Apfel:gut – preliminary results

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Abstract

The Apfel:gut project under the umbrella of the Saat:gut e. V. works intensively in organic apple and pear breeding to develop cultivars that are better suited for organic fruit production. Since the last Ecofruit conference, two new partners joined the Apfel:gut project under the umbrella of the Saat:gut e. V. This group is now comprised of 12 farmers and breeders on nine orchards spread through all parts of Germany.

Apfel:gut is now partnered with the Egon project through the university of Oldenburg. Together we are searching for ways to implement cultivars in a commons oriented way. In the Egon project, the botanical garden in Oldenburg raises new seedlings of the Apfel:gut crosses. Genetic analyses are being performed with seedlings and parental cultivars.

Keywords: Pre-breeding for diversity, heritability, observations for parental selection, funding for organic breeding

Introduction

We would like to report some current results from the organic fruit breeding project Apfel:gut like on the ecofruit conferences 2014 (Ristel and Sattler 2014) and 2016 (Ristel et al. 2016). First fruits of seedlings obtained from controlled crosses, give us a clearer overview concerning heritability of fruit traits.

From 2017 to 2019 the Apfel:gut project has been working together with the ÖON e. V. and the University of Oldenburg in the research project Egon as described in the submitted contribution for the ecofruit 2018 “Research Project EGON: Development of organically bred fruit cultivars in commons-based initiatives” by Wolter et al. (2018). In the framework of this research, project Apfel:gut and ÖON e. V. share the main practical breeding work while the University of Oldenburg is involved in social-science and botanical/genetical analyzation research. An organic apple seedling orchard has been established in the botanical garden of Oldenburg and genetical analyses with SNP’s are being conducted to optimize parental selection.

Material and Methods

We cultivated about 1600 seedlings/year from crosses between heirloom and modern varieties, selecting only under outdoor field conditions. In sum, the Apfel:gut project grew on in the last two years with two more farmers and one more mobile breeder being now active partners. Figure 1 gives an overview, where and whom the active Apfel:gut partners are.

In February 2016 and February 2017, we cut budwood of our most healthiest 100-200 seedlings/year when they were at least 1,80 m high. This budwood was then grafted on M9 in the organic part of the nursery Fleuren. First trees will be planted onto the ESTEBURG research station and three of the Apfel:gut farms. The trees will then be compared to the original seedling on its own roots, concerning first year of flowering/bearing of fruits, fruit size, growth habit and ripening time.

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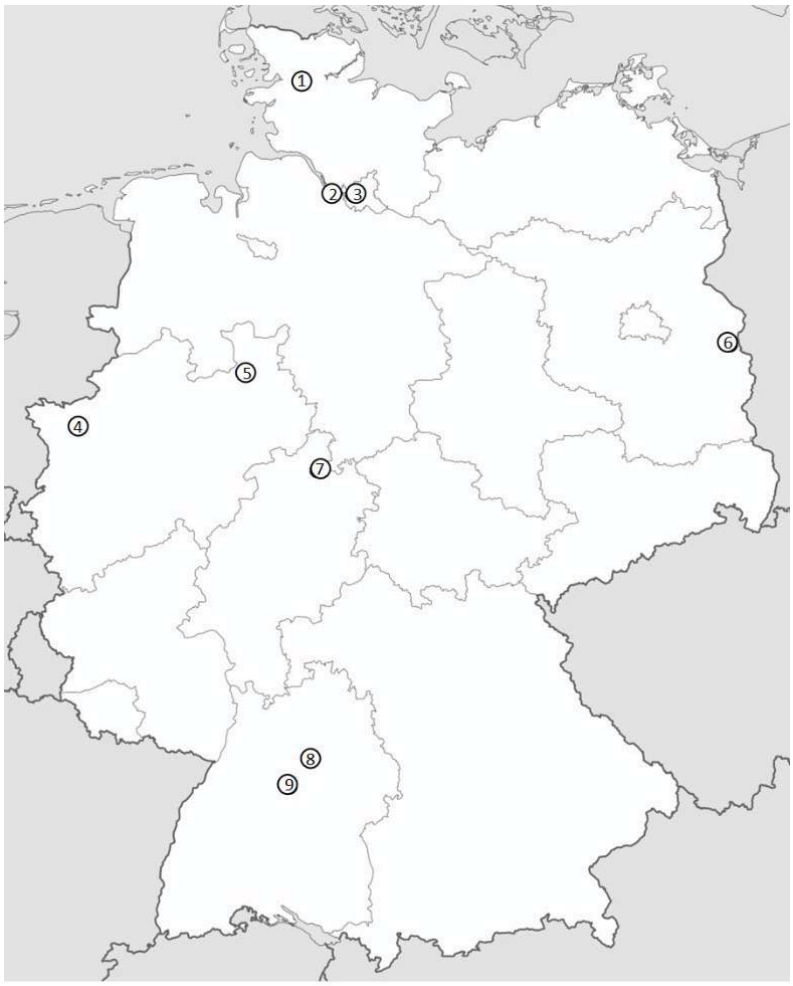

Legend

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4 = Rolf Clostermann, Wesel-Bislich

5 = Hans-Joachim Bannier, Bielefeld

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7 = Thomas Mauer, Kassel

8 = Lukas & Georg Adrion, Backnang

9 = Reinhard Ortlieb, Stuttgart-Uhlbach

Figure 1: Map showing the nine Apfel:gut locations and the main partners(Wikimedia 2017, adapted by Maren Bornemann)

Results

Concerning parental cultivars, we have harvested mainly fruits of progenies derived from the parental cultivars listed in table 1.

Table 1 provides a spotlight for some important parental cultivars used in this project. We use the term “vitality” as an indicator for a sufficient plant growth and shining green leaves even under biotic and abiotic stress conditions. The term robustness is used for a very high level of tolerance to diseases, such as scab (*Venturia inaequalis*) and canker (*Nectria galligena*), which may occur but only at low levels. These observations were mainly made in northern Germany, while the more southern orchards are younger and did not bear as many fruits yet. In the rather cool and humid climate of northern Germany, the mildew (*Podosphaera leucotricha*) pressure is low. Other factors are much more important once seedlings bear fruit, so mildew observations are not included in table 1.

The apple selection 232 and pear selection B30 described in our previous report (Ristel et al. 2016) performed well again in terms of yield on their own roots. On M9 rootstock, 232 set many fruits already in the second year in the nursery, but B30 on Quince A without intergrafting did not yield sufficiently yet. The 232 would be interesting for home gardens and direct sellers because of high robustness combined with a very nice aromatic taste. For commercial cultivation, the stalk is too short, it is not red enough, and it does not store longer than Alkmene. We hope to find a fitting rootstock/intergrafting for B30. If we do, it will be a variety suitable for commercial growers because of its very good fruit quality and storability.

We could observe some pear scab (*Venturia pirina*) on leaves and fruits, but no twig scab yet under high scab pressure conditions, so at least a minimum plant protection will be recommended for B30.

Table 1: First observations on Apfel:gut offsprings.

Variety	Observation on offspring	
	Negative	Positive
Alkmene	scab on fruits	vital leaves
Allurel	canker, scab on leaves, russeting on fruits	fruits with good texture and crunchiness, high level of juice and sugar
Beauty of Bath	Canker	scab resistance on leaves
Corinna	low fruit quality	high fertility
Discovery	Canker	scab resistance on leaves
Gelber Münsterländer Borsdorfer	low fruit quality	high plant vitality
Goldrush	partner with high scab robustness needed	fruits with good texture, hardiness and storability
Natyra	scab on fruits	crispy fruits
Pristine	Some seedlings suffer of Elsinoe (*Elsinoe pyri*) spots	fruits with good texture, scab resistance on fruits
Realka	Elsinoe spots, scab in tree nurseries in the Netherlands	high level of scab resistance in Northern Germany
Rewena	Elsinoe spots, low level of plant vitality, low fruit quality	good coloring of fruits
Rosana	Canker	high productivity
Seestermüher Zitronenapfel	low level of outer fruit quality	high level of plant vitality, good fruit sizes, scab and canker robustness
Strauwalds neue Goldparmäne	to be determined	high level of plant vitality, interesting fruit aromatics, scab robustness
Topaz	low level of plant vitality, low level of plant robustness	high fertility

Discussion

Table 1 shows heritability of some under-utilized apple cultivars in breeding. With many other heirloom cultivars, we simply do not know yet which will give us the cultivars for tomorrow. For certain traits, especially fruit texture, we have the working hypothesis that the combination of these heirloom with modern culivars through crossbreeding is an efficient way for an organic variety development. Concerning breeding goals, we do question if non-russeting is the right criterium. We know big retail chains reject e. g. Elstar if it is russeted, at least in years with enough fruit - 2017 has been an exception in Europe because of the strong frost events in spring. However, sooty blotch and flyspeck disease occurs much less on russeted cultivars (Weber et al. 2016) and they can be recognized by consumers due to their russeting. Direct sellers report that the russeted cultivar Wellant sells even better than non-russeted cultivars. This can be explained by a high level of inner fruit quality. For us, russeting is not necessarily negative as listed in table 1.

Apfel:gut partners will discuss in 2018 whether to register apple 232 as an amateur variety or not. We will do more testing with the pear B30 until 2020 e. g. on the rootstock Pyrodwarf. We are optimistic that other cultivars will follow after 2020, but we want to evaluate them properly, which will take at least 15 years from the cross to the registration.

Besides the practical breeding questions, organization of funding is a primary concern, limiting our breeding efforts. The project started and continues with support from the "Saatgutfonds der Zukunftsstiftung Landwirtschaft" and Software AG foundation. For the intensification and growing of the Apfel:gut approach over the last years, public funds are and will be necessary. One application at the Federal Office for Agriculture and Food (BLE) and another one for the EU research program Horizon 2020 were rejected. These processes let us discuss how we can organize a long-term funding concept. In our opinion, public sponsorship should also be given to organic breeding work itself and not mainly the breeding research. The Egon project is one example how such funding might work for us. Though the Egon project secures some part of our work, we search strongly for funding to be able to continue our research after 2019.

We look on a phenotypical level for plants which do not inherit susceptibility, especially against scab and canker. For some cultivars, such as Corinna, Seestermüher Zitronenapfel, and Strauwalds neue Goldparmäne, we already seem to have found examples for naturally non-scab- nor canker-susceptible inheriting cultivars. We will focus on these instead of trying to pyramid monogenic dominant resistance genes.

The context of our breeding work has changed in some aspects, as we grew in people, orchards, and capacities. The motivation to resist genetic engineering techniques, e. g. CRISPR/Cas, ODM, remains, as so called new gene-technologies threaten the organic breeding model (Nuijten et al. 2016). We are even more encouraged than before to show that it is not necessary to intervene on the DNA level of a plant to fulfill our breeding goals (Rudolf 2017). In some cases, creativity in parental selection and diverse environmental conditions seem to be key factors for finding resilient cultivars for future needs.

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