after being brushed (y-axis) based on the initial infestation category (x-axis) of the tested cultivars, ‘Topaz’ and ‘Natyra®’ for all three years of trial. Apples classified in category 2 before brushing were marketable afterwards at a rate of more than 60 % in all three years for both tested cultivars. For fruit in category 3, the amount of first class fruit after brushing was still approximately 30 %. With

the specified brush settings, only a marginal share of apples of category 4 and 5 could comply with the quality demands of the marketer after brushing. The majority of these fruit were classified as cider fruit.

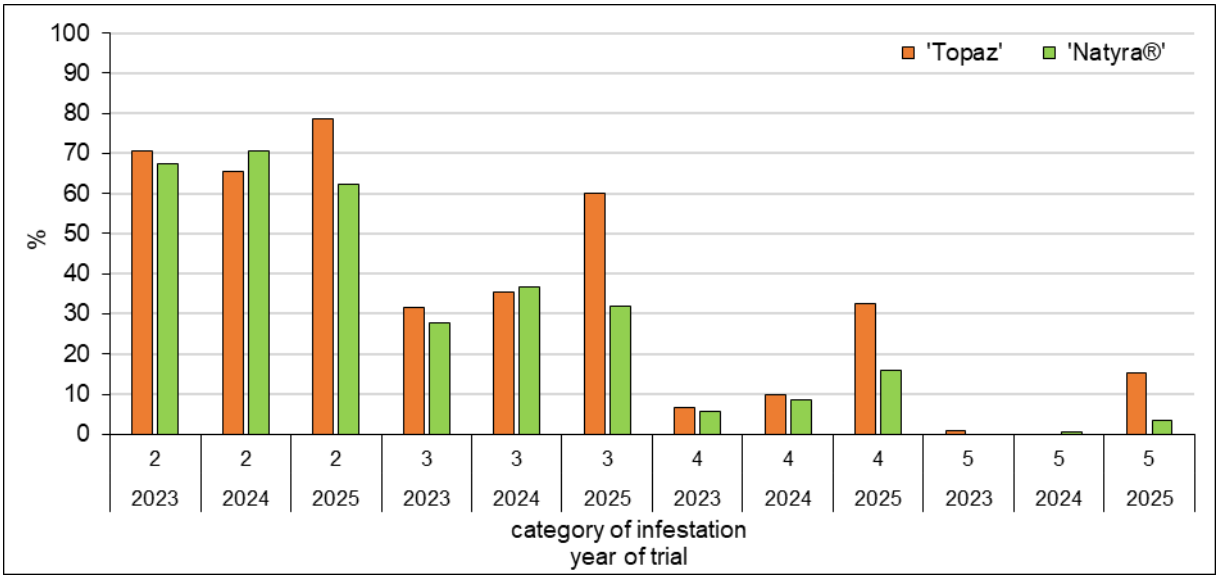

Figure 1: Sooty blotch on apple of ‘Topaz’ and ‘Natyra®’, 2023 to 2025. Initial Infestation in categories (x-axis) and percentage of first class table fruit after brushing (y-axis).

Targeting the influence of fruit shape on possible results of brushing, effective removal was detected for both spherically (‘Topaz’) and cylindrically (‘Braeburn’) shaped apples. Sooty blotch symptoms spread on the fruit surface except for the stem pit (category 2b) were successfully removed up to a level of first class fruit for 80 % of the apples throughout all years of trial (compare figure 2). In contrast, infestation surrounding the apple stem pit (categories 2a and 2ab) was removed to a higher degree from ‘Topaz’ than from ‘Braeburn’ apples. Precisely, around 60 % of ‘Topaz’ fruits were cleaned to a level of first class table fruit in both years, whereas only 10-20% of ‘Braeburn’ fruits reached marketability while majority of fruit remained in category 2a.

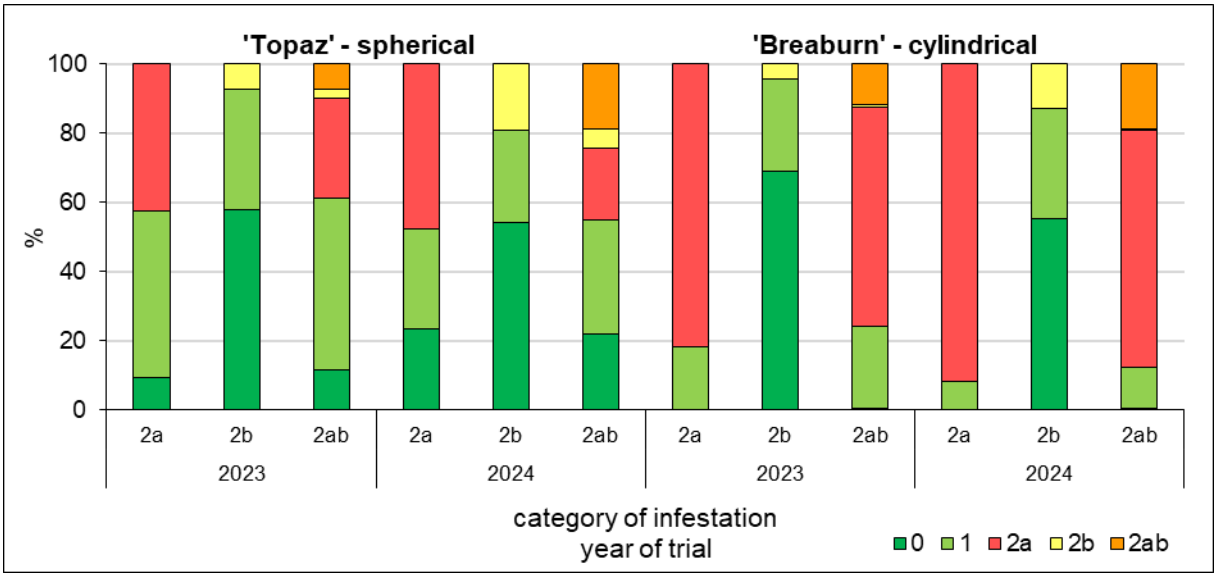

Figure 2: Brushing effectivity depending on fruit shape. ‘Topaz’ and ‘Braeburn’ 2023 to 2024. Relative amount of fruit per category after brushing in % (y-axis) and the initial classification (x-axis).

Discussion

The results of this study indicate that using specialized brushing technique leads to reduction of sooty blotch symptoms on apples of all tested cultivars in all categories of infestation. This shows that reducing sooty blotch on apple after harvest is possible in general.

However, our study demonstrates that, using the standard settings, a high amount of first class table fruit can only be reached when cleaning comparatively light infestation levels up to category 2. In category 3, a medium amount of apples was marketable after brushing, while in categories of strong infestation, 4 and 5, a high amount of fruit was discarded, still. These results might possibly be improvable by using adjusted settings such as a longer exposure time of apples to the brushes. Such adjustments seem to be most promising when applied to category 3 apples, as there was already about one third of all fruit marketable as first class fruit after brushing and this share could most likely be increased to a satisfying result using only little adjustments.

Additionally, this study indicates that fruit shape has an impact on the process of successfully brushing off sooty blotch. This was shown for the most common shapes, cylindrical and spherical fruit. Cylindrically shaped fruit enter the brushing unit and are quickly locked in a steady position that does not expose the stem pit area to the brushes. Contrasting, spherically shaped apples change their position continuously during their way through the brushing unit. Therefore, all fruit surface gets a chance to be cleaned and even less accessible areas can be reached by the brushes.

Altogether, this trial showed that satisfying results of brushing are strongly depending on the shape of each cultivar and infestation level, therefor generic statements about brushing efficacy cannot be given.

To further investigate the impact of exposure time of apples to brushes and refine adjustments of the brushing units, further research is needed. Especially factors like degree of infection, economic aspects (possible price of fruit in dependence on available marketing channels, cost of brushing, etc.), suitability for other cultivars than the ones tested and accessibility of brushing units to farmers must be considered, too.

Besides feasibility questions, also political pressure to decrease plant protection input must be considered when thinking about integrating brushing units into every day operational routine.

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