

Effect on abundance of important pome fruit pests and diseases by mixing four apple varieties in one orchard

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Abstract

In 2007 a mixed cultivation consisting of four little genetically related varieties of apple was planted in an ecologically managed orchard. There is a monitoring for any changes in abundance of important pome fruit pests and diseases. This will include a review of the biological consequences of a mix of varieties. In addition, economic data of culture are measured and evaluated with known data.

Keywords: mix of varieties, apple scab, *Venturia inaequalis*, pests

Introduction

Most commercial fruit growing farms handle just a few *Malus* species over a large area. These genetically identical plants have an increased risk for the occurrence and spread of insects and fungal organisms especially *Venturia inaequalis* (Kellerhals et al., 2003). Aim of the project was to determine whether mixed orchards can contribute the abundance of pests and diseases. Additionally the work processes of mixed orchard and monoculture are compared to show whether possible economic disadvantages could be balanced by advantages of a variety mix like lower use of plant protection agents.

Material and Methods

The trial orchard is located in a typical organic fruit farm at the area "Altes Land". The orchard was divided into a mixed orchard and a monoculture system (Fig. 1). Each system consisted of four *Malus* species growing on M9 rootstock with a planting distance of 1.2 m in rows and 3.8 m between rows. The mixed orchard consists of 1.800 trees; the pure orchard consists of four species, each consisting of 120 trees planted in two rows. In the mixed orchard the varieties are the same as in the monocultures. Within the variety-mix always two trees of one cultivar standing next to another were combined to one unit. This "two-tree units" have the greatest possible distance within and between the rows.

Caused by the young age of the orchard, the differences are actually comparatively small. For this reason, only the actual situations concerning to apple scab as an example for fungal diseases as well as economically data are shown below. Furthermore investigations concerning powdery mildew (*Podosphaera leucotricha*), apple sawfly (*Hoplocampa testudinea*) and red spidermite (*Panonychus ulmi*) are done.

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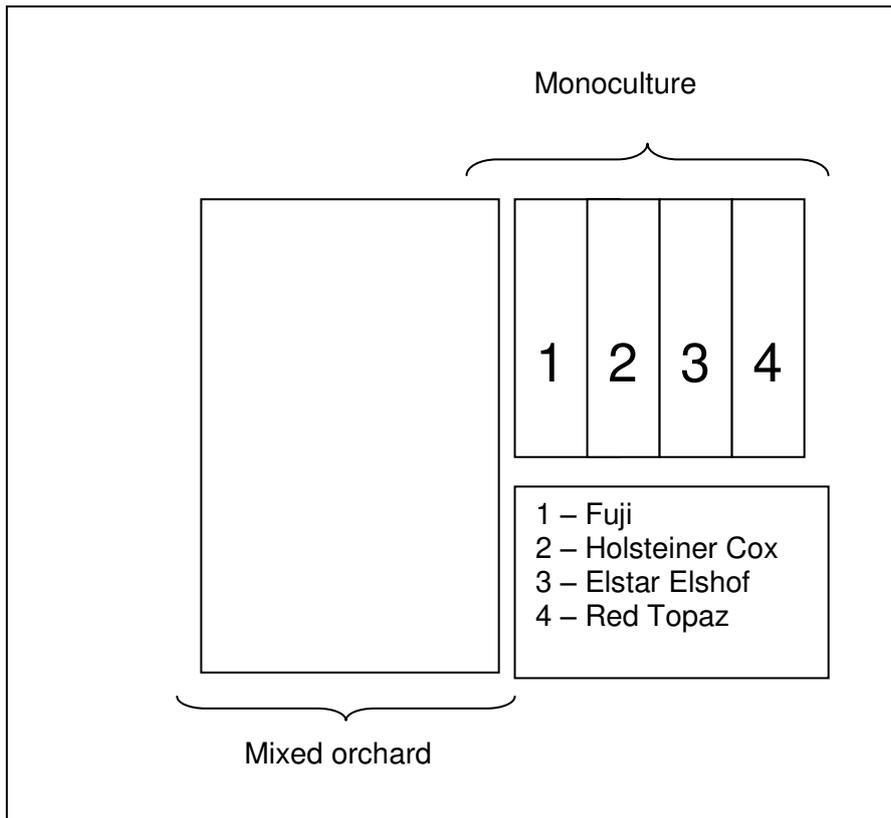


Figure 1: Planting plan mixed orchard and monoculture (not to scale)
(Fieger-Metag, N., 2009, modified)

Orchard management and plant protection was done by the fruit grower. Treatments were applied with a tractor mounted sprayer. During the first year of planting no plant protection products were used. 2008 and 2009 plant protection products and application rates in the trial and the remaining fruit farm were the same. In 2010 plant protection measures in the secondary scab season were reduced.

The collection of economical data and the monitoring of possible pest infestation is the most important matter to be attended.

Results

The results of investigation, based on observed changes in pest infestation and apple scab are not affected by extreme differences in data. In 2010 the primary apple scab infections were particularly high. The number of scabbed leaves and fruits were rather low even so the application of plant protection products was reduced in the orchard (Fig. 2). The high susceptibility to scab infections of 'Fuji' was recognized in all observations.

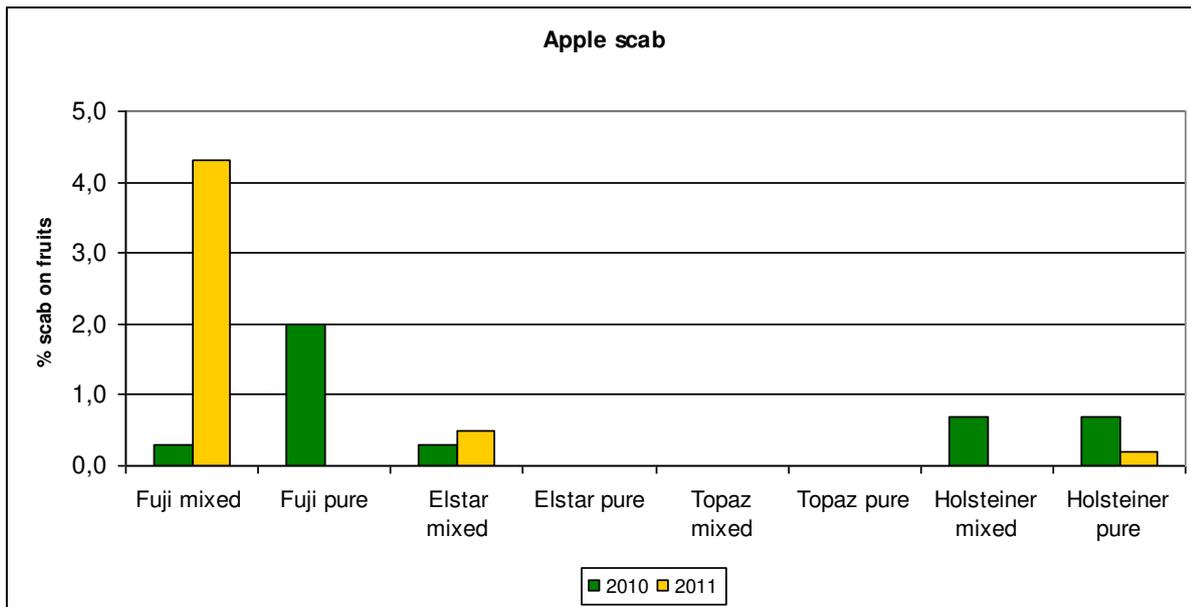


Figure 2: Scab on fruits in 2010 and 2011

Economic data are also used to analyse the effort of tree planting, which was twice as high in the mixed culture as in the monoculture (Beer, M., 2011). Productivity of fruit picking was measured by the picking rate. Differences in rates of pick are due to volume of fruit per tree, tree height and fruit size. The fruit picking rate in the mixed orchard of the *Malus* species Topaz was 1 % lower than in the monoculture. In 'Fuji', however, the difference was about 11 % (Fig. 3).

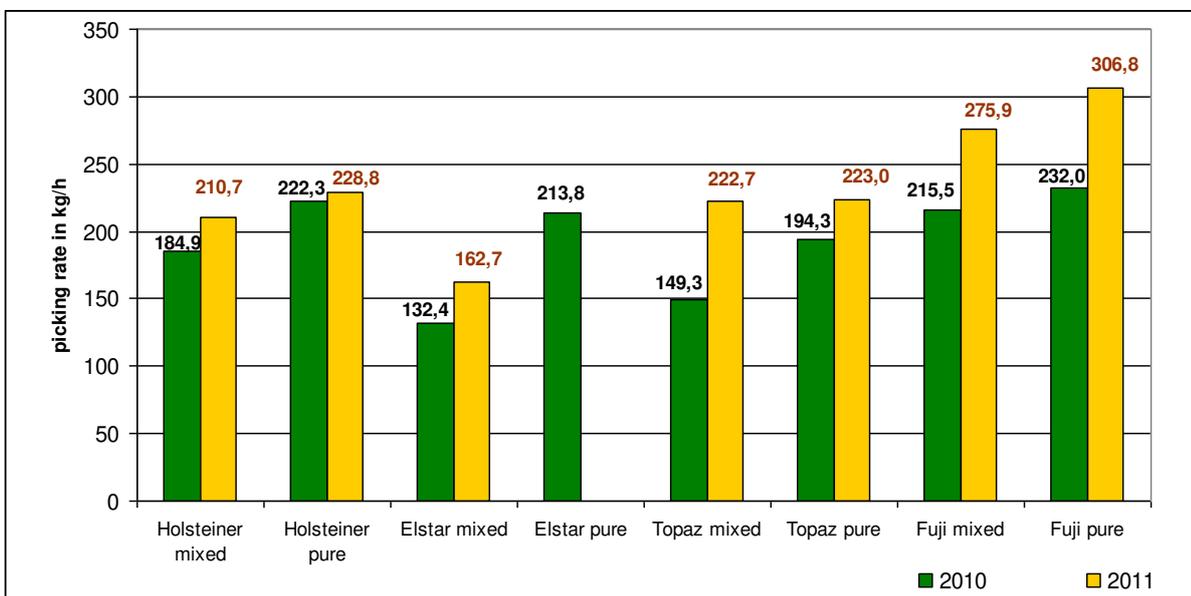


Figure 3: Economic data in both systems 2010 and 2011

Investigations on powdery mildew (*Podosphaera leucotricha*), apple sawfly (*Hoplocampa testudinea*) and red spidermite (*Panonychus ulmi*) do not show any differences in degree of infestation, so far.

Discussion

During the five-year trial, the differences in pests and diseases between the pure culture and the mixed culture stayed on a low level. The high picking rate of 'Fuji' in the monoculture about 307 kg per hour is due to the volume of fruit per tree and the tree height which made harvesting convenient. This will decrease in the following years because those plants grow into larger trees. The effort in the mixed culture will also increase due to the different varieties. Apple trees must be accurately labelled in order that seasonal workers can reap the fruits correctly.

Over the years no significantly differences between mixed plantation and monoculture in consideration of pest infestation and apple scab were observed. It is essential to continue the observation to see whether monocultures have a higher level of pest population than mixed orchards.

Due to the various *Malus species* management of mixed orchards in comparison to monoculture is very time consuming and labour intensive. For mixed orchards efficient harvesting and good logistics are fundamental to be profitably.

The results strongly suggest that further investigations concerning on fruit yield data, efficiency of fruit pickers, time and effort during pest management, plant protection and pruning may need to be done, to give a critical evaluation of the economical characteristic of mixed and mono cultures.

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