Influence of different soil preparation techniques on organically grown strawberries

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Abstract

From June 2005 till June 2007 different soil preparation techniques like chiselling and advance sowing of medicinal plants and green manuring were proofed for their influence on reducing plant losses of strawberries caused by root diseases like Phytophthora species and Verticillium dahliae. The variants were combined with potted plants and Frigos. The experiment took place on an organic fruit farm near Stuttgart, Germany, with the strawberry variety ´Elsanta´.

Focused on root diseases, habit and yield chiselling combined with Frigos and green manuring combined with potted plants showed the best results. Generally the marketable yield was often below yields from conventional cultivation.

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Keywords: Strawberry, organic orchards, root diseases, soil preparation techniques, green manuring

Introduction

Root diseases on strawberry plants are specially found in areas with heavy soil (SCHERER, 1989). Stagnant moisture, soil compaction, nematodes and soil exhaustion support presence of *Phytophthora sp.*. Therefore fruit growers have to take care of a proper soil preparation to guarantee optimal soil conditions for strawberries.

The influence of different green manuring plants on the infestation of root diseases and nematodes were described by KRÜGER (1996). Also KREBS and FORRER (2001) reduced late blight of potatoes with different medicinal plants like mallow or sage (dried plants as addition to the potting substrate).

The experiment also includes a comparison between Frigos and potted plants. Organic fruit growers prefer Frigos as planting stock although there were considerable quality problems in the past. One great problem is the special sensitiveness towards *Phytophthora cactorum*. Frigos are more sensitive than potted plants (SCHERER, 1989).

The experiment should result in new findings transfered into recommendations for the practical use in organic cultivation of strawberries.

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Material and methods

The experiment took place at an organic fruit farm near Stuttgart. Apart from the controls there were the following four variants: “Chiselling + Frigos”, “Chiselling + potted plants”, “*Malva sylvestris* + potted plants” and “Green manuring + potted plants” (tab. 1). Potted plants control couldn’t be continued in 2007 caused by an apple replanting.

Table 1: Combinations 2005 - 2007

Variant	Soil preparation 2005	Planting stock	Planting date
1	Control	Frigoplants	03.06.05
2	Chiselling	Frigoplants	03.06.05
3	Control	Potted plants	19.08.05
4	Chiselling	Potted plants	19.08.05
5	Sowing of *Malva sylvestris*	Potted plants	19.08.05
6	Sowing of Green manuring	Potted plants	19.08.05

Four rows with 33 strawberry plants of the variety ´Elsanta´ were planted per variant, with a distance of 0,30 m x 1,00 m. The Frigos and potted plants had been propagated organically but not by the same growers. In the year 2006 a number of 25 uniform plants were chosen per variant, without repetition. In the year 2007 three repetitions per variant were set up with 15 equal plants per repetition.
The medicinal plant *Malva sylvestris* (4 kg/ha) and the green manuring (190 kg/ha) were sawn in the middle of April 2005. The green manuring consisted of broads, pease, vetches and cereal. The chiselling with a depth of 0,5 m at the beginning of June 2005 was done shortly before the planting of the Frigos. After the incorporation of mallows and green manuring the potted plants could be placed in the field by mid of August 2005.
In the harvest years 2006 and 2007 the yield, fruit size and fruit damage like botrytis blight, sunburn, leather rot and deformation were evaluated. Furthermore there was a monitoring of habit, foliage diseases and plant losses. Two times per growing period the habit from each strawberry plant was evaluated with a grade from one to nine. One means “small plant”, nine means “vigorous plant”. The plants were also checked two times per growing period for leaf scorch of strawberry, powdery mildew and strawberry leaf spot. Each parcel was evaluated by grades from one to nine. One means “without infestation”, nine means “strong infestation”. The plant losses caused by *V. dahliae* and *Phytophthora sp*. were counted per variant.

Results and discussion

During the years 2006 and 2007 the combination “Chiselling + Frigos” showed the best results. Caused by the early planting date the Frigos had the advantage of being ahead in growing for eleven weeks showing a vigorous habit. In November 2005 for example Frigos had an average grade of 6 while potted plants were valuated with grade 3. This trend continued in 2006 (Frigos: grade 8, potted plants: grade 4). The plant losses by root diseases were low while small potted plants showed infections with strawberry black root rot. Furthermore this combination reached the highest marketable yield in 2006 and 2007 with 320 g per plant (approx. 9 t/ha) each year.

The best potted plant variant was “green manuring”. Infection with strawberry black root rot was very low and the plants showed a good habit. Potted plants had also a lower infestation with strawberry leaf spot than the Frigos. The early planting date of the Frigos forced the infection with foliage diseases.
Powdery mildew and leaf scorch of strawberry couldn´t be observed. The marketable yield from the green manuring was given with 200 g per plant in 2006 and 160 g per plant in 2007.

Figure 1 and 2 show the total yield of ´Elsanta´ in the year 2006 and 2007 divided into marketable yield and fruit losses.

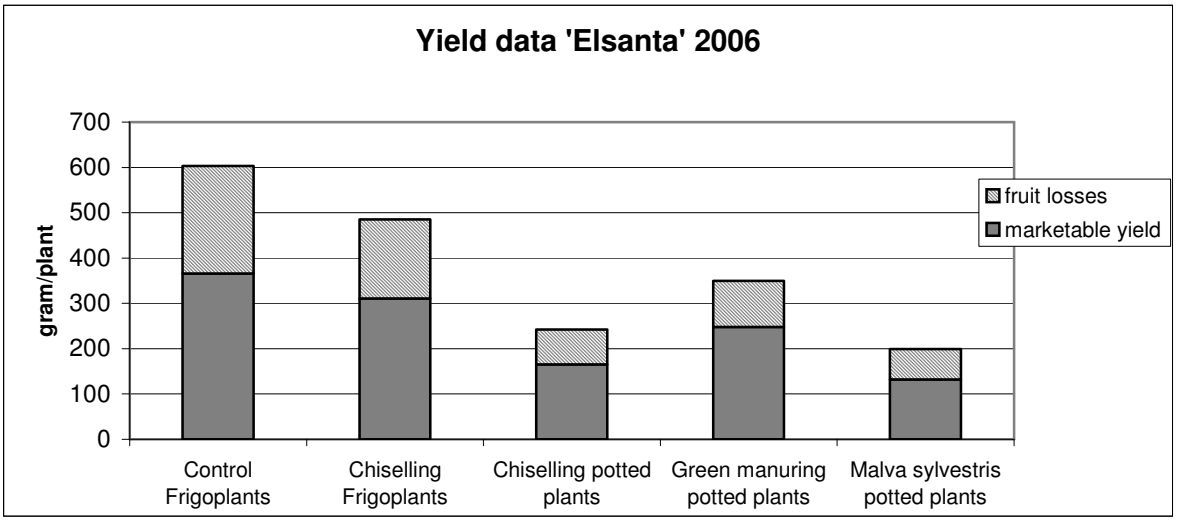

Figure 1: Total yield of ´Elsanta´ influenced by soil preparation technique and type of planting stock in 2006

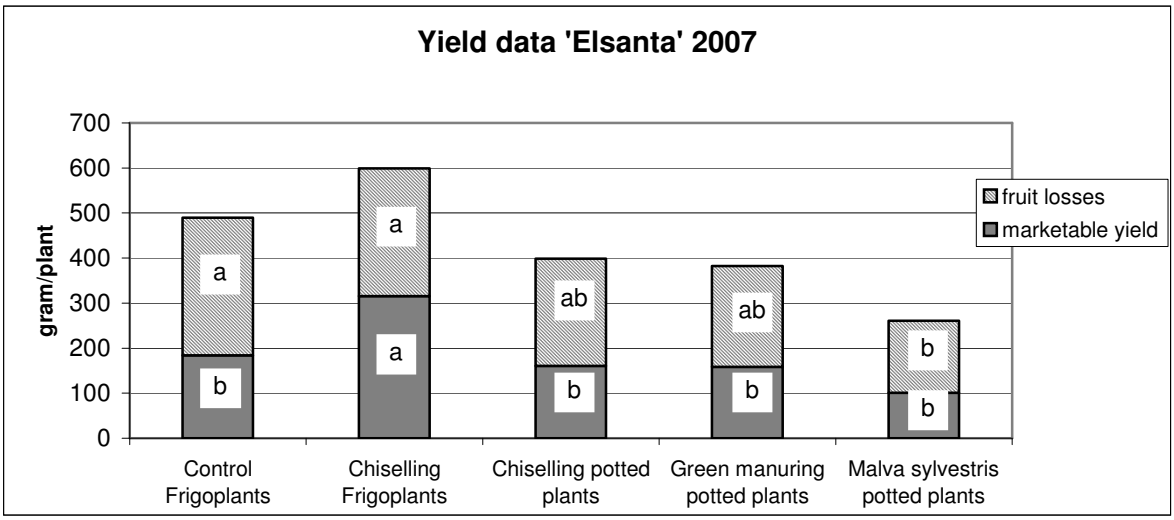

Figure 2: Total yield of ´Elsanta´ influenced by soil preparation technique and type of planting stock in 2007 (Tukey Test for fruit losses and marketable yield, α = 0,05)

The marketable yield includes fruit sizes > 30 mm and > 25 mm. Fruit damages like botrytis blight, sunburn, leather rot or deformation and small fruits (< 25 mm, < 22 mm) were counted as fruit losses. In the year 2006 the fruit loss mainly consisted of deformation (11%) and feeding damages (14%). The infestation with *Botrytis cinerea* was very low (1%).

The year 2007 instead showed a higher percentage of fruit losses. On the one hand there was an increase of small not marketable fruits (20 %) which is typical for the second harvest year. On the other hand supported warm and humid weather in the middle and at the end of harvest the presence of *B. cinerea* (4 %). Snails caused an additional damage of 20%.

The combinations "Chiselling + potted plants" and "*Malva sylvestris* + potted plants" couldn't satisfy because of low marketable yield, weakly habit and many plant losses.
An examination of plants showed that the most losses weren't caused by *Phytophthora sp.* as initially expected but by Verticillium dahliae initiated by arid weather in spring and at the beginning of harvest. This result allows new ways of controlling, for example inoculation of plants with a mixture of *Verticillium* genotypes (Leibniz-Zentrum for Agrarian Landscape Research) and Biofumigation.

Looking at the described results an optimal combination could be "Green manuring + Frigos". But before this can be given as recommendation for the practical use it first should be tested in additional experiments. At least one soil preparation technique should become a standard in every organic fruit farm. Application of tillage implements against soil compaction or advance sowing of green manuring have a fundamental positive influence on the soil structure. This results finally into positive effects for habit, disease susceptibility and yield of strawberry plants.
If the fruit grower choose an advance sowing he had to consider that plants like clover, lucern, phacelia and potatoes support the presence of nematodes (MICHEL, 2007). Instead Cereals and *Tagetes erecta / patula* for example can be used against nematodes reducing potential infestation with *V. dahliae* (KRÜGER, 1996).

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