Comparison of Rootstocks Geneva 16, M9 and CG11 under organic cultivation at the LVWO Weinsberg 2009-2013

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Abstract

A comparison of the cultivar 'GoldRush' grafted on the rootstocks Geneva 16 (weaker than M9), M9 (as standard) and Geneva CG11 (stronger than M9) is going on in the organically cultivated part Q 624 of the LVWO Weinsberg since February 2008. Data were evaluated about growth of the stem, flower setting, fruit-setting, effort for thinning by hand, yield, colour- and size-sorting. Over five years the rootstock Geneva 11 had a positive effect on the yield, size and colour of the fruits, the yield was slightly more balanced (better relation growth:yield). 2013 was the first year, when differences were seen at russeting, trees on CG16 had about 10 % more apples with middle russeting. Breakdown of scab-resistance has been watched in the organic orchard of the LVWO Weinsberg since 2008, 2013 was a year with an extreme infection level of Venturia inaequalis*. Sprayed with the same organic scab-strategy, the trees on CG11 had some more scab-infections on the leaves and on the fruits in 2013 because of stronger growth, so additional evaluations were done about the infestation level of scab and sooty blotch.*

Keywords: Rootstocks Geneva 11 and 16, organic apple growing, yield, scab infections

Introduction

In 2001 a European exact trial started on several research institutes in middle Europe about the comparison of rootstocks, which should be less susceptible against fire blight, in combination with the variety 'Golden 'Delicious'. This trial was grown under conventional conditions, but showed good results even at the sites Klein-Altendorf and Weinsberg for the rootstocks G 16 and CG11, which were estimated either a little bit weaker or a little bit stronger than standard M9 T 337. Based on these results three new trials were planted at research institute in Weinsberg, two conventional trials with the varieties 'Pinova' and 'Gala'. At the same time a third trial started in the organically grown orchard of Obstversuchsgut Heuchlingen with the variety 'GoldRush', which was chosen as a variety, which is only low susceptible for fire blight and which shows changes in average fruit weight and in alternate bearing depending from adjusted crop load either by thinning strategies or by using adequate rootstocks. The results of this trial will be presented in this article.

Material and Methods

The unifactorial trial was planted in February 2008 with distance of 3.5 m x 1.2 m in the organic research plot of Obstversuchsgut Heuchlingen. Because of varying grafting success in the nursery only two replications were planted for three rootstocks: 2 x 12 trees on CG16, 2 x 10 trees on M9 and 2 x 8 trees on CG11 (at time of grafting the availability of the rootstock CG11 was not so good). In 2008 flower clusters were removed to encourage the growing in the first year after planting. In the following years no thinning by lime sulphur or rope thinner during blossom was done, only thinning by hand one or two times depending from each crop load, at high crop loading first time at end of May.

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The following evaluations were done every year from 2009 to 2013 **per tree**: Intensity of flowering at phenological stage full blossom (1-9, 1 = no flowers at all, 9 = white blossom), bearing index (1-9, 1 = no fruits at all), number and kg/tree at harvest. During each winter the diameter of the trunk has been measured. The yield of each parcel of the rootstocks was sorted by a GREEFA-sorting machine. In order to make visible the influence of the rootstock in the data, which was clearly observed at harvest in the orchard, special classes were defined to distinguish the single shades of yellow or green: dark green, green-yellow, light yellow and golden, all with/without red cheek.

Size was divided into 8 classes (< 60 mm, 60-65 mm etc. up to 85-90 mm, > 90 mm). Altogether from combination of colour and size 64 classes of quality were sorted, so that either only the colour or only the size could be estimated or either four groups of quality could be cumulated as clue for marketing value: “bad, only for juice” (dark green or < 65 mm), middle (> 65 mm, green-yellow), good (> 65 mm, light yellow) or excellent (> 65 mm, golden colour). The content of acid, sugar and vitamin C was determined of an average sample per rootstock every year. When sorting the apples of the trial for selling the weight of all apples sorted out was assessed and an average sample was controlled, which diseases or insects mainly caused the damages.

2013 was an outstanding year concerning the infection level for *Venturia inaequalis*, differrences were seen between the rootstocks about infection on the leaves of the young shoots and later on the fruits at harvest, even if the plant protecting measurements were the same on the whole trial. So 2 x 25 shoots per rootstock were evaluated about scab infections at beginning of July, each leaf got a note between 1 and 4 (1 = no scab, 4= heavily scabbed), after harvest a sample of 2 x 100 apples per rootstock was determined in a similar way, but combined with assessment of sooty blotch (5 classes) and russeting (B1-B4, B1 = no russeting, B2 = 0-10 %, B3= 10-30 %, B4 =>30 % russeted skin).

Results

From all years the most important data about flowering setting and yield were described in table 1, outstanding data were marked grey. In 2009 the trees started with a uniform level of flowering setting of 5,6 to 7,5 and was adjusted to approximately 30-40 per tree by thinning by hand. Between the years only moderate alternating bearing has been observed, not as heavy as it was seen in the older trial with ‘Golden Delicious’. CG11 started in 2010 with some trees alternating, but this equalized in the following years. The time for thinning by hand was stopped at each pass, but depended more on the intensity of flowering than on the rootstock, calculated per ha between 150 and 200 h/ha were necessary.

Partly the apples grown on CG16 were about 5 mm smaller than M9 (see figure 1), the trees had a more compact canopy than M9, but the accumulated yield from 2009-2013 was comparable to M9, even the proportion > 65 mm. In years with less rain the trees on CG16 grew too weak, the trees on CG11 were adapted better. CG11had a significantly higher total yield (2009-2013) and higher cumulated yield >65 mm than M9 (see table 1, ANOVA oneway, tukey-test, α=5 %), in the single years no significant differences could be seen. CG11 influenced sorting of size (figure 1), average fruit weight and colour of the apples (figure 2) in a positive way. The higher proportion of golden and yellow apples was a striking detail, so that the increased percentage of the apples with excellent quality for the market was a clear advantage of this rootstock, it was combined with an increased content of sugar or lower content of acid, too.

Table 1: Flowering intensity, bearing index (notes 1-9), yield (number and kg/tree), average fruit weight (g) of organically grown 'GoldRush' on the rootstocks CG16, M9 and CG11 (P1 =parcel 1, P2 = parcel 2) in the years 2009-2013, additional % of middle+heavy russeted fruits in 2013

year	characteristic	G 16 P1	G 16 P2	M 9 P1	M9 P2	CG11 P1	CG11 P2
2009	flowering intensity	7,0	7,1	7,5	7,1	6,0	5,6
	bearing index	6,5	6,9	7,5	7,3	6,3	6,1
	apples/tree	30	40	37	31	34	37
	kg/tree	6,95	8,81	8,08	7,17	8,76	8,52
	fruit weight (g)	228	221	219	230	260	230
2010	flowering intensity	6,4	6,6	6,7	6,8	7,1	4,4
	bearing index	6,4	6,0	7,0	7,2	7,4	5,6
	apples/tree	57	50	73	60	117	65
	kg/tree	10,20	8,10	12,34	10,73	19,33	12,15
	fruit weight (g)	179	162	170	179	165	186
2011	flowering intensity	5,6	6,8	5,5	5,6	3,5	6,6
	bearing index	5,2	6,5	4,9	4,8	2,1	5,4
	apples/tree	74	79	48	40	15	75
	kg/tree	9,43	10,94	6,64	5,71	2,19	11,78
	fruit weight (g)	128	138	139	141	151	157
2012	flowering intensity	7,3	6,6	6,9	7,4	8,1	7,0
	bearing index	7,2	5,8	6,7	7,1	7,3	6,9
	apples/tree	86	54	65	74	116	98
	kg/tree	12,77	8,16	10,22	11,17	16,82	14,35
	fruit weight (g)	148	150	157	150	146	146
2013	flowering intensity	6,9	6,8	6,5	6,6	4,8	6,0
	bearing index	6,9	68	7,0	7,1	5,9	6,9
	apples/tree	143	139	136	133	124	159
	kg/tree	18,81	17,02	16,42	15,29	18,06	18,40
	fruit weight (g)	132	122	120	115	146	116
	russeting % B3+B4	19,1	14,2	4,0	3,8	4,2	3,7
2009-2013	kg/tree total	58,16	53,03	53,70	50,07	65,15	65,21
	kg > 65 mm	45,51	41,86	42,31	37,91	56,45	51,83

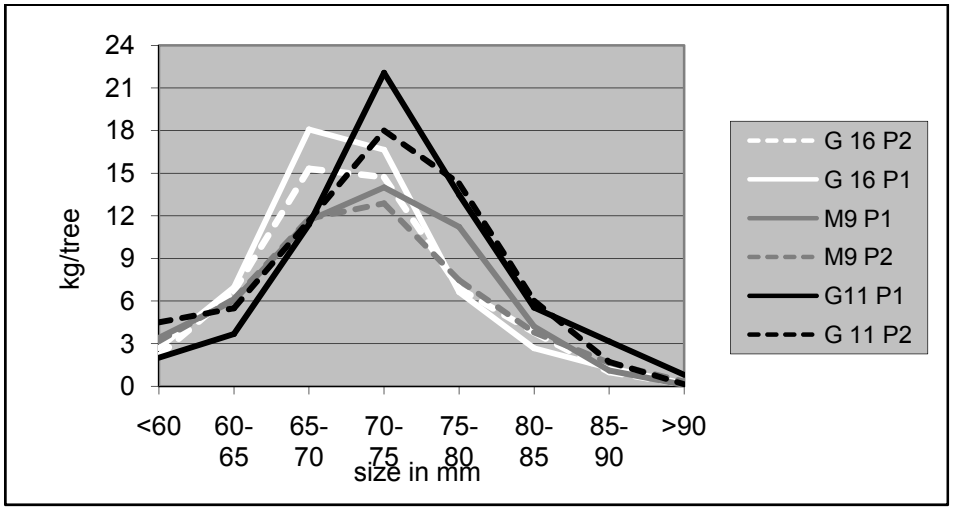

Figure 1: Size grading of organically grown 'GoldRush' on rootstocks CG16, M9 and CG11, cumulated yield (kg/tree) 2009-2013

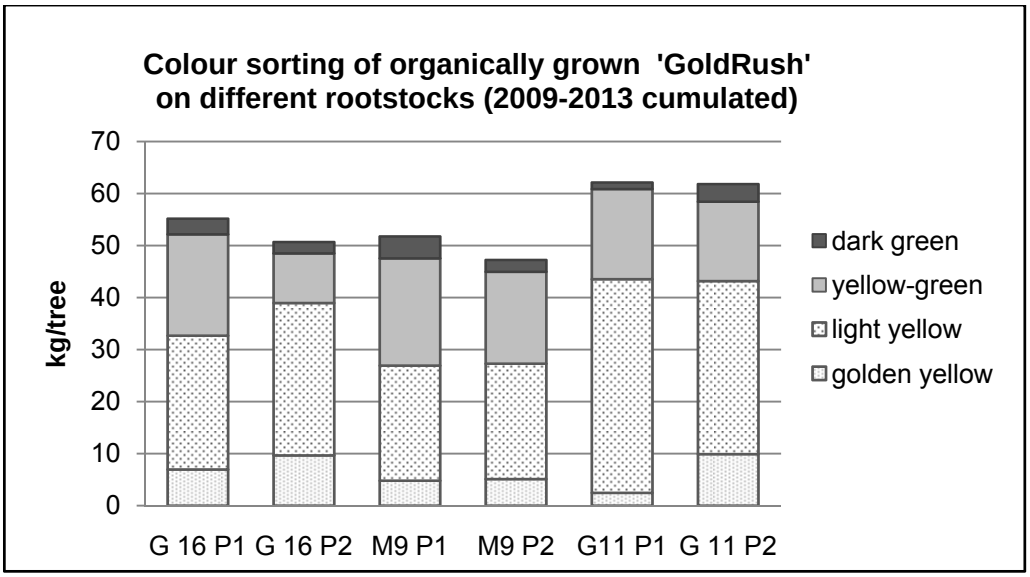

Figure 2: Results of colour sorting (four classes of base colour) of organically grown 'GoldRush' on rootstocks CG16, M9 and CG11, cumulated 2009-2013 (kg/tree).

In the years 2009-2012 no differences in scab in infections could be observed in the trial, only single apples had weak symptoms, but in 2013 there were found clear differences, because of variation only significant at α= 10 %, nonparametric Kruskal-Wallis-test), which can be put down to the stronger growth of the trees on CG11 in the main infection periods this spring. Partly the number of leaves/shoot was higher, partly the infection level of the leaves was increased (figure 3), which can be changed at the same weather conditions by the leaf area or by the content of nitrogen in the leaves, both parameters could be influenced by stronger growing rootstocks. The same tendency was found at harvest looking at the fruit infections by scab, the infections on the leaves from June of this special scab-race produced high amount of conidia, which led to severe damages in combination with a very humid autumn.

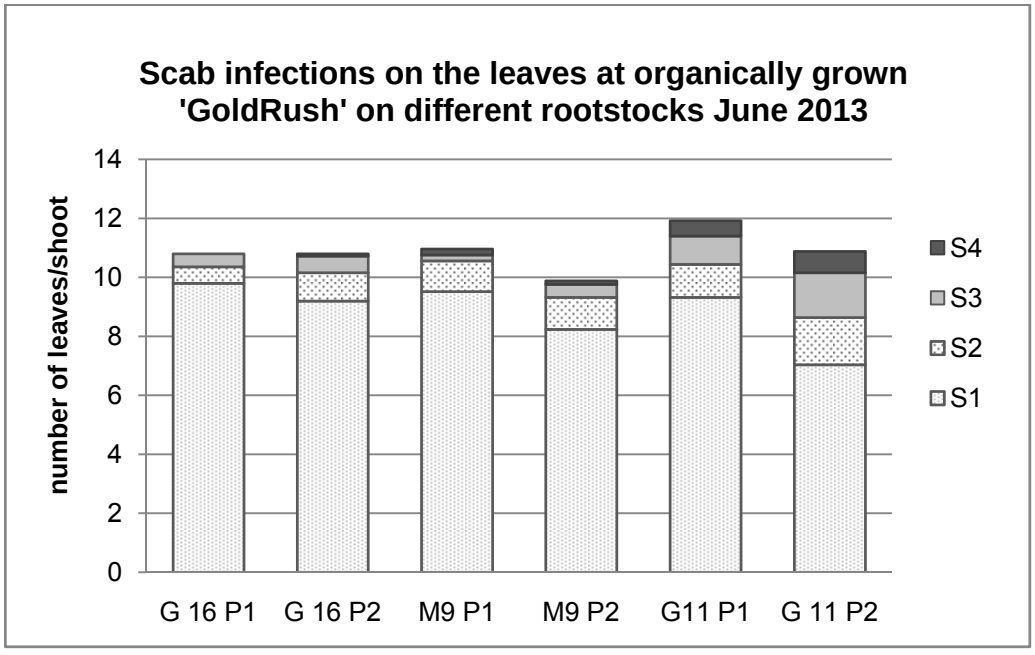

Figure 3: Number of leaves/shoot of 'GoldRush' in June 2013, divided in 4 scab-classes (S1 = without, 4 = heavy scab), depending from rootstocks CG16, M9 and CG11.

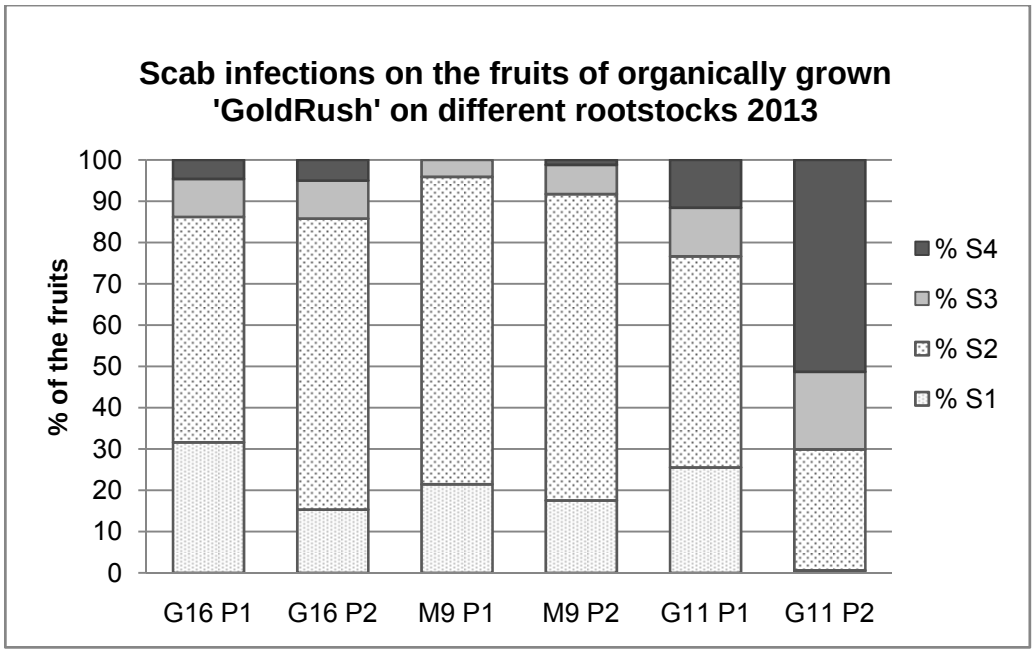

Figure 4: Percentage of fruits of 'GoldRush' 2013 with fruit-scab, divided in 4 scab-classes (S1 = without, 4 = heavy scab), depending from rootstocks CG16, M9 and CG11.

Discussion

Guerra (2011) showed similar trends and remarked, that for CG11 tissue culture propagation is recommended, because the rootstock is less willing to produce runners in rootstock nurseries, on the other side CG16 seemed to be susceptible for latent viruses in his trials. In spite of the results about scab in an extreme scab season 2013, the rootstock CG11 should be tested also in private organic grown orchards, because the results about yield and colour had the same tendencies like in the previous trials and in the parallel trials at LVWO Weinsberg in the conventional part with the cultivars 'Gala' and 'Pinova'.

Even if the trees grafted on CG11 would be more expensive, the system has economic advantages: When a price of 1 € per kg for marketable apples and 16 Cent per kg cider-apples is assumed (based on the data, where the amount of apples, which were sorted out, is respected over five years), CG 11 had about 4100 € higher proceeds than M9 per year and ha. The spraying strategies should be adjusted to the growth characteristics of this rootstock, the costs per ha for one additional treatment with wetting sulphur can be estimated at 50 € per ha (costs for worker, use of tractor, and sulphur product).

Acknowledgements

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