Occurrence of Guignardia bidwellii, the causal fungus of Black Rot on grapevine, in the vine growing areas of Rhineland-Palatinate, Germany

M Harms
DLR Rheinpfalz, Breitenweg 71, D-67435 Neustadt an der Weinstraße, Germany

B Holz, C Hoffmann
BBA, Institut für Pflanzenschutz im Weinbau, Brünigstraße 84, D-54470 Bernkastel-Kues, Germany

H-P Lipps
DLR Rheinhessen-Nahe-Hunsrück, Rüdesheimer Straße 60-68, D-55545 Bad Kreuznach, Germany

W Silvanus
DLR Mosel, Tessenowstraße 6, D-54295 Trier, Germany
Email: marco.harms@dlr.rlp.de

ABSTRACT

Between the years 2003 and 2004 attacks of Black Rot on grapevine, causing strong economical losses, have been observed in some of the vine-growing areas of Rhineland-Palatinate. Especially the regions of Mosel-Saar-Ruwer, Mittelrhein and Nahe have been mainly affected. Suitable climatic conditions and a high number of overgrown vineyards favoured the development of the disease in these regions. Fungicide treatments with Dithiocarbamates, Strobilurines and Azoles resulted in sufficient disease control indicating that the development of a practicable protection strategy seems to be possible.

INTRODUCTION

Black Rot on grapevine is a dangerous disease in viticulture. The ascomycete fungus *Guignardia bidwellii* is able to cause considerable economic losses under favourable climatic conditions in insufficient protected vineyards. The fungus has been protracted from North America to Europe just as the downy and the powdery mildew of grapevine with rootstock material in the 19th century (Pearson & Goheen, 1988).

While downy and powdery mildew have been able to spread rapidly over all vine-growing areas of Europe, problems with Black Rot have been limited to temperate regions of Northern Italy and southwestern France with high summer precipitation. In 1988 the disease has been detected for the first time in Switzerland and spread also to the vine-growing area of Champagne (Pezet & Jermini, 1989). In the past observations of Black Rot in Germany have been absolutly rare and without any economical importance (Müller, 1934; Lüstner, 1935; Kast, 1990), so the disease symptoms have been unknown for the growers.

In 2002, the symptoms of *G. bidwellii* have been observed by Holz (2003) on overgrown vineyards for the first time in the area of Mosel-Saar-Ruwer. Since 2003 massive infections which resulted in considerable yield losses, especially in the vine-growing areas of Mosel-Saar-Ruwer, Mittelrhein and Nahe, have been reported. During the last two years the work of the official plant protection service of Rhineland-Palatinate and the BBA was concentrated on the possible origin for the strong appearance of the disease and the development of practicable protection strategies.

MATERIAL AND METHODS

Observation of disease development

Appearance and development of the disease have been observed in different vine-growing areas at trial sites and vineyards with high disease risk in 2003 and 2004. Disease development was compared to weather conditions and fungicide treatments.

Fungicide trials

At different locations in the valleys of Mosel (Trier, Niedermennig, variety Riesling) and Mittelrhein (Kaub, variety Pinot noir), where in 2003 strong attacks could be observed, protection trials with different fungicides have been taken through in 2004.
Experiences from other countries and observations from own trials in 2003 showed that fungicides belonging to the chemical groups of dithiocarbamates, strobilurines and inhibitors of the sterolbiosynthesis (Azoles) are also effective against Black Rot on grapevine (Bolay *et al.,* 1994; Hoffmann & Wilcox, 2003). A number of these chemicals are registered as plant protection products in Germany in viticulture against other fungal diseases. So main emphasis was layed on these products. Additionally other important fungicides with different modes of action have included in the trials too. The tested products are listed in table 1.

The trials have been arranged in a randomised block design (30 m^2 per plot). Depending on the size of the experimental vineyard three to four repetitions have been installed. Fungicide applications started from phenological stage “five leaves unfolded” (BBCH growth stage 15) and continued until “beginning of maturation” (BBCH growth stage 81) in regular intervalls of 12 to 14 days. The fungicide rate and the spray volume was adapted to the different development stages of the canopy (400-800 l/ha). Altogether eigth treatments have been done per variant. The disease development was recorded for three times on leaves and bunches according to the EPPO Guidline No. 31. To protect the experimental plots from infections by downy and powdery mildew, vineyards have been treated with “Forum” (0,48 l/ha) or “Fortress 250” (0,8 l/ha). Dimethomorph and Quinoxyfen had no effect on *G. bidwellii*.

Table 1. Tested fungicides against Black Rot in Rhineland-Palatinate 2004

Chemical group	Active ingredients	Trade name	Base rat [kg resp. l/ha]	Number c trials
Dithiocarbamates	Mancozeb	Dithane NeoTec	0,8	2
	Mancozeb + Zoxamide	Electis	0,72	1
	Metiram	Polyram WG	0,8	2
Strobilurines	Azoxystrobin + Folpet	Quadris max	0,4	2
	Kresoxim-Methyl	Discus	0,06	2
	Kresoxim-Methyl + Boscalid	Collis	0,16	2
	Pyraclostrobin + Metiram	Cabrio Top	0,8	2
	Trifloxystrobin	Flint	0,06	2
Azoles	Fluquinconazol	Castellan	0,08	1
	Myclobutanil	Systhane 20 EW	0,06	2
	Penconazol	Topas	0,06	2
	Tebuconazol + Tolylfluanid	Folicur EM	1,0	2
Quinones	Dithianon	Delan WG 700	0,2	2
Phtalimides	Folpet	Folpan 80 WDG	0,4	2
Morpholines	Spiroxamine	Prosper	0,2	2

RESULTS AND DISCUSSION

Since 2002, *G. bidwellii*, the causal fungus of Black Rot on grapevine, can be observed in different vine-growing areas of Rhineland-Palatinate. Mostly affected are the regions of Mosel-Saar-Ruwer, Mittelrhein and Nahe. In this areas between 30 % and 80 % of the grape bunches have been destroyed by the fungus in some vineyards 2004.

Table 2: Yearly average temperature and precipitation at different weather stations in Rhineland-Palatinate (2000-2004)

Year	Mosel (Trier)		Nahe (Bad Kreuznach)		Pfalz (Neustadt a. d. W.)	
	Temp. [°C]	Precipitation [mm]	Temp. [°C]	Precipitation [mm]	Temp. [°C]	Precipitation [mm]
2000	10,4	1060,3	10,7	750,6	11,5	705,6
2001	9,9	996,5	10,2	707,4	10,9	666,6
2002	10,5	957,6	10,8	715,6	11,3	760,1
2003	10,5	780,7	11,0	404,4	11,2	439,1
2004	10,0	724,5	10,3	467,1	11,0	609,6
Long term average	**9,1**	**784,3**	**9,5**	**512**	**10,1**	**643,9**

Temp. = temperature

Table 3: Monthly average temperature and precipitation at different weather stations in Rhineland-Palatinate (May-August 2004)

Year	Mosel (Trier)		Nahe (Bad Kreuznach)		Pfalz (Neustadt a. d. W.)	
	Temp. [°C]	Precipitation [mm]	Temp. [°C]	Precipitation [mm]	Temp. [°C]	Precipitation [mm]
May	13,0	84,2	13,2	40,4	14,1	38,2
June	16,8	57,3	17,3	52,8	18,1	62,0
July	18,2	94,6	18,6	69,0	19,6	79,1
August	19,3	133,8	19,6	73,2	20,0	86,5
Av. resp. sum	16,8	369,9	17,2	235,4	18,0	265,8
Long term average	**15,8**	**282,2**	**16,6**	**219**	**17,2**	**249,5**

Temp. = temperature
Av. = average

During the last three years disease incidence and severity increased continously. While Black Rot symptoms have been limited in 2002 on untreated abandoned plots, the fungus could be found in the entire Mosel area also in regularly treated vineyards 2004 indicating that the disease had successfully established in the last three years. Strong outbreaks of disease symptoms on bunches have been observed in July and in the end of August 2004 after intensive rainfalls. This was surprising and atypically because of leaf infections had not take place or have been recorded only in minor scale until this moment. In contrast, in the areas of Ahr, Pfalz and Rheinhessen infections have been only rare and without economical importance.

The observations of recent years showed that the reasons for the strong disease development especially in the areas of Mosel and Mittelrhein have been favourable weather conditions for the fungus and above all the high number of overgrown vineyards in the affected regions.

In general higher temperatures have been detected since 2000 in the different vine-growing areas of Rhineland-Palatinate (table 2). The yearly average temperatures ranged between 0,8 °C and 1,4 °C above the long term average in the last five years indicating a development to a warmer climate. Though precipitation of 2003 and 2004 ranged under the long term average the highest disease severity of Black Rot could be observed in this years. The reason has been found in intensive rainfalls in July and August especially in the Mosel valley (table 3). In this period main infections take place normally. The combination of strong precipitation in summer and increasing average temperatures during the period of highest susceptibility of grape bunches led to improved conditions for the disease.

The existance of many overgrown vineyards in the affected regions was the second important factor that enhanced the fungal development. Overgrown vineyards with untreated vines allowed the fungus a continous uncontrolled propagation and led to the present high disease pressure. The source of these plots are vineyards that have been abandoned by their growers without clearing the vines.

Table 4: Degrees of efficiency of fungicide treatments on bunch attacks of Black Rot in Rhineland-Palatinate 2004

Chemical group	Active ingredients	Trade name	Kaub (31.8.04)		Mosel[1,2] (17.9.04)	
			DE_{di} [%]	DE_{ds} [%]	DE_{di} [%]	DE_{ds} [%]
Dithio-carbamates	Mancozeb	Dithane NeoTec	76	86	97[2]	98[2]
	Mancozeb + Zoxamide	Electis	-	-	92[2]	95[2]
	Metiram	Polyram WG	64	77	96[1]	98[1]
Strobilurines	Azoxystrobin + Folpet	Quadris max	97	99	99[1]	99[1]
	Kresoxim-Methyl	Discus	90	96	95[2]	98[2]
	Kresoxim-Methyl + Boscalid	Collis	89	96	90[2]	95[2]
	Pyraclostrobin + Metiram	Cabrio Top	98	99	100[1]	100[1]
	Trifloxystrobin	Flint	95	98	100[1]	100[1]
Azoles	Fluquinconazol	Castellan	-	-	95[2]	93[2]
	Myclobutanil	Systhane 20 EW	92	97	99[1]	99[1]
	Penconazol	Topas	94	97	89[2]	91[2]
	Tebuconazol + Tolylfluanid	Folicur EM	96	99	100[2]	100[2]
Quinones	Dithianon	Delan WG 700	18	32	60[2]	67[2]
Phtalimides	Folpet	Folpan 80 WDG	17	26	58[2]	61[2]
Morpholines	Spiroxamine	Prosper	47	64	14[2]	0[2]

DE = degree of efficiency; di = disease incidence; ds = disease severity
Control: Kaub: di = 84 %, ds = 3,4; Trier: di = 64 %, ds = 2,8; Niedermennig: ds = 55 %, ds = 2,4
[1]trial site Trier; [2]trial site Niedermennig

For a successful protection strategy against *G. bidwellii* sanitary measures, cultural techniques and the use of effective fungicides should be combined. Much attention has to be put on the eradication of sources of inoculum like overgrown vineyards or mummified berries (overwintering place of the fungus!) from infestated vineyards. Only by this way a considerable reduction of the disease pressure for the affected regions seems to be possible.

The fungicide trials showed good protection results with all active substances belonging to the groups of dithiocarbamates, strobilurines and azoles. Efficiency related to disease severity on bunches varied between 77 % and 98 % for dithiocarbamates, between 95 % to 100 % for Strobilurines and between 91 % to 100 % for the azoles. The effect of the other fungicides which have been tested was lower (table 4). The results showed that successful protection of vineyards against *G. bidwellii* is possible under the predominant climatical conditions and disease pressure with the registered local fungicide rates against downy and powdery mildew. Depending on the weather conditions effective fungicides should be applied beginning between five to seven leaves unfolded (BBCH growth stage 15-17) until bunch closing respectively to the begin of maturation (BBCH growth stage 79-81). Fungicide treatments can be completed with optimal timed measures of canopy management which favours the adherance of fungicides and reduces the duration of leafwetness.

Further problems will be expected for organic farms, because of fungicides containing copper or sulphur exhibited no satisfying protection results (data not shown) and grape varieties with a sufficient level of resistance against the Black Rot fungus are not known. Varieties with good levels of resistance against downy and powdery mildew (e.g. Regent) showed to be highly susceptible againt *G. bidwellii*.

The results of the trials give hope that a suitable protection strategy can be developed and implemented within the existing integrated protection strategies against downy and powdery mildew with the fungicides registered yet. Further research is needed on spore release to improve the understanding of the epidemiology of the fungus and to discover effective products for organic viticulture.

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