Influence of water volume and drop size in raspberries

Rudolf Faby, Jens-Peter Ralfs und Kristin Dröge
ESTEBURG Obstbauzentrum Jork
Landwirtschaftskammer Niedersachsen
Spredaer Straße 2
49377 Vechta-Langförden
Germany

Alfred-Peter Entrop
ESTEBURG Obstbauzentrum Jork
Obstbauversuchsring Altes Land
Moorende 53
21635 Jork
Germany

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Abstract

The main disease in raspberries is Botrytis fruit rot. For a good control 3 or 4 treatments with chemicals during the flowering period are needed. A questionnaire in 2010 revealed that the raspberry growers use a wide range of water volumes (300 to 1000 L per hectare) and also apply different nozzles resulting in different drop sizes. In 2010 we started a project to optimize the chemical treatments in raspberries. We compared the application of 300, 600 and 900 L water per hectare with coarse and fine drop size respectively. We measured the deposition of the chemicals on leaves and evaluated the biological efficacy on Botrytis fruit rot and two-spotted spider mites. The deposition trials showed more chemicals on the leaves with the lowest water volume (300 L) and with coarse drop size. There was no correlation between the deposition on the leaves and the control of Botrytis fruit rot and the spider mites. All treatments gave a good result in controlling Botrytis fruit rot, with no differences between the variants. The spider mites live on the bottom side of the leaves. There was no efficient control from the different water volumes. Further trials showed a better efficacy, we used a water volume of 1.800 L per hectare and the air volume was increased from 25500 m^3 per hour to 35800 m^3 per hour.

INTRODUCTION

The main disease in raspberries is Botrytis fruit rot. For a good control 3 or 4 treatments with chemicals during the flowering period are needed. A questionnaire in 2010 revealed that the raspberry growers use a wide range of water volume (300 to 1000 L per hectare) and also apply different types of nozzles with a wide range in drop size. This prompted us to initiate a project to optimize the chemical treatments in raspberries. We measured the deposition of the chemicals on the leaves and evaluated the biological efficacy on Botrytis fruit rot (*Botytis cinerea*) and two-spotted spider mites (*Tetranychus urticae*).

MATERIAL AND METHODS

We compared 300 L, 600 L, 900 L water per hectare with hollow cone nozzles (fine drop size) and flat fan nozzles (coarse drop size) (Table 1). Deposition trials were performed in an 8-year-old plantation(cultivar 'Tulameen') with 3 m row distance. The sprayings were done at the end of flowering (23.06.2010) with the spraying machine Wanner NA32. As fluorescent chemical we used Brilliantsulphoflavin (BSF) with 10 g per 100 L water. The row length of the plot was 10 m with 4 replications per treatment. For characterising spray deposition, plants were divided in 9 sections by separating the different heights (50 – 100 cm, 100 – 150 cm and 150 – 200 cm) and additionally

separating in left side, right side and a middle part (Fig. 1). We took 10 leaves per position, i.e. 90 leaves per plot. BSF was washed from the leaves and measured in a fluorimeter (Kontron Fluorometer Typ SFM25). The leaf area was determined with a scanner (Li-Cor. inc. Leaf Area Meter Typ LI 3100-C) (Raisigel et al., 2004). With both values the percentage of BSF on the leaves was calculated.

The trial for controlling botrytis fruit rot was carried out in a 5-year-old planting with the cultivar 'Tulameen'. Fungicide sprays were applied with the Lochmann APS 4/80 Q-sprayer at four times during the flowering 1) 10.06., 20 % open flowers, Switch (a.i. Cyprodinil + Fludioxonil) 1 kg/ha, 2) 16.06., 60 % open flowers, Signum (a.i. Boscalid + Pyraclostrobin) 1 kg/ha, 3) 23.06., 90 % open flowers, Teldor 50 WG (a.i. Fenhexamid) 2 kg/ha, 4) 30.06., end of flowering, Switch 1 kg/ha. The row distance was 3 m, the plot length 8 m, and 4 replications per treatment were made. The percentage rotted fruits was determined in fruit samples (250 g), which were collected at 5 times over the harvest period (11.07., 17.07., 20.07., 24.07., 27.07.2010).

Trials for controlling two-spotted spider mites were carried out in a 5-year-old 'Tulameen' plantation. The row distance was 3.5 m, plot length 12 m, and 4 replications were carried out. The sprayings were done with the Lochmann-sprayer. The first trial was treated on 19.08.2010 and the second one on 02.09.2010, using the acarizides Vertimec (a.i. Abamectin) 0.5 L/ha and Envidor (a.i. Spirodiclofen) at 0.4 L/ha. The number of mites per leaf was counted before the application and 7, 14 and 20 days later.

RESULTS

The deposition trials with BSF showed a large variation within the treatments, but differences between treatments were clear. 300 L water per hectare gave a higher percentage BSF on the leaves than 900 L, and flat fan nozzles were better than hollow nozzles (Fig. 2). Measurements in the different positions of the plants showed the same ranking. The distribution in the plants was regular, with reduced percentages of BSF in the middle of the plants and at 150 – 200 cm (Fig. 3). This figure shows the results of treatments with the highest percentage BSF (300 L per hectare, coarse drop size) and the lowest (900 L per hectare, fine drop size).

The trial for controlling Botrytis fruit rot gave 42,2 % rotted fruits in the control as the mean value of the 5 sampling dates (Fig. 4). All treatments showed a good efficacy. No evident differences were obvious between the treatments.

In the first trial against two-spotted spider mites we compared 300, 600 and 900 L water per hectare with flat fan nozzles. Before the treatment 5 to 9 mites per leaf were observed (Table 2). 7 days later similar numbers we obtained, with no effects of the treatments. 14 days later the number of mites increased, still without any effect of the sprayings. The reason for these unsatisfying results was that no wetting of the underside of leaves was achieved where spider mites are mainly located.

In the following second trial we increased the air volume about 10.000 m^3/h to 35.800 m^3/h and doubled the water volume to 1800 L per hectare, hoping to achieve improved wetting on the bottom side of the leaves. All treatments reduced the mites significantly, although no differences between the treatments were observed (Table 3).

CONCLUSION

The deposition trial showed the highest percentage BSF on the leaves with the lowest water volume and flat fan nozzles. There was no correlation between this results and the control of Botrytis fruit rot and the two-spotted spider mites. For a good control of

grey mould it is essential to protect the open flowers (Bristol et al., 1986; Powelson, 1960). The deposition of chemicals on the flowers might be different from the leaves. Because of the highest percentage BSF and also a good control of fruit rot with 300 L water per hectare, a reduced amount of water could be useful in practical work. For controlling spider mites as well as aphids, the bottom side of the leaves must be wetted. In the second trial against the mites it was apparent that higher air volume and higher amounts of water can be successful. In the next year we have to optimize the control of pests under the leaves, but also with a view on Botrytis fruit rot, because we want to control pests and diseases with the same spraying. Further deposition trials should separate the upper and bottom side of the leaves in order to generate more information on the distribution of the chemicals in the plants.

ACKNOWLEDGEMENTS

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Tables

Table 1. Treatments in 2010

amount of water per hectare	nozzles	drop size	pressure bar	speed km/h
300 L	ATR brown[1]	fine	7.7	5.5
300 L	AVI 8001, orange[2]	coarse	6.5	5.5
600 L	ATR orange[1]	fine	7.1	5.5
600 L	AVI 8002, yellow[2]	coarse	6,5	5.5
900 L	ATR red[1]	fine	8.4	5.5
900 L	AVI 8003, blue[2]	coarse	6.5	5.5

[1]hollow cone nozzles (Agrotop)
[2]flat fan nozzles (Agrotop)

Table 2. Control of two-spotted spider mites 2010

	number spider mites per leaf		
	19.08.2010 0 days	26.08.2010 7 d.a.t.[1]	02.09.2010 14 d.a.t.[1]
1. control	9.3	11.7	19.8
2. 300 L/ha, coarse	5.2	8.2	11.1
3. 600 L/ha, coarse	5.3	8.1	14.0
4. 900 L/ha, coarse	8.2	5.0	14.0
L.S.D. 5 % (t-Test)	n.s.	n.s.	n.s.

[1]days after treatment

Table 3. Control of two-spotted spider mites 2010 (trial II)

	number spider mites per leaf			
	02.09.2010 0 days	09.09.2010 6 d.a.t.[1]	17.09.2010 14 d.a.t.[1]	23.09.2010 20 d.a.t[1]
1. control	19.8	22.5	13.9	15.1
2. 300 L/ha, coarse	11.1	7.7	3.5	4.8
3. 600 L/ha, coarse	14.0	6.5	5.5	3.9
4. 900 L/ha, coarse	14.0	7.9	3.0	2.4
L.S.D. 5 % (t-Test)	n.s.	5.0	4.0	3.1

[1]days after treatment

Figures

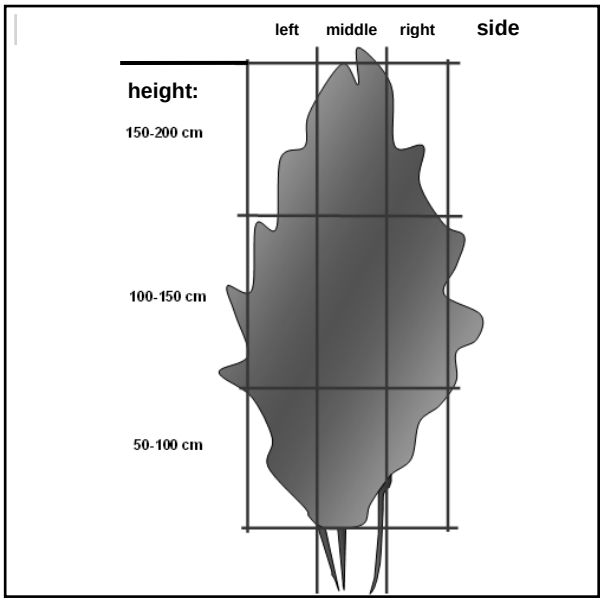

Fig. 1. Collection of leaf samples

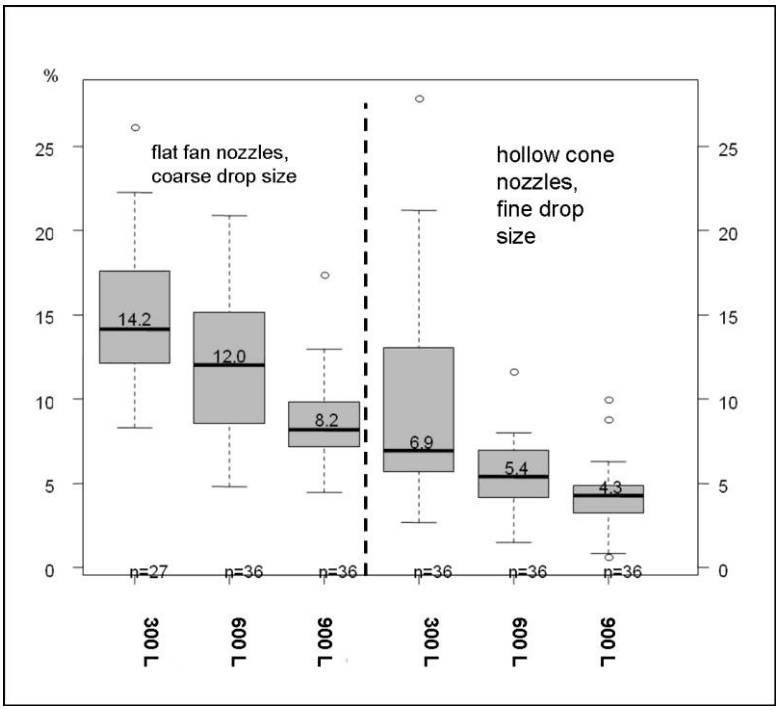

Fig. 2 The influence of water volume and drop size on the BSF (%) on the leaves (mean value of all positions) (median value)

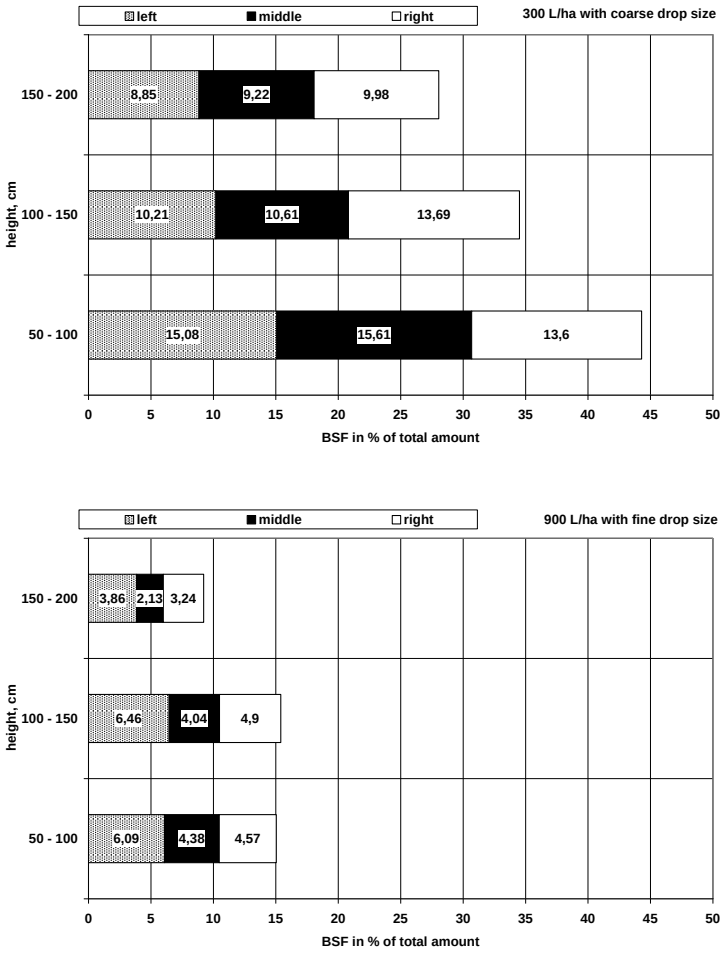

Fig. 3 BSF (%) on the leaves in the different positions in the plants

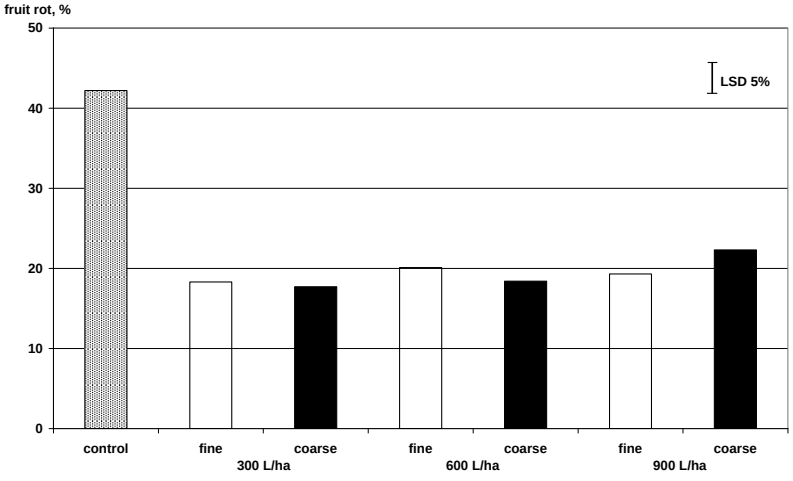

Fig. 4 The influence of water volume and drop size on Botrytis fruit rot (%)