APPLIED PLANT RESEARCH
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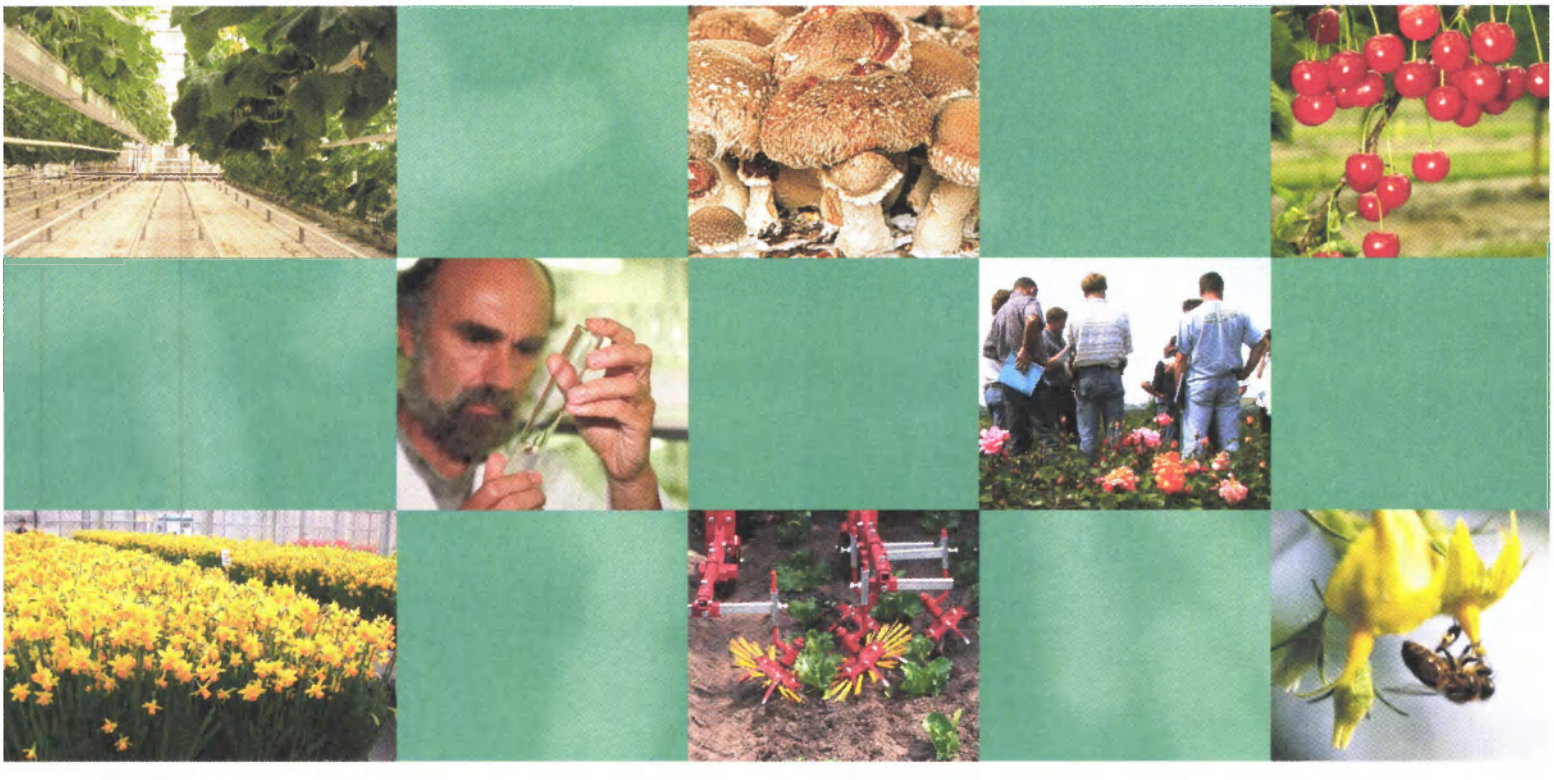
Application of Vydate L by fertigation tubes in lilies

A.Th.J. Koster and B.J. Kok



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Research Unit Flower bulbs
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Financed by:

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1 Summary

The aim of this project was to find out if the liquid formulation of Vydate (L) can be applied by fertigation tubes in order to control nematodes. In an experiment lilies were grown on a field that was heavily infested with Pratylenchus penetrans. Soil treatment was carried out with the standard treatments of 40 kg /ha Vydate 10G before planting, or 30 kg/ha Temik 10G after planting. These were compared to the effect of Vydate L, applied by fertigation tubes during the growing season. During the growing season, treatments were fertigated 4 times or 6 times with Vydate L. For each treatment the same total amount of Vydate L was applied.
During the growing season the crop stand was less good in the untreated plots and at first also in the treatment that was fertigated 6 times during growing season with Vydate. Probably this was because at the start there was too little of the chemical in the root zone. Later, no differences could be seen in stand of crop between the chemical treatments, but there was still a difference with the untreated control. There was no significant difference in bulb yield between the granulate and the liquid Vydate L. In both treatments fertigated with Vydate L, the root rot occurrence was less severe than in the soil treatments. Vydate L, applied by fertigation tubes during the growing season, resulted after harvest in more larger bulbs, size 14-16 and 16-18. From these results it can be concluded that Vydate L can be applied by fertigation tubes for the control of nematodes in lilies.

2 Introduction

Pratylenchus penetrans is a root lesion nematode that can cause a lot of damage in the cultivation of lily. When a plot is infected with the root lesion nematode the soil is treated before planting with Temik, Vydate or Mocap. Apart from the root lesion nematode, lilies can be infected during cultivation by leaf nematodes (Aphelenchoides). When infection by leaf nematodes is diagnosed, no control is possible anymore.
Vydate L is available as a liquid which can be applied during cultivation by means of fertigation tubes. This makes it possible to control root lesion nematodes and leaf nematodes during the growing season.
The aim of this research was to investigate the control of Pratylenchus penetrans with Vydate L, applied by fertigation tubes during the growing season.
The moment of application was studied on infected soil. The effects of the liquid formulation were compared with an untreated control and with the standard treatment with Vydate or Temik granules.

3 Material and Methods

3.1 Experimental data

Crop	
Crop	lily
Cultivar	Star Gazer
Plant size	9-11 repl. A-B-C; 11-13 repl. D
Pretreatment bulbs	hotwater-treated bulbs, in 0.5% formaldehyde
Standard disinfection bulbs	yes
Location	
Location	PPO Lisse
Greenhouse/field	field
Soil type	dune sand
Previous crop	2003 lily, 2004 grass
Planting method	4 furrows in a plot
Standard disinfection soil	no
Plot size	
Bruto area/surface	3.4 m^2
Netto area/surface	1.5 m^2
Plant depth	10 cm
Number of bulbs	150 (ABC)/120 (D)
Plant weight	2600 grams (ABC)/ 2810 grams (D)
Number of replications	4
Disease pressure	Pratylenchus penetrans
Natural occurrence	yes
Infection pressure	field was sampled on February 1st, with incubation method: 48 Pp/100 ml soil
Trial data	
Infection date	natural infection
Soil treatment(s)	according to schedule
Chemical application	Vydate and Temik
Planting date(s)	April 28th, 2005

Measurements and observations

Efficacy	
Crop damage	yes, cropstand and dying back of crop
Root damage	yes, after harvest
Yield	yes, total of bulb weight/ number of bulbs
Phytotoxicity	
Emergence	yes
Stand (crop)	yes
Die back of decrease	yes
Yield	yes

Observation scales 'Phytotoxicity'	0-10 scales, where 0 = 100% 'Phytotoxicity' , 10 = no Phytotoxicity'
Observation scales 'Efficacy'	0-10 scales, where 0 = 100% diseased, 10 = completely healthy
Exceptions	
Remarks or notes	Vydate granules milled in before planting Temik was scattered in furrow after planting Vydate L applied by way of fertigation tubes, during the growing season
Statistics	Genstat (ANOVA)

3.2 Treatments

3.2.1 Treatments applied

Treatment	Product	Active ingredient	Active ingredient%	Formulation	Dose in kg, l/ha	Mode of application
1.	Untreated	-	-	-	-	-
2.	Vydate 10 G	oxamyl	10	granulate	40 kg	Mill
3.	Temik 10 G	aldicarb	10	granulate	30 kg	Scatter in furrow
4.	water	-	-	-	16 l	Fertigation
5.	Vydate	oxamyl	250 g/l	Liquid	16 l	Fertigation
6.	Vydate	oxamyl	250 g/l	liquid	16 l	Fertigation

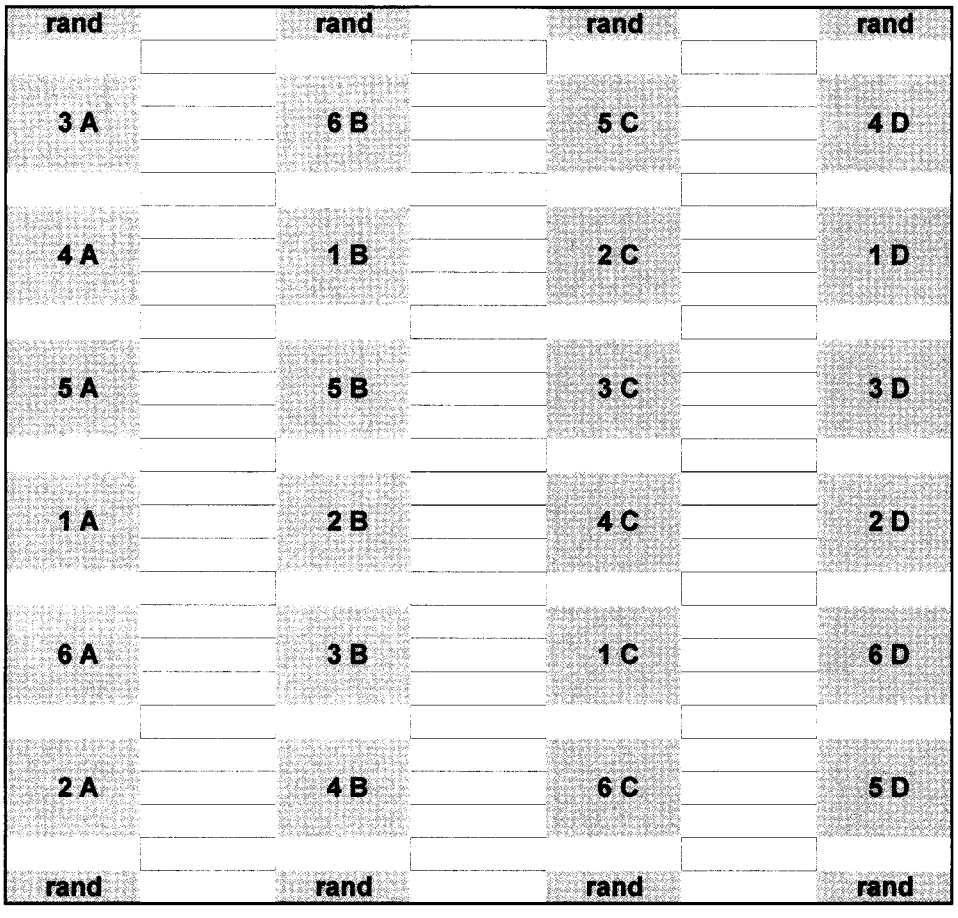
3.2.2 Time of application and amounts

Treatment	Product	Time of application	Amount of water to be prepared (l)	Amount of product to be prepared per treatment (g or ml)
1.	untreated	-	-	-
2.	40 kg Vydate 10 G	before planting	-	6 gram
3.	30 kg Temik 10 G	after planting	-	4,5 gram
4.	Water	after planting	6 liter	0 ml
	,,	at emergence	6 liter	0 ml
	,,	flowering	6 liter	0 ml
	,,	Early August	6 liter	0 ml
5.	10 l Vydate	after planting	6 liter	0,9 ml
	10 l Vydate	at emergence	6 liter	0,9 ml
	10 l Vydate	flowering	6 liter	0,9 ml
	10 l Vydate	Early August	6 liter	0,9 ml
6.	6,5 l Vydate	April	6 liter	0,6 ml
	6,5 l Vydate	May	6 liter	0,6 ml
	6,5 l Vydate	June	6 liter	0,6 ml
	6,5 l Vydate	July	6 liter	0,6 ml
	6,5 l Vydate	August	6 liter	0,6 ml
	6,5 l Vydate	September	6 liter	0,6 ml

3.2.3 Fertigation

Type of hose : TSX-506-20-500
Diameter of hose : 16 mm
Thickness of material : 0.150 mm
Distance between holes : 20 cm
Water emission : 500 l/hour/100 m hose
Pressure : 0.3 – 0.7 bar

3.2.4 Plot plan



4 Results

Table 1. Dates of fertigation in the treatments

Week number		Treatment 4	Treatment 5	Treatment 6
17	April 28 bulbs planted			
18				
19		May 13	May 13	May 13
20				
21				
22	May 23 start emergence			
23	May 30 100% emergence	June 8	June 8	June 8
24				
25				
26				June 30
27				
28	July 11 decapitate	July 11	July 11	
29				July 21
30				
31		August 2		
32				
33				August 18
34				
35				
36				September 8

Treatments 4, 5 and 6 were fertigated for the first time on May 13, so 15 days after planting. The soil was very dry and was sprinkled for some hours before fertigation with 3 mm water per m^2. After that, the soil was fertigated. Water and Vydate could spread well through the moist soil. At the time of fertigation, no emergence was seen. The sprouts were about 5 cm long.

On May 30 the percentage of emergence of the replications A, B and C were about 90-100%. On June 6 the percentage of emergence of replication D was 90-100%.
Treatment 4, 5 and 6 were fertigated for the second time on June 8. In the morning the soil was sprinkled with 3 mm water per m^2. Also this time, like before, spreading of the fluid over the plots was good. Crop height of replications A, B and C was about 10-15 cm, and in replication D crop height was about 5-10 cm.

Treatment 6 was fertigated for the third time on June 30. During the night 14 mm of rain had fallen, so the soil was moist enough to fertigate. During the night after fertigation, 3.7 mm rain had fallen.

Treatments 4 and 5 were fertigated for the third time on July 11. A top layer of 0.5 cm of the soil was dry, underneath the soil was moist enough, so it was not sprinkled before fertigation.
The next day all the flowers of the experimental field were removed.

On July 21 treatment 6 was fertigated for the 4th time. The day before it had rained, so the soil was moist enough.
Treatments 4 and 5 were fertigated for the 4th and last time on August 2. The soil was moist enough, so it was not sprinkled before fertigation.
Treatment 6 was fertigated for the 5th time on August 18, in a moist soil.
Treatment 6 was fertigated for the 6th and last time on September 8. Because the soil was dry, 3 mm water was sprinkled before fertigation.

Table 2. Weather conditions on the day before, during and after fertigation

Date	Precipitation sum (mm) from 9.00 til 9.00	Temperature (°C) 10 cm above soil surface, 24 h.	Radiation sum per 24 hours (J/cm)
May 12	0	9,89	2347,8
May 13	0	12,2	2292,7
May 14	0	12,5	2718,6
June 7	0	11,59	1963,9
June 8	0	11,96	2851,3
June 9	0	13,23	2976,7
June 29	0,4	19,9	1786,6
June 30	13,0	18,07	1846,4
July 1	3,2	16,72	2013,5
July 10	0,2	22,14	2748,5
July 11	0	20,95	2126,6
July 12	0	19,75	2374,5
July 20	0	16,97	1703,5
July 21	6,8	15,35	572,21
July 22	0	15,03	776,03
August 1	4,8	16,91	2009,8
August 2	0	17,22	2692,2
August 3	0	16,2	1523,1
August 17	0	17,71	2260,4
August 18	0	19,64	2186,7
August 19	0	18,06	710,51
September 7	0,2	17,61	1564,1
September 8	0	18,01	1800,6
September 9	0	20,19	1259,2

In the second half of June, a nematode patch was seen in the field. In the diagram below, a separation line is drawn between good and less good plants: of all plots above the line the crop stand was less than of those below the line.

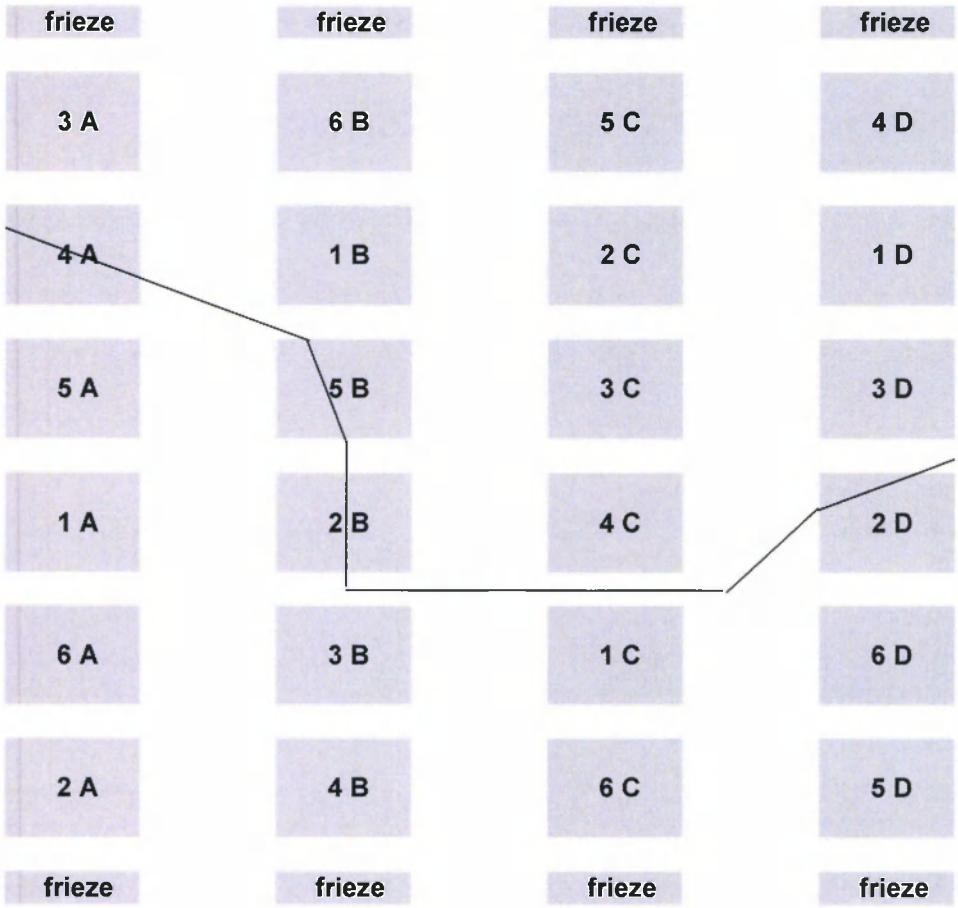


Photo of lilifield with patch. The lilies above the black line were healthier as they were under the black line.

On June 30 the number of emerged plants was counted. Overall in all treatments 99 to 100% of the plants emerged.

Table 3. Effects of the treatments on stand of crop and percentage green crop.

treatm	Mode of application	Product	Stand of crop		% green crop	
			June 27	August 18	September 12	September 28
1	Soil treatment	untreated	6	8,7	65	29
2	,,	40 kg Vydate	7,5	9,4	90	60
3	,,	30 kg Temik	7	9,2	75	56
4	Fertigation tubes	water	5,1	8,7	55	25
5	,,	4 x 10 l Vydate L	6,6	9,0	74	49
6	,,	6 x 6,5 l Vydate L	4,9	9,0	72	50
LSD			1,3	ns	12	15

Soil treatment with Vydate resulted in a better crop stand than in the untreated control. Soil treatment with Temik did not have a significant effect on the crop stand. On June 27, the fertigation treatment in which the highest dose of Vydate was used (treatment 5), had a significant better crop stand. The treatment in wich the lowest amount of Vydate was used so far (treatment 6), was not different from the untreated control. On August 18, there was no effect of the treatments on the crop stand, although the control plots showed a tendency to be less green. Dying off started earlier in plants of the control plots, than in those of the treated plots. On September 12 the plants of the plots treated with 40 kg Vydate before planting, were the greenest. Plots treated before planting with Temik were not different from those fertigated with Vydate after planting (regardless the concentration). On September 28 plants of control plots were died off most. Plots treated before planting with Temik or Vydate and treatments fertigated during growing season with Vydate all had comparable percentages of green crop.

At the end of October the crop had died off for 100%. On December 7 the trial plots were harvested. The separation line between good and less good lilies was going right through plots 2B and 5B. The left two rows of these plots were harvested apart from the right two rows. A statistical correction (nematode patch 0 and healthy patch 1 as co variable) was applied for plots in the nematode patch with the Genstat program.

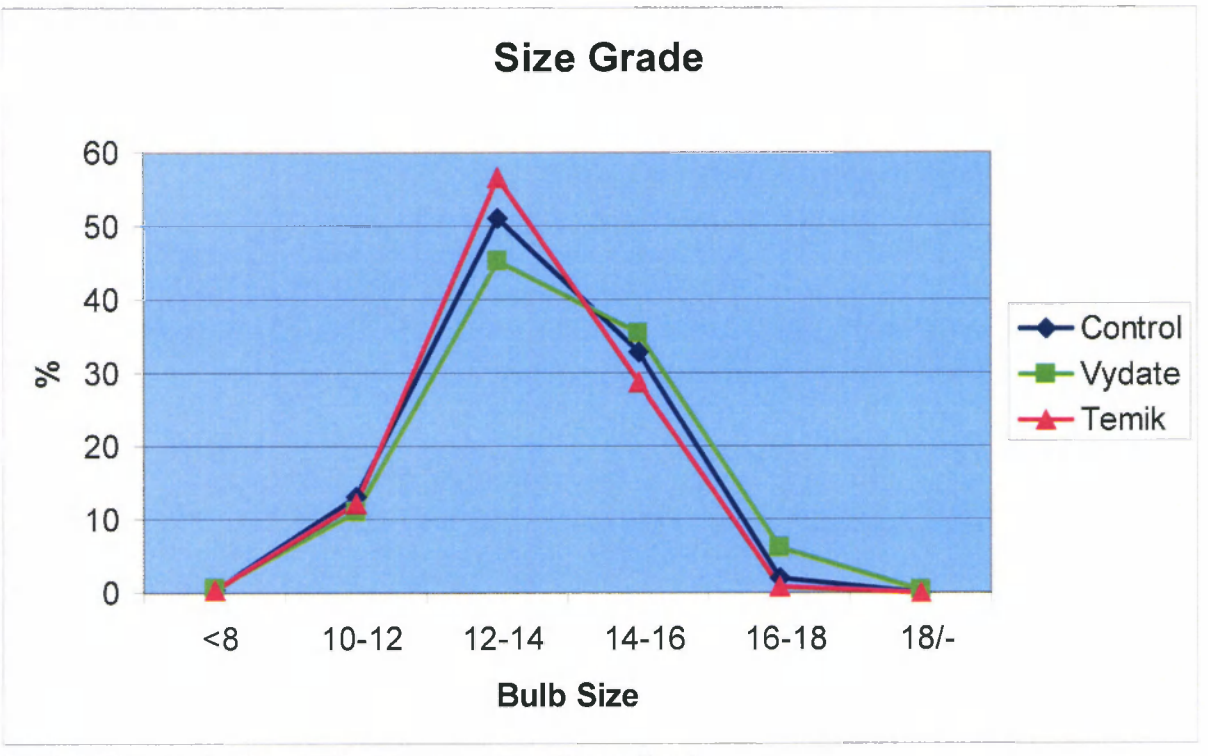
Bulb yield was assessed on December 20.

Table 4. Effects of treatments on total number of harvested bulbs, total harvested weight, average weight per harvested bulb and root rot index (0= healthy, 10= 100% infected)

Treatm nr	Mode of application	Product	Average harvested bulbs per plot	Average harvested weight per plot	Average weight per bulb	Root rot index
1	Soil treatment	Untreated	141,7	4710	33,1	9,3
2	,,	40 kg Vydate	136,5	5241	38,6	7,8
3	,,	30 kg Temik	145,5	5400	37,2	8,6
4	Fertigation tubes	Water	139,5	4422	31,6	9,5
5	,,	4 x 10 l Vydate	140,7	5043	36,6	7,7
6	,,	6 x 6,5 l Vydate	140,9	4960	35,9	7,4
LSD			5,4	438,4	3,4	1,7

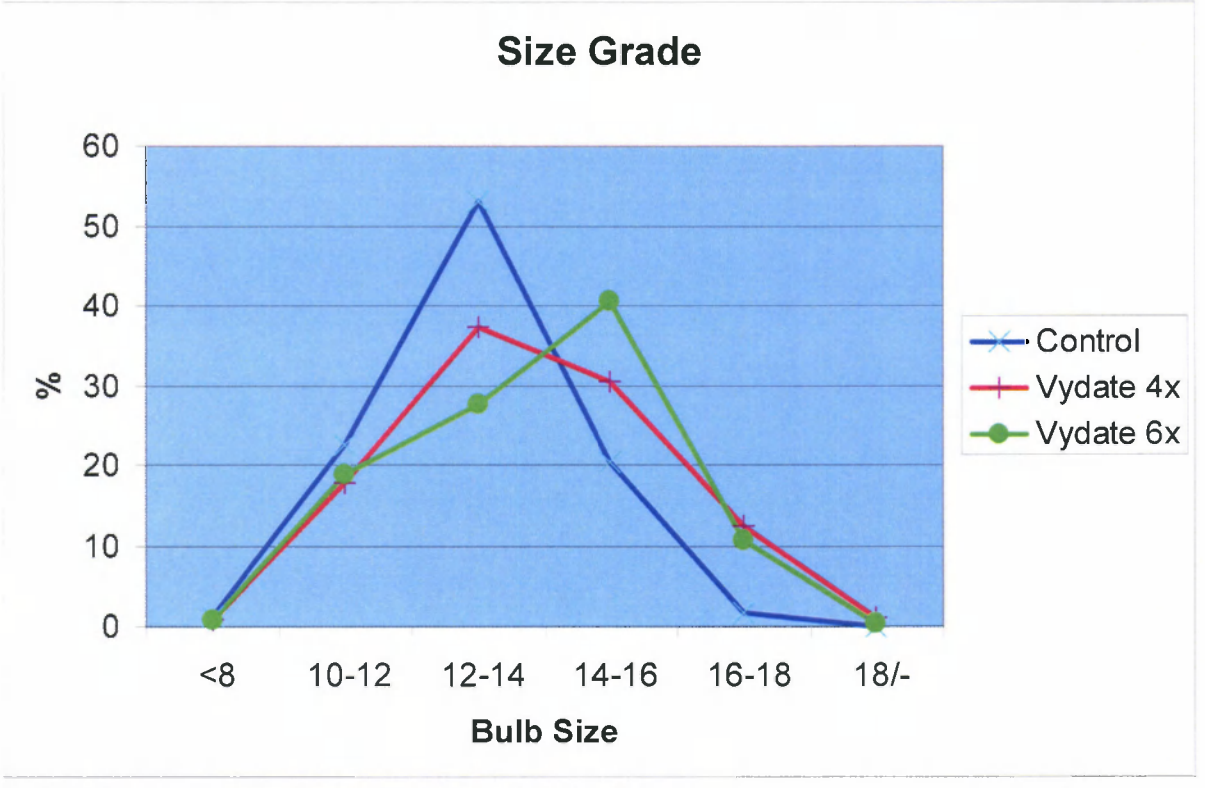
On an average 99% of the treatments was harvested. Total harvest weight and bulb weight was lowest in both control treatments. All chemical treatments were not significantly different. There was a tendency that bulb yield was highest after soil treatment with Temik or Vydate.
Bulb yields of the two treatments which were fertigated with Vydate were not different from them.
Most root rot occurred in both control treatments. Also for root rot index, there was no significant difference between the chemical treatments. There was a tendency that the level of root rot was least in the treatment that had been fertigated 6 times with Vydate (object 6).

The size grade of the harvested bulbs was assessed.



Graph 1. Size grade after a soil treatment with Vydate or Temik.

Differences between bulb sizes were very small. After a soil treatment with Vydate somewhat less bulbs size 12-14, and somewhat more bulbs of the bigger sizes 14-16 and 16-18 were harvested, compared to the control.
After a soil treatment with Temik, results were the other way round. Somewhat more bulbs size 12-14 and somewhat less size 14-16 were harvested, compared to the control.



Graph 2. Size grade after 4 or 6 times fertigation with Vydate.

Application of fertigation with Vydate showed a larger effect on the size grade of the bulbs. Less bulbs size 12-14 and more 14-16 and 16-18 were harvested in the fertigation with Vydate treatments, compared to the untreated control. This was found especially after 6 times of fertigation with Vydate.

Extra assessment of nematodes in the roots after harvest.

To verify if the nematode patch was caused by Pratylenchus penetrans, after harvest a root sample was taken from the control treatment and from the treatment with 40 kg/ha Vydate before planting. From both treatments, root samples were taken from a healthy patch (good cropstand) and from the nematode patch (bad cropstand) in the plots.

Table 5. Effects of soil treatment and nematode patch on the number of Pratylenchus penetrans in lily roots after harvest (root rot index between brackets: 0= healthy, 10= 100% infected).

Treatment	Soil treatment	Healthy patch	Nematode patch
1	Control	2424 (8)	1248 (10)
2	40 kg/ha Vydate	1224 (5)	216 (9)

In the control treatment, as well as in the treatment with Vydate, most nematodes were found in the healthy patch. Roots with the highest root rot index contained the lowest numbers of living root lesion nematodes. This has also been seen in earlier research (see report lily research 1999).
After harvest it can not be established that the nematode patch in this trial was caused by an increased population of nematodes.

Summarized results

- During the growing season a patch was found that divided the lilies into differences in yield.
- During the growing season the crop stand was inferior in both control treatments.
- At the start of the trial the crop stand was somewhat less in treatments that were fertigated 6 times with Vydate L, later on there were no differences in crop stand in the various chemical treatments.
- Bulb yield was lowest in both control treatments (see table 4).
- There were no differences in yield between the chemical treatments, although there was a tendency that yield was higher after soil treatment with Temik 10G or Vydate 10G.
- Root rot index was lowest in both fertigation treatments with Vydate L.
- After 4 or 6 times of fertigation with Vydate L more bulbs were harvested in the bigger sizes 14-16 and 16-18.
- Analysis of the roots after harvest to determine the number of nematodes in the healthy patch as well as in the nematode patch did not lead to a clear explanation for this patch-structure within the trial, but it could well be caused by nematodes during the growing season. This phenomenon is well-known from other research.

5 Conclusions

Vydate L can be applied in lilies by fertigation tubes.
There was no difference in crop stand between soil treatment with Vydate 10G before planting and 4 times Vydate L, applied by fertigation tubes during the growing season.
Shortly after emergence of the lilies the crop stand of the 6 times Vydate L fertigation treatment was bad and did not differ from the control treatments. Lateron in the growing season there was a better % green crop of the treatment with Vydate L in comparison with the water treatment by fertigation tubes.
All treatments had at 28 September a better % green crop than the control treatments.
After harvest there were no differences in bulb yield between the treatments, where the soil was treated with the granules of Temik or Vydate before planting and the treatments where Vydate L was applied by fertigation tubes during the growing season. There were no differences in bulb yield between the treatments with 4 or 6 times Vydate L, applied by fertigation tubes during the growing season. All treatments were better than the water treatment by fertigation tubes.

Appendix 1 Raw data crop

Beh!	Herh!	30/6 opkon	27/6 stand	%groen 18	gele plante	12/9 % gro	% groen op 28/9
1	A	149	9	10	geen	9	6
1	B	148	3	7	wel	4	1
1	C	148	7	10	wel	8	4
1	D	115	5	8	wel	5	1
2	A	149	8	10	geen	10	10
2	B	148	7	9	wel	9	4
2	C	145	7	8	wel	7	3
2	D	117	7	10	wel	9	6
3	A	150	5	9	wel	6	4
3	B	150	8	10	geen	10	8
3	C	150	6	7	wel	4	2
3	D	117	6	9	wel	6	4
4	A	148	4	8	wel	4	3
4	B	146	7	10	wel	7	3
4	C	147	4	8	wel	4	1
4	D	117	4	8	wel	5	1
5	A	149	8	10	geen	10	9
5	B	149	6	9	wel	8	4
5	C	148	6	8	wel	4	1
5	D	118	8	10	geen	10	8
6	A	150	5	10	geen	9	7
6	B	149	3	8	wel	5	2
6	C	150	7	10	geen	9	8
6	D	115	8	10	geen	10	8

Appendix 2 Raw data bulbs

behandeling	herh.	aantal 8\10	gewicht 8\10	aantal 10\12	gewicht 10\12	aantal 12\14	gewicht 12\14	aantal 14\16	gewicht 14\16	aantal 16\18	gewicht 16\18	aantal 18\20	gewicht 18\20	aantal dubbeln	gewicht dubbeln	totaal aa	totaal ge	gewicht/l	wortelrot
1	a	0	0	10	222	63	2046	71	3302	5	335	0	0	1	43	150	5948	39.7	8
1	b	2	27	52	973	91	2373	3	107	0	0	0	0	0	0	148	3480	23.5	10
1	c	0	0	5	104	60	1839	83	3494	6	341	0	0	0	0	154	5778	37.5	9
1	d	0	0	7	142	76	2332	30	1197	0	0	0	0	2	78	115	3749	32.6	10
2	a	0	0	3	61	53	1749	69	3232	22	1303	2	172	0	0	149	6517	43.7	5
2 slechte plek	b	1	17	22	422	38	1149	9	400	1	66	0	0	0	0	71	2054	28.9	10
2	b	0	0	4	69	21	708	32	1490	8	463	0	0	0	0	65	2730	42.0	8
2	c	3	35	29	554	94	2782	21	871	0	0	0	0	0	0	147	4242	28.9	9
2	d	0	0	3	58	41	1448	63	3031	3	203	0	0	3	107	113	4847	42.9	9
3	a	1	14	26	582	88	2746	34	1444	0	0	0	0	2	73	151	4859	32.2	9
3	b	0	0	6	139	71	2475	80	3796	2	128	0	0	0	0	159	6538	41.1	8
3	c	1	13	35	657	105	2771	8	310	0	0	0	0	0	0	149	3751	25.2	10
3	d	1	10	4	84	63	2009	45	1880	3	168	0	0	3	116	119	4267	35.9	10
4	a	1	15	45	902	75	2238	25	1066	2	140	0	0	0	0	148	4361	29.5	10
4	b	0	0	11	230	68	2047	62	2588	7	388	0	0	1	41	149	5294	35.5	9
4	c	4	44	48	910	83	2305	6	212	0	0	0	0	1	14	142	3485	24.5	10
4	d	2	31	22	460	69	2092	20	774	0	0	0	0	4	155	117	3512	30.0	10
5	a	0	0	4	83	53	1868	85	4048	8	476	0	0	0	0	150	6475	43.2	6
5 slechte plek	b	3	42	27	566	40	1204	5	211	0	0	0	0	0	0	75	2023	27.0	10
5	b	0	0	3	63	45	1353	45	1127	2	122	0	0	0	0	95	2665	28.1	9
5	c	2	22	67	1374	68	2008	8	304	0	0	0	0	0	0	145	3708	25.6	10
5	d	0	0	0	0	5	153	49	2339	60	3614	6	459	0	0	120	6565	54.7	4
6	a	0	0	14	275	47	1489	78	3398	11	679	0	0	0	0	150	5841	38.9	7
6	b	4	56	82	1662	58	1676	6	269	0	0	0	0	0	0	150	3663	24.4	9
6	c	0	0	10	215	39	1317	86	4039	14	866	0	0	0	0	149	6437	43.2	5
6	d	1	12	1	18	14	504	61	3061	36	2312	2	164	4	246	119	6317	53.1	6
																			0=gezond
																			10=100% a