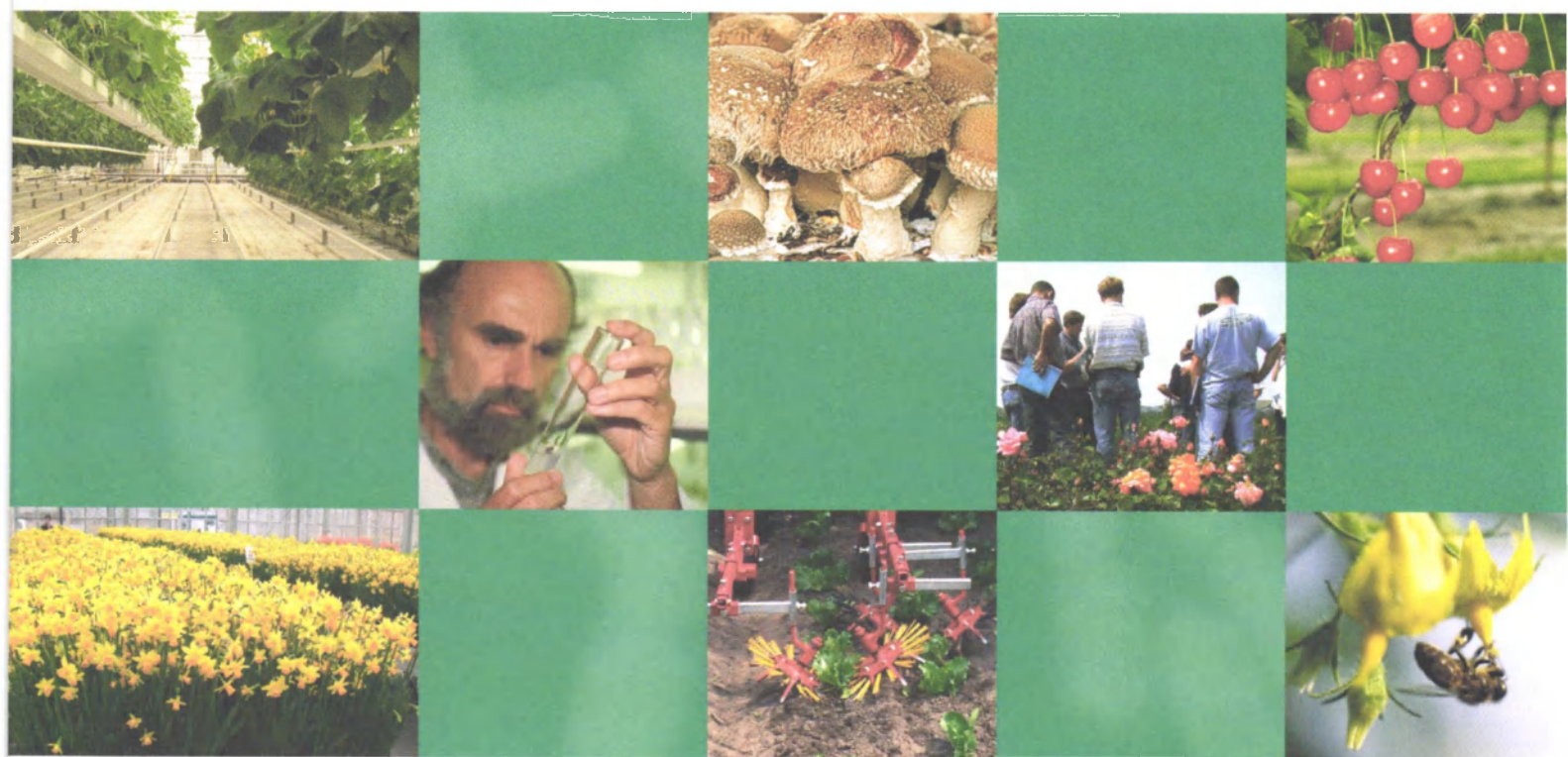




Disinfection of Lily bulbs with Spirit

Control of *Penicillium* in saleable sizes of Lilium

B.J. Kok, A.Th.J. Koster en A.A.E. Bulle



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Summary

Saleable sizes of lily bulbs are stored for year-round flower production at temperatures below 0°C, after a cold storage at 2°C for 6 to 8 weeks after harvesting. During this storage the fungus *Penicillium* may cause problems. To prevent attack of the bulbs by *Penicillium*, the disinfection advice is to dip bulbs for 10 minutes in 1,25 % Mirage Plus before the storage period has been started.

In this research the control of *Penicillium* by dipping the bulbs in 1,25 % Spirit SC has been compared with the above described disinfection advice and some other chemicals.

The control of *Penicillium* on bulbs which were dipped in Spirit SC, was not as good as the control treatment in which the bulbs were dipped in Mirage Plus, Mirage Elan or Allure. The bulbs dipped in Spirit SC were more lightly and moderate infected by *Penicillium* in comparison with the other treatments, but the quality was still acceptable for practical purposes.

1 Introduction

Saleable sizes of lily bulbs are stored for year-round flower production at temperatures below 0°C, after a cold storage at 2°C for 6 to 8 weeks. During this storage the fungus *Penicillium* may cause problems on the bulb surface. *Penicillium* penetrates the bulbs through wounds. Therefore wounding during harvest and handling must be kept to a minimum. Because there is always some wounding the bulbs may not become too dry after the washing treatment after harvest (moisture is necessary for wound healing) and they must be disinfected and placed at 2°C after harvesting as soon as possible. The advice for disinfection is to dip bulbs for 10 minutes in a fungicide. In this research the control of *Penicillium* by dipping the bulbs in 1.25% Spirit SC is compared with the disinfection advice with 1.25 % Mirage Plus and some other chemicals.

2 Material and method

Different bulb dipping treatments were examined for their use against *Penicillium*.

In the treatment schedule (table 2.1) Mirage Plus is the standard treatment. After bulb dipping the bulbs were stored in a climate room at 2°C.

Table 2.1. Treatment schedule

Treat. no	Product	Name active ingredient (a.i.)	% a.i.	Formulation	Dosage (%)	Mode of application/timing
1	Spirit SC	tebuconazole + folpet	100 g/l	SC	1.25%	bulb dipping 10 min
2	Mirage Plus (dipping advice)	prochloraz + folpet	120 g/l 450 g/l	SC	1.25%	bulb dipping 10 min
3	Allure	chlorothalonil + prochloraz	330 g/l	SC	1.5%	bulb dipping 10 min
4	Mirage Elan	prochloraz	105 g/l	SC	0.35%	bulb dipping 10 min
5	Folpan 80 WP	folpet	80%	WP	0.7%	bulb dipping 10 min
6	Folicur WG	tebuconazole	25%	WG	0.5%	bulb dipping 10 min
7	Daconil	chlorothalonil	500 g/l	SC	1%	bulb dipping 10 min
8	Shirlan	fluazinam	500 g/l	SC	0.25%	bulb dipping 10 min
9	Captosan	captan	500 g/l	SC	1%	bulb dipping 10 min
10	Untreated check	dipping in water				bulb dipping 10 min
11	Untreated check	no dipping in water				
12	Shirlan	fluazinam	500 g/l	SC	0.125%	bulb dipping 10 min

On June 22, July 24 and August 20 assessments were made for *Penicillium* infection. The classification for this was: Healthy = no *Penicillium*

Light *Penicillium* = single scale with *Penicillium*

Moderate *Penicillium* = more *Penicillium* spots

Heavy *Penicillium* = 100% diseased

The picture shows the different classes.



Picture 2.1. Classification of *Penicillium* infection: healthy (above left), light (above right), moderate (down left) and heavy (down right).

For the statistical analysis Genstat 10th edition was used.
A detailed overview of the experimental setup can be found in appendix 1.

3 Results

Both untreated bulbs (treatments 9 and 10) were heavily infected by *Penicillium* on June 22. The untreated bulbs which were kept dry were the most infected by *Penicillium*, followed by the bulbs which were dipped in only water. The bulbs dipped in both concentrations of Shirlan were most infected by *Penicillium* of all the treated bulbs. This was remarkable because we saw in previous trials an excellent activity of Shirlan against *Penicillium* in lilies.

The bulbs dipped in Mirage Plus, Mirage Elan or in Allure had the most healthy bulbs.

The bulbs dipped in Spirit were a little bit more lightly infected compared to the bulbs dipped in Mirage Plus and Mirage Elan. Although they don't differ from the bulbs dipped in Allure.

The other treatments were more lightly infected.

Table 1. Number of bulbs infected by *Penicillium* on June 22 (N=25). Treatments with different codes are significantly different

Treatment	Dose	Degree of infection by <i>Penicillium</i> on the bulbs			
		Healthy	Lightly infected	Moderate infected	Heavily infected
1 Spirit SC	1.25%	21 ef	4 b	0 a	0 a
2 Mirage Plus (dipping advice)	1.25%	24 g	1 a	0 a	0 a
3 Allure	1.50%	23 fg	1 a	0 a	0 a
4 Mirage Elan	0.35%	25 g	1 a	0 a	0 a
5 Folpan 80 WP	0.70%	14 d	10 c	1 a	0 a
6 Folicur WG	0.50%	7 c	14 d	4 b	0 a
7 Daconil	1%	19 e	6 b	0 a	0 a
8 Shirlan	0.25%	4 b	11 c	6 c	5 b
9 Captosan	1%	15 d	9 c	1 a	0 a
10 Untreated	Wet	0 a	1 a	3 b	21 d
11 Untreated	Dry	0 a	0 a	0 a	25 e
12 Shirlan	0.13%	2 ab	4 b	9 d	10 c
	p-level	< 0.001	< 0.001	< 0.001	< 0.001
	lsd	2.583	2.296	1.976	2.286

On July 24 both untreated bulbs were 100% infected and also the bulbs dipped in Shirlan were almost 100% heavy infected by *Penicillium*. The bulbs dipped in Spirit were less healthy and more lightly and moderate infected by *Penicillium* compared to the bulbs dipped in Mirage Plus. The *Penicillium* control in the bulbs dipped in Mirage Plus, Allure and Mirage Elan was almost the same and these treatments were the best of all. The bulbs dipped in Folicur WG had a high number of heavily infected bulbs.

Table 2. Number of bulbs infected by *Penicillium* on July 24 (N=25). Treatments with different codes are significant different

Treatment	Dose	Degree of infection by <i>Penicillium</i> on the bulbs			
		Healthy	Lightly infected	Moderate infected	Heavily infected
1 Spirit SC	1.25%	16 c	7 e	2 b,c,d	0 ab
2 Mirage Plus (dipping advice)	1.25%	23 d	2 b,c	0 a	0 a
3 Allure	1.50%	21 d	3 c	0 a	0 a
4 Mirage Elan	0.35%	23 d	2 b,c	0 a,b	0 a
5 Folpan 80 WP	0.70%	6 b	9 f	8 e	2 bc
6 Folicur WG	0.50%	0 a	1 a,b,c	8 e	16 d
7 Daconil	1%	14 c	7 e	4 d	1 ab
8 Shirlan	0.25%	0 a	0 a,b	3 c,d	22 e
9 Captosan	1%	7 b	5 d	11 e	4 c
10 Untreated	Wet	0 a	0 a	0 a	25 f
11 Untreated	Dry	0 a	0 a	0 a	25 f
12 Shirlan	0.13%	1 a	0 a	1 b,c	24 ef
	P-level	< 0.001	< 0.001	< 0.001	< 0.001
	Isd	2.463	1.680	2.066	1.826

The results on August 20 were almost exactly the same as on July 24.

The most healthy bulbs were those which were dipped in Mirage Plus, Mirage Elan or Allure. Second best were the treatments with bulbs dipped in Spirit or Daconil, followed by Folpan 80 WP and Captosan.

The bulbs dipped in Shirlan or Folicur WG were heavily infected by *Penicillium*. In the untreated treatments all the bulbs were heavily infected.

Table 3. Number of bulbs infected by *Penicillium* on August 20 (N=25). Treatments with different codes are significant different

Treatment		Dose	Degree of infection by <i>Penicillium</i> on the bulbs			
			Healthy	Lightly infected	Moderate infected	Heavily infected
1	Spirit SC	1.25%	10 c	10 e	5 c	0 a
	Mirage Plus	1.25%				
2	(dipping advice)		22 d	2 a,b	1 a,b	0 a
3	Allure	1.50%	20 d	3 b,c	1 a,b	0 a
4	Mirage Elan	0.35%	20 d	4 c	1 a,b	0 a
5	Folpan 80 WP	0.70%	3 a,b	7 d	12 e	3 b
6	Folicur WG	0.50%	0 a	0 a	3 b,c	22 d
7	Daconil	1%	13 c	8 d	4 b,c	1 a,b
8	Shirlan	0.25%	0 a	0 a	1 a,b	24 d,e
9	Captosan	1%	4 b	2 b	9 d	10 c
10	Untreated	Wet	0 a	0 a	0 a	25 e
11	Untreated	Dry	0 a	0 a	0 a	25 e
12	Shirlan	0.13%	1 a	0 a	0 a	24 e
P-level			< 0.001	< 0.001	< 0.001	< 0.001
lsd			2.78	2.245	2.594	2.466

4 Conclusions

The control of *Penicillium* in bulbs which were dipped in Spirit SC was not as good as the control of *Penicillium* in the bulbs which were dipped in Mirage Plus, Mirage Elan or Allure. The bulbs dipped in Spirit SC were more lightly and moderately infected by *Penicillium*, but the quality was still acceptable for practical purposes.

Appendix 1 Experimental data

1 Experimental data

- 1.1. Crop : lily
 - cultivar : Star Gazer
 - plant size : 14-16
 - pre-treatment bulbs : the bulbs were cut off, disinfect and dried out for 24 hours immediately
 - standard disinfection bulbs : no
- 1.2. Disease-pressure : Penicillium
 - natural occurrence : Penicillium is always present and occurs more heavily after drying out the bulbs
- 1.3. Location : PPO Lisse
 - storage room : at 2°C
- 1.4. Number of bulbs : 25 bulbs
 - number of replications : 4
- 1.5. Trial data
 - rinse and cut off the bulbs : May 1 2007
 - disinfection treatments : May 2
 - storage at 15 to 20°C : May 3
 - storage at 2°C in plastic : May 4, until Penicillium occurs
- 1.6. Observations
 I. Efficacy
 - Penicillium on bulb : on June 22, July 24 and August 20 2007
 Observation scales 'efficacy' : Healthy = no Penicillium
 Light Penicillium = single scale with Penicillium
 Moderate Penicillium = more Penicillium spots
 Heavy Penicillium = 100% diseased

2 Treatments

2.1. Number of treatments and coding

Treat. no	Product	Name active ingredient (a.i.)	Amount a.i.	Formulation	Dosage (%)	Mode of application/ timing
1	Spirit SC	tebuconazool + folpet	100 g/l	SC	1.25%	bulb dipping 10 min
2	Mirage Plus (dipping advice)	prochloraz + folpet	120 g/l 450 g/l	SC	1.25%	bulb dipping 10 min
3	Allure	chloorthalonil + prochloraz	330 g/l	SC	1.5%	bulb dipping 10 min
4	Mirage Elan	prochloraz	105 g/l	SC	0.35%	bulb dipping 10 min
5	Folpan 80 WP	folpet	80%	WP	0.7%	bulb dipping 10 min
6	Folicur WG	tebuconazool	25%	WG	0.5%	bulb dipping 10 min
7	Daconil	chloorthalonil	500 g/l	SC	1%	bulb dipping 10 min
8	Shirlan	fluazinam	500 g/l	SC	0.25%	bulb dipping 10 min
9	Captosan	captan	500 g/l	SC	1%	bulb dipping 10 min
10	Untreated check	dipping in water				bulb dipping 10 min
11	Untreated check	no dipping in water				
12	Shirlan	fluazinam	500 g/l	SC	0.125%	bulb dipping 10 min

2.2. Application of treatment

I. Dipping

:

Treat. no.	Product	Recommended dosage of product	Desired amount of product needed in 10 liter water	Drenching period
1	Spirit SC	1.25%	125 ml	10 minutes
2	Mirage Plus	1.25%	125 ml	„
3	Allure	1.5%	150 ml	„
4	Mirage Elan	0.35%	35 ml	„
5	Folpan 80 WP	0.7%	70 ml	„
6	Folicur WG	0.5%	50 ml	„
7	Daconil	1%	100 ml	„
8	Shirlan	0.25%	25 ml	„
9	Captosan	1%	100 ml	„
10	Untreated check	only water	-	„
11	Untreated check	dry, no dipping in water		
12	Shirlan	0.125%	12,5 ml	„

-Bath temperature : 10-15°C

Appendix 2 Plot design

Each treatment was packed separate in plastic and stored in wooden crates. The whole trial was stored in 12 crates. Per crate four treatments were stored. In the first crate the treatments 7A, 1A, 5A and 9A were stored. In the second crate above, the treatments 4A, 11A, 8A and 12A were stored and so on.

10 D	9 D	8 D	3 D
2 D	6 D	12 D	5 D
11 D	7 D	4 D	1 D
11 C	5 C	1 C	9 C
4 C	2 C	3 C	7 C
12 C	6 C	8 C	10 C
9 B	7 B	3 B	11 B
1 B	10 B	8 B	6 B
5 B	2 B	4 B	12 B
10 A	6 A	2 A	3 A
4 A	11 A	8 A	12 A
7 A	1 A	5 A	9 A

Appendix 3 Raw data bulb assessments

Treatment	replication	june 22 Healthy	june 22 light	june 22 moderate	june 22 heavy	july 24 Healthy	july 24 light	july 24 moderate	24-jul heavy	20-aug Healthy	20-aug light	20-aug moderate	20-aug heavy
1	A	21	4	0	0	15	8	2	0	7	10	8	0
1	B	21	4	0	0	19	5	1	0	13	11	1	0
1	C	22	3	0	0	12	9	4	0	10	10	5	0
1	D	22	3	0	0	16	6	2	1	10	9	5	1
2	A	25	0	0	0	25	0	0	0	22	3	0	0
2	B	25	0	0	0	23	2	0	0	23	1	1	0
2	C	24	1	0	0	22	3	0	0	20	4	1	0
2	D	23	1	1	0	23	2	0	0	23	0	2	0
3	A	24	1	0	0	23	2	0	0	20	4	1	0
3	B	23	2	0	0	22	3	0	0	22	2	1	0
3 **	C	20	0	0	0	17	2	1	0	16	2	2	0
3	D	24	1	0	0	22	3	0	0	22	3	0	0
4	A	24	1	0	0	24	1	0	0	19	6	0	0
4	B	25	0	0	0	23	2	0	0	21	3	1	0
4	C	24	1	0	0	22	2	1	0	22	2	1	0
4	D	25	0	0	0	23	2	0	0	18	6	1	0
5	A	20	5	0	0	10	8	7	0	4	6	14	1
5	B	11	12	2	0	2	6	13	4	1	4	12	8
5	C	14	10	1	0	6	10	8	1	5	9	9	2
5	D	11	12	2	0	5	12	5	3	1	8	14	2
6	A	8	14	3	0	0	2	8	15	0	0	2	23
6	B	5	14	6	0	0	0	6	19	0	0	3	22
6	C	9	14	2	0	1	1	11	12	1	0	5	19
6	D	6	14	5	0	0	1	7	17	0	0	2	23
7	A	19	6	0	0	17	5	3	0	17	5	2	1
7	B	18	6	1	0	10	9	3	3	9	11	2	3
7	C	20	5	0	0	14	7	4	0	13	5	7	0
7	D	20	5	0	0	13	7	5	0	11	10	3	1
8	A	6	13	5	1	0	0	4	21	0	0	1	24
8	B	7	12	3	3	1	1	3	20	1	1	2	21
8	C	2	12	5	6	0	0	2	23	0	0	1	24
8	D	0	5	10	10	0	0	1	24	0	0	0	25
9	A	15	9	1	0	9	4	9	3	6	1	14	4
9	B	16	9	0	0	5	4	13	3	3	3	6	13
9	C	14	9	2	0	6	6	10	3	1	4	10	10
9	D	15	8	2	0	6	4	10	5	6	1	6	12
10	A	0	1	2	22	0	0	0	25	0	0	0	25
10	B	0	2	3	20	0	0	0	25	0	0	0	25
10	C	0	1	4	20	0	0	0	25	0	0	0	25
10	D	0	0	2	23	0	0	0	25	0	0	0	25
11	A	0	0	1	24	0	0	0	25	0	0	0	25
11	B	0	0	0	25	0	0	0	25	0	0	0	25
11	C	0	0	0	25	0	0	0	25	0	0	0	25
11	D	0	0	0	25	0	0	0	25	0	0	0	25
12	A	4	6	10	5	1	0	2	22	1	0	0	24
12	B	3	3	5	14	1	0	1	23	1	0	1	23
12	C	1	3	11	10	0	0	0	25	0	0	0	25
12	D	1	2	9	10	0	0	0	25	0	0	0	25

** 3C 20 in stead of 25 bulbs

Appendix 4 Photo's made on August 21



1,25% Spirit



1,25% Mirage Plus



1,5% Allure



0,35% Mirage Elan



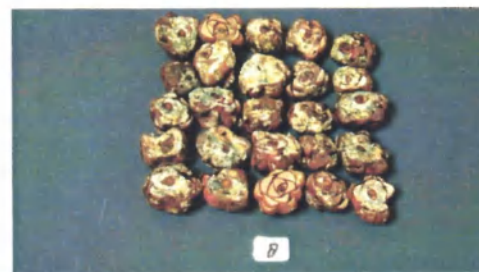
0,7% Folpan 80WP



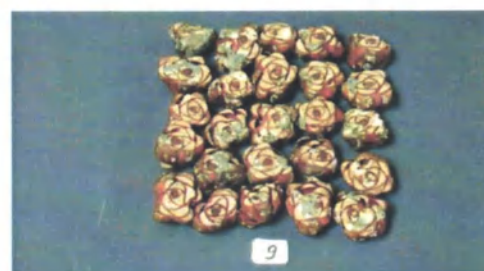
0.5% Folicur WG



1% Daconil



0.25% Shirlan



1% Captosan



0,125% Shirlan



Untreated wet



Untreated dry

