

## Which factors had the largest influence on the marketable yield of five pear cultivars under organic conditions?

B. Pfeiffer<sup>1</sup>

### Abstract

*Since 2009 five pear cultivars ('Concorde', 'Conference', 'Novembra', 'Uta' and 'Gerburg') have been tested under organic conditions at the LVWO Weinsberg. Different spraying strategies against scab were compared, in one row the trees were trained in a Mikado-System. Not for all cultivars this system was senseful. The sprayings against scab had big influence on the russeting of the pears and on the part of marketable fruits, too, less on the fruit-setting. Regarding different parameters (susceptibility to frost during blossom or to dry and hot wetter in summer, e.g.), the cultivars 'Gerburg', 'Novembra' and 'Uta' were the best, but spraying strategy should be adjusted to the cultivar.*

**Keywords:** Pears, organic fruit growing, yield, russeting, fruit setting

### Introduction

Especially in southern Germany there are tendencies to extend the planting areas of organic pears, because in spring there are too less organic pears from regional production, they were mainly imported from the southern hemisphere. So the main topic of this article are results about suitability of five pear cultivars to organic production regarding factors like yield, susceptibility for pear scab, influence of scab spraying on fruit setting and russeting, additionally it was proofed, if the Mikado-training-system is advantageous to yield, scab infections or fruit quality.

### Material and Methods

The trial started in November 2009 with distance of 3.5 m x 1.5 m in the organic research plot of Obstversuchsgut Heuchlingen. The trees were two years old, the rootstock quince Adams with interstem 'Gellerts Butterbirne' was chosen to avoid incompatibilities. In each of the five rows all five cultivars were planted, one row was designed similar to Mikado-system, the others as cultivation system with pillar trees, so within the same row the effects of the same spraying strategy could be compared within the cultivars 'Concorde' (12 trees/row), 'Conference' (7 trees), 'Novembra' (12 trees), 'Uta' (11 trees) and 'Gerburg' (10 trees). Additionally it could be proofed, how the same cultivar reacted to different spraying strategies.

The following data were evaluated for every single tree separately in the years 2011-2015: Measuring of increasing of the diameter of the stems, blossom setting (note 1-9), bearing intensity (note 1-9) and yield. In case of frost the percentage of damaged flowers was estimated for a small sample of flowers. Fruit setting was assessed in 2011 and 2013 by counting at each cultivar in each row at 5 trees the number of pears/blossom-cluster at the blossom clusters of two lateral branches and of about one m of the central leader (no pears/blossom-cluster etc. up to max. 7 pears/blossom-cluster).

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<sup>1</sup> Staatliche Lehr- und Versuchsanstalt für Wein- und Obstbau Weinsberg, Traubenplatz 5, D-74189 Weinsberg, barbara.pfeiffer@lvwo.bwl.de

In 2014 and 2015 the detailed evaluation for fruit setting was done only at 'Conference', 'Novembra' and 'Gerburg'. But assessment of all trees of these cultivars was changed according to thinning trials in apples to counting the number of clusters of blossoms/tree and the number of pears/tree at end of May, before a light thinning by hand was done. Different spraying strategies could be compared in 2011+2013 (details see Sinatsch *et al.* 2014), in 2012 the blossom setting was very low and flowers were severely damaged by frost. In 2014 the same strategies were tested as in 2013, in 2015 the cultivars were treated uniformly (3 x wetting sulphur round blossom), because the flower-setting was only on a middle to low level except for 'Novembra'.

In 2011 and from 2013 to 2015 the russetting of a sample of 50 pears per combination of cultivar and spraying strategy was estimated using the notes 1 to 9 (1 = without and 9 = very strong russetting). Pears from 'Uta' have normally a nearly completely russeted skin, they were left out at this evaluation. After the harvest the fruit infections by scab were divided into four classes: from S1 = without scab up to S4 = strong infection. Size was divided into several classes (< 50 mm, 50-55 mm etc. up to 90-95 mm, > 95 mm, according to the single cultivars). 2014 for the first time average samples of the pears were sliced to control, if the treatments had influence on the number of pits per pear.

## Results

The development of the average of flower setting during the period 2011-2015 is described in table 1. 'Novembra' tended clearly to alternating bearing and was affected the most by the frost incidents in 2011 and 2012.

Table 1: Flowering intensity (notes 1-9, 1 = no flowers at all, 9 = "white blossom") of five pear cultivars under organic cultivation conditions 2011-2015, yield kg/tree cumulated 2011-2015 (unsorted)

cultivar	Row	2011	2012	2013	2014	2015	kg/tree 2011-2015
Concorde	2 spindle	7.8	3.6	4.3	4.8	3.6	15.19
	3 spindle	7.4	3.8	3.9	6.0	4.0	19.74
	4 spindle	7.8	4.3	3.8	6.2	3.6	21.30
	5 Mikado	7.3	2.3	6.1	4.5	5.4	24.70
Conference	2 spindle	7.3	2.3	6.0	3.3	7.1	23.74
	3 spindle	8.2	3.2	6.0	4.8	6.3	29.75
	4 spindle	7.4	3.0	6.7	4.1	6.9	28.50
	5 Mikado	7.3	2.0	6.7	3.9	5.7	29.67
Novembra	2 spindle	8.6	2.9	8.8	3.3	6.9	27.51
	3 spindle	8.3	4.3	9.0	2.7	6.7	24.03
	4 spindle	8.8	4.6	8.9	4.8	6.5	28.99
	5 Mikado	8.8	4.1	9.0	3.1	6.4	30.48
Uta	2 spindle	7.3	2.0	6.6	4.5	4.6	34.03
	3 spindle	6.9	2.1	6.9	4.3	4.8	34.99
	4 spindle	7.5	2.5	7.5	4.5	4.7	34.67
	5 Mikado	4.8	3.2	5.9	5.2	3.4	38.98
Gerburg	2 spindle	7.1	6.2	7.9	6.7	5.0	37.53
	3 spindle	7.5	6.0	7.9	7.3	4.0	31.11
	4 spindle	7.9	6.3	7.9	6.8	3.7	32.50
	5 Mikado	7.9	6.3	7.4	5.9	5.2	36.80

The normal scab-treatments with lime-sulphure (grey marked parts in the table, detailed evaluations about fruit-setting were done in 2011, 2013 and 2014) had no influence on the flower setting in the following year.

The figures 1 and 2 show the results of size-grading (cumulated yield 2011-2015) of the cultivars 'Conference', 'Novembra', 'Uta' and 'Gerburg', for the comparison the data of the rows 4 and 5 were used, which were treated the same in all years (scab strategy based on wetting sulphur). The Mikado-system had advantages for the size of the cultivars 'Uta' and 'Gerburg', the differences were small for the cultivars 'Conference' and 'Novembra'. 'Conference' had the largest proportion of the yield in size-class 55-60 mm.

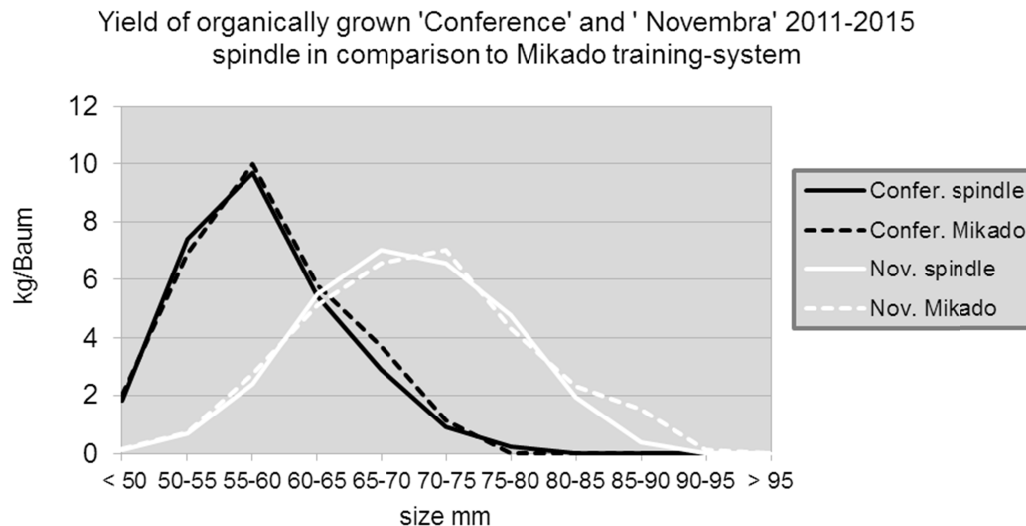


Figure 1: Size grading of organically grown 'Conference' and 'Novembra', comparison of spindle to Mikado training system, cumulated yield (kg/tree) 2011-2015.

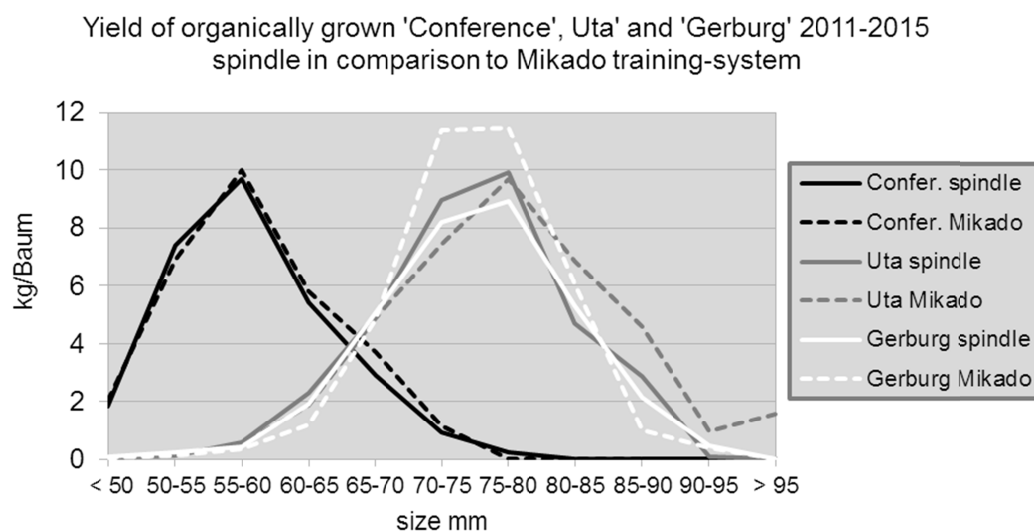


Figure 2: Size grading of organically grown 'Conference', 'Uta' and 'Gerburg', comparison of spindle to Mikado training system, cumulated yield (kg/tree) 2011-2015.

One of the most important characteristics, that caused a reduction of the proportion of marketable pears, was the reaction of the cultivars to spraying strategies in the form of russetting (in combination with weather conditions).

Table 2: Percentage of pears in different classes of russeting in 2014 and 2015 (B1 = no russeting, B5 = middle, B9 = very strong russeting) depending on different spraying strategies (sp. = spindle, Mik. = Mikado-system, NS = wetting sulphur, stand. = standard strategy).

Cultivar	Row	treatment 2014	% B1+B3	% B5	% B7	% B9	treatment 2015	% B1+B3	% B5	% B7	% B9
Concorde	1 sp.	control	92	8	0	0	control	96	4	0	0
	2 sp.	lime sulphur	30	58	8	4	NS stand.	60	34	6	0
	3 sp.	NS raised	74	22	4	0	NS stand.	54	36	10	0
	4 sp.	NS stand.	62	34	4	0	NS stand.	58	42	0	0
	5 Mik.	NS stand.	67	31	2	0	NS stand.	76	24	0	0
Conference	1 sp.	control	8	55	35	2	control	42	40	18	0
	2 sp.	lime sulphur	0	4	20	76	NS stand.	12	36	36	16
	3 sp.	NS raised	4	33	44	19	NS stand.	2	32	52	14
	4 sp.	NS stand.	0	14	40	46	NS stand.	10	46	36	8
	5 Mik.	NS stand.	10	44	46	0	NS stand.	16	46	36	2
Novembra	1 sp.	control	40	54	6	0	control	96	4	0	0
	2 sp.	lime sulphur	0	18	41	41	NS stand.	66	30	4	0
	3 sp.	NS raised	3	60	35	3	NS stand.	78	22	0	0
	4 sp.	NS stand.	15	69	14	2	NS stand.	52	47	2	0
	5 Mik.	NS stand.	36	54	10	0	NS stand.	72	24	4	0
Gerburg	1 sp.	control	91	7	2	0	control	100	0	0	0
	2 sp.	lime sulphur	96	4	0	0	NS stand.	100	0	0	0
	3 sp.	NS raised	96	4	0	0	NS stand.	100	0	0	0
	4 sp.	NS stand.	94	4	0	0	NS stand.	100	0	0	0
	5 Mik.	NS stand.	92	8	0	0	NS stand.	100	0	0	0

2013 (detailed data described by Pfeiffer & Sinatsch, 2014) was a season with strong russeting on the pears especially at 'Conference' and 'Concorde'. Similar tendencies could be seen in 2014 (see table 2), cold nights close to blossom and after blossom enhanced the russeting, too. Again the cultivars 'Conference' and 'Novembra' reacted to the treatments with lime sulphur and wetting sulphur during blossom. In both classes B7 (heavy) and B9 (extreme heavy) the differences to untreated control were for 'Conference' + 59 % (lime sulphur) resp. +49 % (wetting sulphur) and for 'Novembra' +76 % (lime sulphur) resp. + 10 % (wetting sulphur). On the other side the cultivar 'Gerburg' showed nearly no reaction on the scab-treatments during blossom.

In 2015 before the blossom the nights had been cold (first week of April minimum -2.8 °C, in the middle of blossom minimum -0.2 °C), so that the fruit-fall after blossom was strong, russeting was on a normal level. The summer was very dry and extremely hot, so the pears were smaller. The small differences between the untreated control and the treatments with wetting sulphur did not influence the proportion of marketable pears. In both years fruit-scab caused nearly no losses. Sunburst had been only a problem in 2013 as reaction to sulphur treatments at the cultivar 'Gerburg'. One conclusion of five years assessments was that the pears grown in the Mikado-system several times had less russeting than grown as spindle at the same scab strategy, even if it was difficult to explain.

'Concorde' had too low yields (see table 1), the pears could not be stored very long, besides the loss of trees in the year 2014 by infections of fireblight was the highest due to infections during blossom. Combining the middle yield, the smaller fruit-size and the

increased russeting the overall impression of 'Conference' is only mediocre. On the other side 'Novembra' (unfavourable are the susceptibility for frost during blossom and the tendency to alternate bearing), 'Uta' and 'Gerburg' (except for a light sensibility to fire blight) showed the best results. 'Novembra' and 'Gerburg' had good storage characteristics.

## Discussion

Kienholz & Childs (1951) described, that in conventional pear-growing the specific reaction of cultivars to spraying strategies can lead to increased russeting of pears. The results at the site Weinsberg showed under organic conditions similar tendencies about the influence of scab treatments, when the weather circumstances had stimulated the russeting of pears additionally. Apart from the level of yield russeting was a very relevant factor for the proportion of marketable pears. In the marketing structures of wholesale there are tendencies to place more demands on the optical quality of organic grown pears. About training of the trees the Mikado-system is worth to be chosen in organic production, too, if the width of the upper wires is not too large and the rods are fixed at a second lower wire, so that mechanical weed control with machines like Ladurner is not obstructed. 'Uta' had useful results in this combination of rootstock and interstem, when pruning was done late and enough thin branches with blossom-clusters remained in the trees. The impression was, that pollination situation was good in this mixed pear orchard. Skramlik *et al.* (2009) tested different pollinators for 'Uta'. At the site Weinsberg a light thinning by hand was necessary every year.

At the cultivar 'Novembra' the characteristic of alternating bearing should be respected at pruning, too, so that a good mixture of one- and two-years-old branches with flower buds remains in the trees. 'Gerburg' was the cultivar, which was the best adjusted to changing climatic conditions over the whole period, an important precondition for good yield was to calm the strong growing branches. At 'Gerburg' wetting sulphur should be used carefully, when the red colour is visible (danger of sunburn in August). The striking advantage was a low susceptibility to russeting combined with a good taste.

## Acknowledgements

Thanks to all colleagues, to the members of Obstversuchsgut Heuchlingen and to our seasonal workers for their engagement during thinning, picking and evaluation season.

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