AN ANCIENT COMPOUND REDISCOVERED: PERSPECTIVES OF APHID CONTROL IN ORGANIC HOP GROWING BY THE USE OF QUASSIA PRODUCTS

F. Weihrauch, M. Eckert & B. Engelhard

Bavarian State Research Center for Agriculture
Institute for Crop Production and Plant Breeding, Hop Research Center
Hüll 5 1/3, D-85283 Wolnzach, Germany
E-mail: Florian.Weihrauch@LfL.bayern.de

Abstract

In the first three decades of the 20th century, quassia extract was widely used in hop growing as a chemical agent to control *Phorodon humuli* and other insect pests. In the first years of the 21st century this compound was rediscovered by German organic hop growers. In nine efficacy trials conducted in five field seasons, quassia products proved to be effective control agents for *P. humuli* in organically grown aroma cultivars. As the best method of application a systemic variant was developed by painting a suspension of quassia extract to the bines. This method proved not only to be very effective but was also best from an environmental point of view as sprayed quassia extracts had side effects on non-target organisms. As an optimal systemic application rate 24 g/ha of the active ingredient quassine was determined.

Keywords: *Phorodon humuli*, damson-hop aphid, control, organic hop growing, quassia, *Quassia amara*

Introduction

The earliest materials used to control the damson-hop aphid *Phorodon humuli* (Schrank) by spraying were soft soap, quassia and nicotine. Only in the middle of the 20th century nicotine, the standard treatment of that time, was substituted by more effective compounds such as organo-phosphates (Neve 1991). Hence, especially quassia had the status of a sleeping beauty for more than 60 years, until it was rediscovered as an option for aphid control in organic hop growing in Germany in 2001. At that time, especially the pyrethrines registered for organic farming proved to be not satisfying in aphid control. As extracts made from the wood of the South American tree species *Quassia amara* were on the list of approved substances, German organic farmers started to spray quassia solutions they had extracted by homebrews from wood chips as an alternative. This option of aphid control was accompanied scientifically with efficacy trials from the first day onwards, and was advanced in the following years.

Methods

Altogether nine efficacy trials to test quassine, a pyrethrine (“Spruzit Neu”) and an industrial neem extract (“NeemAzal T/S”) were conducted in the five field seasons from 2002 to 2006 in two organic hop farms, one situated in Herpersdorf, Middle Franconia, Germany (former Hersbruck growing region), and one in Ursbach, Lower Bavaria, Germany (Hallertau growing region). The cultivar for trials was chiefly Perle, one trial each was run in cvs Hersbrucker Spät and Spalter Select. Quassine and NeemAzal were tested as spray and as systemic applications. Quassine in systemic application was tested in three different dosages of the active ingredient (12, 24 and 36 g/ha quassine). Each treatment was replicated in three or four plots. All trials included usually a weekly monitoring of aphids in each plot (50 leaves per plot, respectively) during the entire season, and an experimental harvest. In 2002 and 2003 the weekly monitoring included all beneficials and other non-target arthropods that were found on the assessed leaves.

Results

All trials we conducted during five years yielded good or satisfying aphid control in the quassia variants, both in systemic application of an industrial extract and spray application of a homemade extract from wood chips. Although never 100 % control was achieved, the average numbers of *P. humuli* remaining on the leaves never exceeded a level that might have been damaging to the plants. On the other hand, the control effects determined for Neem Azal – systemic or sprayed – and the pyrethrine were not satisfying or poor. Especially extremely high outliers of aphid numbers on single hop plants were not detectable in the quassia variants, contrary to the plots treated with the other compounds. Exemplary results for all trials are shown in Table 1 and Figure 1.
The aphid infestation was also mirrored by the results of the experimental harvests. As regards yield, the quassia variants always were within the significantly best group as shown exemplarily in Figure 2. It has to be noted however that the alpha acids had been reduced significantly in a systemic quassine variant in 2004, but this phenomenon was not confirmed later. The significantly lower alpha acids in systemic quassia plots, compared to sprayed variants, shown in Figure 2 are a result of clear soil differences within this hop garden.
Another problem became evident in the sprayed quassia plots during 2002: As all arthropods present on the monitored leaves were assessed that year, a significant decrease of small leafhoppers (Cicadina) was detected after a quassia spraying, compared to the other plots (cf. Engelhard & Weihrauch 2005). This means that non-target organisms are affected by quassia sprayings. Hence, due to the good control effects we evidenced, the systemic application of quassia is recommended as the currently best aphid control strategy in organic hop growing, as there are no negative environmental effects discernible. Probably the best amount of active ingredient will be 24 g/ha quassine.

Table 1. Aphid development in plots with different variants of aphid control. Means of three replications with 50 leaves, respectively. Herpersdorf, Germany, 2006, cv. Perle. Two applications, respectively, except [1] one application only.

Variant	16 vi 2006 1 day before 1st application	20 vi 2006 4 days after 1st application	30 vi 2006 4 days after 2nd application	04 vii 2006 10 days after 2nd application	15 vii 2006 3 weeks after 2nd application
Control	50	70	73	111	120
Spray applications					
NeemAzal T/S	55	84	86	165	148
Pyrethrine	68	80	69	52	117
Quassia, homebrew	29	43	14	26	10
Quassia with soft soap	40	32	11	7	3
Systemic applications					
NeemAzal T/S	45	84	42	97	151
Quassine 12 g/ha [1]	44	76	24	49	23
Quassine 24 g/ha [1]	40	51	28	14	4
Quassine 36 g/ha [1]	32	43	42	8	10

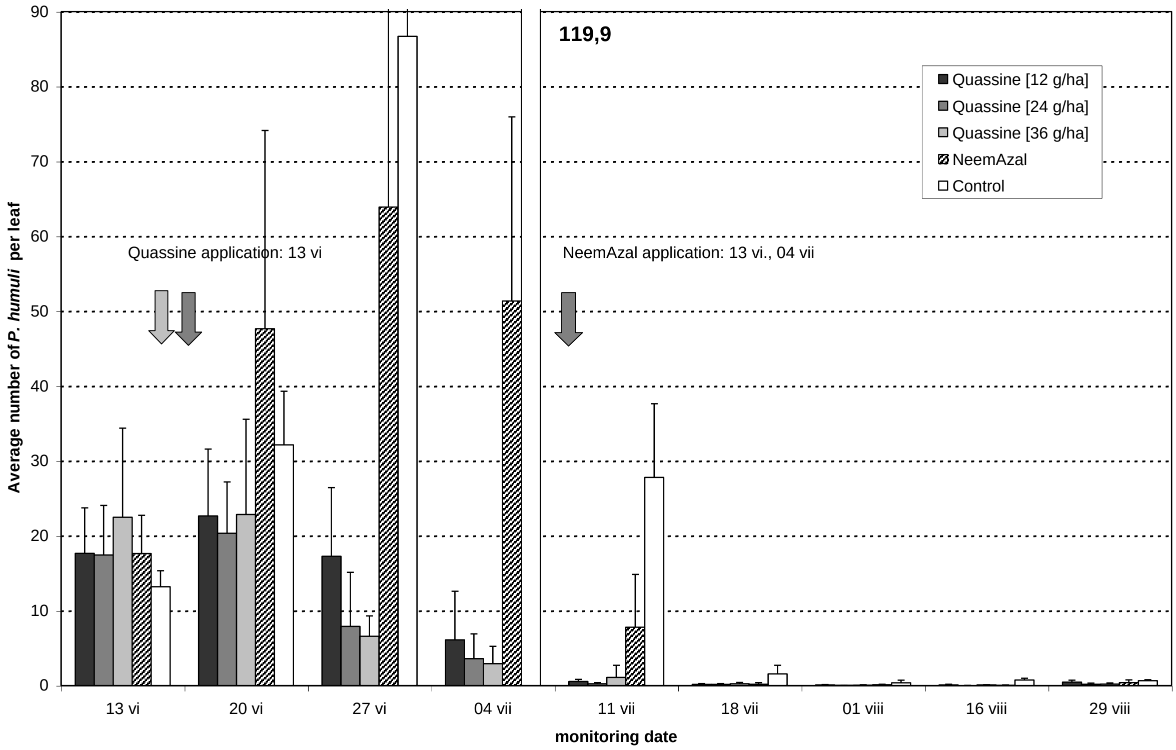

Figure 1: Aphid development in plots with different variants of systemic aphid control. Means and s.e. of four replications with 30 leaves, respectively. Ursbach, Germany, 2006, cv. Perle.

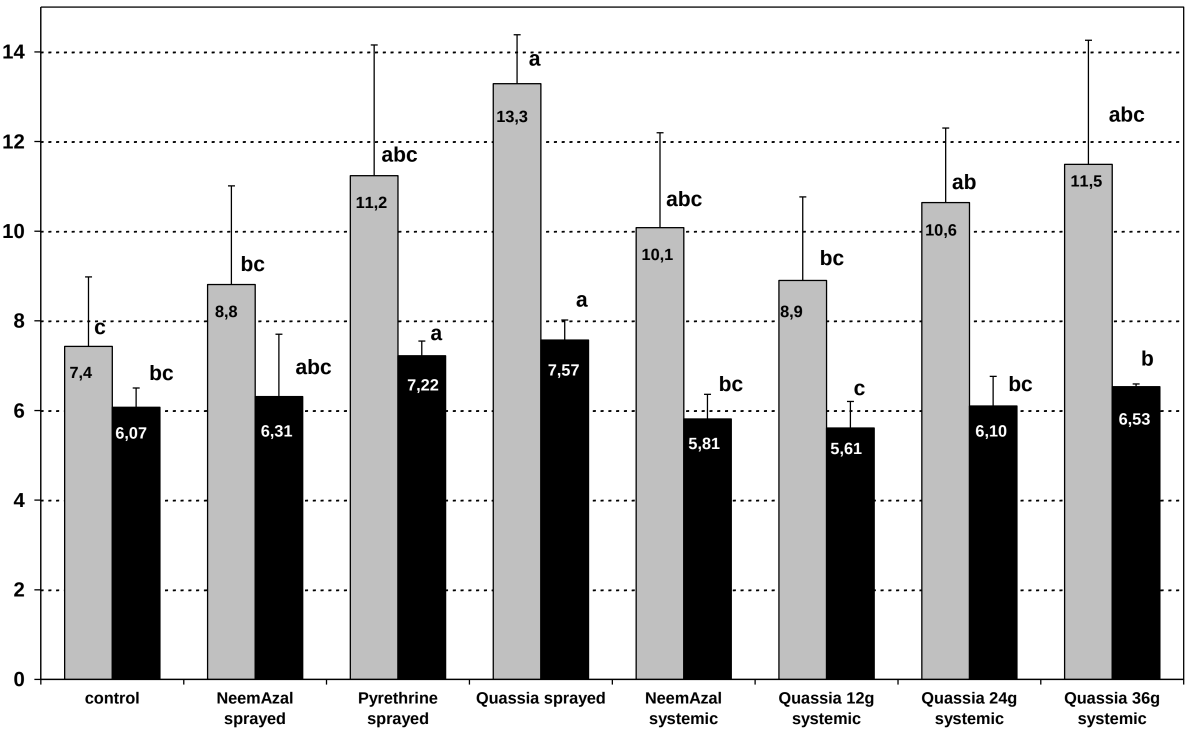

Figure 2: Experimental harvest, Herpersdorf, 05-ix-2006. Yield [dt/ha] (grey bars) and alpha acids [%] (black bars) of plots with different variants of aphid control. Bars with the same letter are not significantly different (ANOVA, $p < 0.05$)

Perspectives

The results we achieved during this study evidence that organic growers in Germany currently are dependent on quassia products in order to safeguard satisfying control of *Phorodon humuli*. Effective compounds or control strategies other than those we tested are not registered for organic farming in Germany, and those guidelines are very strict. At the moment no industrial quassia product is registered for aphid control in the EU, and the current modus operandi of organic growers, i.e. the use of homemade quassia brews, is situated legally within a grey area. Hence, it is most important to register an aphicide with a standardised content of quassine in Annex I of the EU Council Directive 91/414/EEC in order to make this compound available within the EU. According registration trials are performed in the Hallertau and Tettnang growing areas in 2007, not only in organic but also in conventional farms. Of special interest will be what degree of aphid control can be achieved by a systemic quassine treatment in high alpha cultivars like Hallertauer Magnum. If these trials are similarly successful than those of the past years, quassine will not only be a benefit to organic growers, but probably may serve even as a “plan B” in conventional hop growing.

References

Engelhard, B., Weihrauch, F. 2005. Prüfung produktionstechnischer Maßnahmen für den Ökologischen Hopfenbau. Abschlussberischt des Forschungsprojektes, gefördert vom Bayerischen Staatsministerium für Landwirtschaft und Forsten, München. Online on the Internet [15.05.2007], URL: http://www.lfl.bayern.de/ipz/hopfen/23409/endbericht.pdf

Neve, R.A. 1991. Hops. Chapman & Hall, London.