Project title:	Large narcissus fly: effects of defoliation and lifting date on flower and bulb yields
Report:	Final report 1998 Lincolnshire Results
Previous reports:	None
Project number:	BOF 37
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Date commenced:	1 September 1995
Date completion due:	January 1999
Key words:	Narcissus, daffodil, large narcissus fly, non-chemical pest control

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AUTHENTICATION

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

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PRACTICAL SECTION

Objectives and background

Apart from adding chlorpyrifos to the hot-water treatment tank, no suitable chemical treatment is currently available in the UK to control large narcissus fly. Using chlorpyrifos in this way prevents bulbs being infested by the pest, but only during the first year of the two-year growing cycle.

Defoliating narcissus plants prevents the adult fly laying eggs on the foliage, and lifting bulbs before the date of egg-hatch prevents the larvae entering bulbs. Early defoliation and (or) early lifting could be used as cultural means of control of the narcissus fly, timing operations to the narcissus fly prediction service which is already available. This project was set up to determine the likely loss of bulb and flower yield resulting from using different defoliation dates (in year one) and different lifting dates (in year two).

Summary

In a field experiment in Lincolnshire, plots of four narcissus varieties (Carlton, Dutch Master, Golden Harvest and Ice Follies) were planted in 1995. In the first year, plots were defoliated on 23 May or 20 June, or were left untreated. These dates corresponded to egg-laying in an 'early' and a 'late' year. In the second year, plots from each of these three first-year treatments were either lifted on 5 June, 19 June or 2 July, or were defoliated on 5 June but not lifted until 2 July. These dates corresponded to egg-hatch in an early, a middle and a late year.

Defoliation in year one resulted in a loss of flower yield and an increase in the incidence of the disease smoulder in the second year. Applied at the earlier date, defoliation resulted in severe losses in flower yield (6 to 33%), while defoliation at the later date resulted in smaller losses (2 to 8%). Variety Ice Follies was less seriously affected than the other cultivars. This effect did not appear to be related entirely to the stage of foliar senescence at which defoliation took place.

Early lifting in year two led to reduced bulb yields, more rotted bulbs, and bulbs with fewer buds (next year's flowers), compounding the adverse effects of early defoliation in the first year. In year two, defoliating bulbs on the early date but delaying lifting until the late date, appeared to be less detrimental to yield than early lifting.

All treatments reduced yields when compared with plots which were untreated in the first year and lifted on the late date (2 July) in the second. Bulb yield loss was less than 20% in the case of bulbs untreated in the first year and either lifted at the middle date (19 June) or defoliated at the early date (5 June) but not lifted until later (2 July) in the second year. Other treatment combinations resulted in greater losses.

Action points for growers

In situations where serious losses due to large narcissus fly are expected, the use of chlorpyrifos in hot-water treatment should be considered, to protect bulbs in their first year. In the second year, early lifting could be used as a means of cultural control of narcissus fly, lifting just before the predicted date of egg-hatch. Provided this was not too early (say before mid-June in Lincolnshire), the bulb and flower losses incurred might be acceptable if control of large narcissus fly was the prime concern.

Practical and financial benefits from the study

The study may lead to guidelines for using early bulb lifting as part of an integrated strategy for controlling large narcissus fly, but the full implications await the completion of a second field experiment in Cornwall in 1998.

EXPERIMENTAL SECTION

Introduction

Since the withdrawal of the insecticide aldrin in 1989, other means of controlling the large narcissus fly have been sought urgently. Many other chemicals have been tested: most have been ineffective against the pest, while the relatively effective materials have either given inconsistent control and have been difficult to apply accurately (eg, carbofuran or disulfoton granules), have been withdrawn for commercial reasons (omethoate), or need to be applied in hot-water treatment (chlorpyrifos). Amongst non-chemical control methods investigated, charring or physically excising the foliage deters egg laying, and early bulb lifting stops the larvae entering the bulbs.

Early bulb lifting and (or) foliage destruction could provide a practical means of preventing infestations of commercial narcissus stocks by the pest. However, although narcissus crops are nowadays lifted before the foliage has completely died down, even earlier lifting would curtail bulb growth at a time when it is normally most rapid. Surprisingly few data are available on the effect of lifting date on bulb yield, particularly under modern, commercial conditions. In order to be able to balance the pest-controlling effects of early defoliation or early lifting with their possibly detrimental effects on bulb yield, reliable information on the effect of defoliation or lifting date on yield is needed. There is also a need to assess flower production in the year following these treatments, as there is a suggestion that this may also be lowered. As the date of egg-laying can be forecast from meteorological data, it should be possible to construct a site-specific balance sheet for the relative benefits of early lifting (to control infestation) and late lifting (to increase crop yield). Any reduction in egg-laying or bulb invasion may be worthwhile, as no insecticide is likely to be 100 per cent effective, so it may be practical to have a compromise, with some control by somewhat earlier defoliation or lifting without unacceptable loss of bulb yield. The value of narcissus bulbs and the economics of flower cropping can change rapidly, so it is important to have this information if sensible management decisions are to be made. Even in the absence of a serious problem with narcissus fly, data on the effects of lifting date are relevant to meeting deadlines and yields for bulb exports. In the wider context of integrated pest and disease control, defoliation and lifting dates are also likely to have an effect on the susceptibility of crops to fungal and viral infections.

This project was set up to determine the effects of defoliation and lifting dates on bulb and flower yield. Field experiments were carried out both in Lincolnshire and Cornwall. This first report on the project describes the work in Lincolnshire, carried out in 1995-1997. The experiment in Cornwall runs from 1996 to 1998, and when this is completed a further report will be issued.

Materials and methods

Plant material

The Lincolnshire experiment was started in 1995, using 10-12 cm grade bulbs of cultivars Carlton, Golden Harvest, Dutch Master and Ice Follies. The first two varieties were taken from stocks grown at HRI-Kirton, the second two were purchased from a grower in South Lincolnshire. Following receipt or allocation of the bulbs in July-August 1995, bulbs were stored at ambient temperatures, received standard hot-water treatment (HWT), and were then dried and stored at ambient temperatures until planting. HWT consisted of a three hour treatment at 44.4°C with formalin, Storite Clear Liquid and non-ionic wetter, all at recommended rates.

During storage bulbs of each variety were weighed into 36 lots of 10 kg each for the experimental plots, and each 10 kg lot was placed evenly in a 7.5 m length of tubular nylon netting (Netlon Oriented 1). Planting bulbs in netting was to ensure full recovery of bulbs at the end of the experiment. Additional lots of bulbs, 1008 kg in all for each variety, were weighed out into appropriate amounts to use as guard plants around the experimental plots.

Crop husbandry

The bulbs were planted in a field at HRI-Kirton, Lincolnshire, on 20 September 1995. The trial area had been previously ridged and the plot and guard areas marked in, each plot consisting of a 7.5 m length of ridge (the experimental plot), with a 1 m guard area at either end and a guard ridge (9.5 m long) at each side. At planting the netted experimental plots were laid in the ridge bottom, the guard bulbs were scattered evenly in the guard areas, and the ridges were split back. The arrangement gave a uniform planting density of 17.5 t/ha with ridge centres at 0.76 m.

Routine husbandry followed good commercial practice for eastern England. Fertilisers were applied according to analysis and MAFF recommendations, potash in the base before cultivation and nitrogen as a top-dressing pre-emergence in the first year. Weed control was by dormant season application of diquat + paraquat, pre-emergence cyanazine and early-post-emergence chlorpropham + linuron. From emergence the crop received a regular fungicide spray programme (involving iprodione, chlorothalonil, mancozeb, benomyl and vinclozolin), with five sprays in the first year and three in the second. All pesticides were applied at recommended rates. In the September between the two growing seasons, the trials area was re-ridged. Crop defoliation and lifting formed part of the experimental treatments (see below). In the second year flowers were cropped at a commercial picking stage (upright 'pencil').

Following lifting, bulbs were dried under fans at ambient temperatures, cleaned and graded.

Treatments

First year In the first year (1995-1996) plots were either allowed to die-down naturally, or had their foliage removed by flailing 'early' on 23 May or 'late' on 20 June 1996. These defoliation dates corresponded with the dates of 5 per cent egg-laying in an early or late year (for the region).

Second year In the second year (1996-1997) plots from each of the first year treatments (not defoliated, or defoliated early or late) received one of four treatments. They were lifted on three dates, 5 June, 19 June or 2 July 1997, or were defoliated on 5 June but not lifted until 2 July. The three lifting dates corresponded with the dates of 5 per cent egg-hatching in an early, average or late year (for the region). The fourth treatment (early defoliation, later lifting) represented a situation in which early lifting might not be practical.

The expected dates of egg-laying and egg-hatching were derived from the previous few years' monitoring of fly activity, using 1990 as an example of an early year and 1986 as an example of a late year.

Defoliation refers to the removal of foliage just above the ridge surface. At lifting, plots were defoliated immediately before lifting, except in the last treatment mentioned above where delayed lifting was part of the experiment.

The treatments are shown below:

Treatment	Year 1	Year 2
1	None	Lift 5 June
2	None	Lift 19 June
3	None	Lift 2 July
4	None	Defoliate 5 June, Lift 2 July
5	Defoliate 23 May	Lift 5 June
6	Defoliate 23 May	Lift 19 June
7	Defoliate 23 May	Lift 2 July
8	Defoliate 23 May	Defoliate 5 June, Lift 2 July
9	Defoliate 20 June	Lift 5 June
10	Defoliate 20 June	Lift 19 June
11	Defoliate 20 June	Lift 2 July
12	Defoliate 20 June	Defoliate 5 June, Lift 2 July

Treatments 1 to 4 represented a situation in which no cultural control was needed in the first year (for example, if chlorpyrifos had been used in the HWT tank), and timed lifting or defoliation was used as a control in the second year

Treatments 5 to 12 represented a situation in which no pre-planting chlorpyrifos was used, and control was by timed defoliation in the first year and timed lifting in the second

Records

During the growing season the following records were taken:

- percentage foliage senescence at the experimental defoliation and lifting dates (these figures are given in Tables 1 (for year 1) and 3 (for year 2))
- flower yield (second year only)
- flower diameter, stem and foliage length from a sample of 10 central blooms per plot (second year only)
- extent of foliar diseases (the main records taken were of smoulder, recorded as the number of affected plants per plot on 14 April and 13 May 1997)

Following lifting and grading the following were recorded (on 5 August 1997):

- bulb yield (number and weight of marketable bulbs in grades <8, 8-10 .... 16-18 and >18 cm)

- number and weight of rotted bulbs at grading

Bulbs were then stored at ambient temperatures in a shed until November 1997, when the following were recorded:

- number of flowers initiated in a weighed sample of 50, 10-12 cm bulbs (an estimate of flower yield for the subsequent year), by cutting bulbs transversely (recorded on 25-26 November)

- the number of bulbs with basal, neck or whole-bulb rots or large narcissus fly maggots, determined from samples of 100, 10+ cm grade bulbs, by bisecting bulbs lengthways (recorded on 6-13 November)

Experimental design and statistical analysis

The four varieties were planted in separate areas and the data for each were treated separately. For each variety the 12 treatments were laid out in a randomised block design with three replicate blocks. All recorded plots were surrounded by guard areas, and treatments were applied across the three ridges making up the recorded area with its guard area. The trial design was approved by HRI Biometrics Department.

Data were subjected to the analysis of variance as appropriate.

Results

Flower yield and quality in year 2

Compared with plots untreated in year 1, late defoliation reduced flower yield in the next year and the effects of early defoliation were even more severe (Table 1). In Carlton, flower yields were reduced by 7 per cent by late defoliation and by 27 per cent by early defoliation. In Dutch Master the figures were 8% and 33%, in Golden Harvest 2% and 25%, and in Ice Follies 5% and 6%, respectively. In Ice Follies, the reductions were not statistically significant. Hand in hand with the loss of flower yield, stem and foliage lengths were reduced by defoliation the previous year, severely so following early defoliation (Table 1). Flower size was similarly affected, although the effects were not severe (Table 1).

All four varieties had foliage which was about 5 per cent senescent at the date of the early defoliation treatment, so differences in the rate of senescence do not apparently explain the resistance of Ice Follies to flower losses following early defoliation (Table 1). Golden Harvest was the earliest variety to senesce, and the weak effect of late defoliation on subsequent flower losses can be explained by the 70 per cent senescence of its foliage at late defoliation. Early defoliation treatments in the first year appeared to lead to somewhat earlier senescence in the second year (Table 3).

Foliar disease in year 2

The relatively low incidence of smoulder in plots which had been untreated in year 1 was increased significantly by late defoliation and very seriously by early defoliation (Table 2). In plots of Dutch Master which had high levels of smoulder, there also appeared to be a high incidence of the physiological disorder 'chocolate spot'. Variety Ice Follies was less affected by smoulder than the other varieties.

Bulb yields

Carlton For the treatments applied in year 2, marketable bulb yields (both by weight and numbers) increased with later lifting (Table 3a). For the second year treatment in which plants were defoliated early but not lifted until later, the weight of bulbs harvested was more like that of bulbs lifted at the middle date. In the case of bulb numbers, plots which were defoliated early and lifted later gave the greatest yields of the four treatments.

Bulb yields were reduced when defoliation had been carried out in year 1, particularly when it had been done at the earlier date.

The numbers of bulbs which were rotted at grading was significantly increased in plots defoliated in year 1, especially when defoliated early (Table 3a).

Dutch Master As in the case of Carlton, progressively later lifting in year 2 resulted in greater yields (weights and numbers) (Table 3b). However, unlike the case in Carlton, the plots defoliated early and lifted later gave similar yields to those lifted early.

Bulb yields were reduced when defoliation had taken place in year 1, particularly when defoliated early.

Early defoliation in year 1 also led to an increased number of bulbs which were rotted at grading.

Golden Harvest The effect of the year 1 and year 2 treatments on yield were the same as for Carlton, although the effects of the year 1 treatments on bulb numbers were not significant (Table 3c).

Earlier defoliation in year 1 again led to more rotted bulbs at harvest.

Ice Follies As in the case of Carlton, the weight of bulbs harvested (and generally also the numbers, although these just failed to achieve statistical significance) increased with later lifting in year 2, and the plots which were defoliated early but lifted later performed better than those lifted early (Table 3d).

Bulb yields by weight were reduced when defoliation, especially early defoliation, was carried out in year 1.

The numbers of rotted bulbs were small, but there appeared to be an increase related to early defoliation in year 1 (not statistically significant).

Bulb pests and diseases

There were only low rates of large narcissus fly larvae and of bulb rots in the experiment: overall percentages for the four varieties are given in Table 4. With such low incidences, statistical analysis would not be valid, but the treatment means for larvae and bulb rots (all types of rot combined) are given in Table 5. The bulb rots found were typical of those caused by *Fusarium oxysporum f. sp. narcissi*.

Flowering potential of bulbs

Table 6 shows the number of flower buds in harvested bulbs. These are expressed both per bulb and per weight, because results could be affected by different bulb weights in different treatments.

Defoliation in year 1, especially early defoliation, resulted in lower flower bud numbers. Ice Follies was less affected than other varieties.

The effects of treatments applied in year 2 were not entirely consistent. In Carlton plots defoliated early and lifted later resulted in the greatest number of flower buds. In Dutch Master and Ice Follies most buds resulted from early lifting. Effects of year 2 treatments on Golden Harvest were not statistically significant.

Discussion

Crop defoliation treatments in the first year of the two-year-down cycle reduced flower yields and quality in the second year. In addition, aspects of flower quality (stem length and flower size) were also reduced, and the incidence of smoulder was increased. Ice Follies was less affected by these treatments than the other three varieties included, but this did not appear to be related to the amount of senescence at the time defoliation in year one took place. Otherwise, only in the case of Golden Harvest, where late defoliation was carried out when foliar senescence was already fairly advanced, were the effects of defoliation trivial. Bulb yields were seriously affected by defoliation in year one, and especially when carried out at the earlier date. These yield reductions were connected with an increase in bulb rots. Bulb yields were also seriously affected by the earlier lifting dates in the second year (curiously, yields were generally better from plots defoliated early and lifted later, than from plots simply lifted at the early date).

On the basis of this single experiment, there would appear to be little scope for using early defoliation or early lifting as cultural methods of control of large narcissus fly, if bulb yields are to be maintained. Taking as a 'control' treatment 3 (untreated in year one, lifted late in year two), bulb yields as a percentage of the control are shown in parenthesis in Table 3. With one exception, all treatments reduced yield compared with the control. Taking as an 'acceptable' yield a figure of 90 per cent of the control, only four treatment combinations would be judged acceptable, namely treatments 2 (untreated in year one, middle lifting date in year two) and 4 (untreated in year one, early defoliation and later lifting in year two) in cultivars Carlton and Dutch Master only. Extending the 'acceptable' limits to 80 per cent of the control yield, these two treatments would also be acceptable for Golden Harvest and

Ice Follies, along with treatments 10 and 11 (late defoliation in year one, mid or late lifting in year two) in the case of Golden Harvest only. The early dates of defoliation and lifting were unacceptable in the present experiment. These treatments also resulted in a lower bud count, so flower yields from these bulbs would be severely affected.

Further discussion of these results will be deferred until the other part of this project, a field trial in Cornwall, is completed in 1998.

Acknowledgements

Thanks are due to the staff of HRI-Kirton, especially Mrs L J Withers and Mr R Asher, for carefully carrying out this trial.

Table 1 Flower and leaf measurements in year 2 following defoliation treatments in year 1[a]

Treatment (in year 1)	% foliar senescence at treatment	Flower yield (no./plot)	Flower diam (mm)	Stem length (mm)	Foliage length (mm)
cv Carlton					
Untreated	-	372	105	480	484
Early defoliation	5	272	94	400	396
Late defoliation	30	346	100	452	464
SED (31 df)		12.7	1.2	6.3	7.3
Significance		***	***	***	***
cv Dutch Master					
Untreated	-	239	112	480	476
Early defoliation	5	161	103	421	419
Late defoliation	40	220	112	454	443
SED (31 df)		6.2	1.4	8.0	6.7
Significance		***	***	***	***
cv Golden Harvest					
Untreated	-	389	109	486	496
Early defoliation	5	291	100	451	450
Late defoliation	70	380	108	481	484
SED (31 df)		8.8	0.8	5.1	7.5
Significance		***	***	***	***
cv Ice Follies					
Untreated	-	429	105	476	471
Early defoliation	5	402	98	435	439
Late defoliation	20	408	102	464	467
SED (31 df)		18.0	0.6	6.8	6.8
Significance		NS	***	***	***

[a]In this and subsequent tables, statistical significance is indicated by NS, not significant, and *, ** and ***, significant at the 5, 1 and 0.1% levels of probability, respectively.

Table 2 Incidence of smoulder in year 2 following defoliation treatments in year 1

Treatment (in year 1)	Smoulder incidence (no. plants/plot)	
	April	May
cv Carlton		
Untreated	10	19
Early defoliation	71	100
Late defoliation	40	69
SED (31 df)	6.6	8.8
Significance	***	***
cv Dutch Master		
Untreated	6	15
Early defoliation	67	71
Late defoliation	29	38
SED (31 df)	3.4	4.1
Significance	***	***
cv Golden Harvest		
Untreated	12	23
Early defoliation	81	84
Late defoliation	38	53
SED (31 df)	7.1	6.8
Significance	***	***
cv Ice Follies		
Untreated	6	5
Early defoliation	49	28
Late defoliation	17	13
SED (31 df)	4.3	3.1
Significance	***	***

Table 3 Bulb yields after two years' defoliation and lifting date treatments
(a) cv Carlton

Treatment		% foliar senescence at year 2 treatment	Marketable bulbs (yield/plot)			Rotted bulbs (no./plot)
Year 1	Year 2		weight (kg)	% increase[a]	Number	
Untreated	Early lifting	35	17.9	79 (64)	487	4
	Mid lifting	50	20.1	101 (82)	540	7
	Late lifting	75	22.3	123 (100)	543	3
	Early defoliation + late lift	35	20.3	103 (84)	555	5
Early defoliation	Early lifting	50	10.8	8 (7)	390	32
	Mid lifting	70	12.0	20 (16)	503	22
	Late lifting	95	12.9	29 (24)	514	18
	Early defoliation + late lift	50	12.6	26 (21)	541	14
Late defoliation	Early lifting	40	13.0	30 (24)	444	19
	Mid lifting	45	16.8	68 (55)	519	3
	Late lifting	75	18.0	80 (65)	517	5
	Early defoliation + late lift	40	16.9	69 (56)	541	7
SED (22 df)			0.56	5.6	25.9	8.1
Significance						
Year 1 treatments			***	***	**	***
Year 2 treatments			***	***	***	NS
Interaction			*	*	NS	NS

[a]figures in parenthesis are yield as a percentage of treatment 3 (untreated in year one, late lifted in year two)

(b) cv Dutch Master

Treatment		% foliar senescence at year 2 treatment	Marketable bulbs (yield/plot)			Rotted bulbs (no./plot)
Year 1	Year 2		weight (kg)	% increase	Number	
Untreated	Early lifting	35	15.6	56 (66)	377	11
	Mid lifting	75	17.5	75 (88)	398	7
	Late lifting	95	18.5	85 (100)	410	10
	Early defoliation + late lift	35	16.9	69 (81)	395	9
Early defoliation	Early lifting	50	10.1	1 (1)	340	30
	Mid lifting	90	10.3	3 (4)	347	20
	Late lifting	95	12.2	22 (26)	389	13
	Early defoliation + late lift	50	11.3	13 (15)	412	15
Late defoliation	Early lifting	45	13.5	35 (41)	391	8
	Mid lifting	75	14.7	47 (55)	358	13
	Late lifting	95	15.6	56 (66)	395	14
	Early defoliation + late lift	45	13.3	33 (39)	364	18
SED (22 df)			0.62	6.2	20.1	5.2
Significance						
Year 1 treatments			***	***	NS	**
Year 2 treatments			***	***	*	NS
Interaction			NS	NS	*	NS

(c) cv Golden Harvest

Treatment		% foliar senescence at year 2 treatment	Marketable bulbs (yield/plot)			Rotted bulbs (no./plot)
Year 1	Year 2		weight (kg)	% increase	Number	
Untreated	Early lifting	45	15.3	53 (70)	446	12
	Mid lifting	95	17.5	75 (99)	473	9
	Late lifting	100	17.6	76 (100)	502	2
	Early defoliation + late lift	45	19.0	90 (118)	492	6
Early defoliation	Early lifting	60	11.1	11 (14)	447	8
	Mid lifting	95	12.1	21 (28)	463	11
	Late lifting	100	12.5	25 (33)	483	8
	Early defoliation + late lift	60	12.4	24 (32)	487	8
Late defoliation	Early lifting	50	14.5	45 (59)	466	12
	Mid lifting	95	17.0	70 (92)	497	13
	Late lifting	100	17.5	75 (99)	483	12
	Early defoliation + late lift	50	15.8	58 (76)	481	13
SED (22 df)			0.84	8.4	22.8	3.5
Significance						
Year 1 treatments			***	***	NS	*
Year 2 treatments			***	***	*	NS
Interaction			NS	NS	NS	NS

(d) Ice Follies

Treatment		% foliar senescence at year 2 treatment	Marketable bulbs (yield/plot)			Rotted bulbs (no./plot)
Year 1	Year 2		weight (kg)	% increase	Number	
Untreated	Early lifting	30	16.6	66 (72)	637	3
	Mid lifting	95	18.6	86 (93)	721	3
	Late lifting	100	19.2	92 (100)	694	12
	Early defoliation + late lift	30	18.7	87 (95)	680	4
Early defoliation	Early lifting	45	12.9	29 (32)	620	5
	Mid lifting	100	13.4	34 (37)	686	10
	Late lifting	100	13.8	38 (41)	654	8
	Early defoliation + late lift	45	13.0	30 (33)	668	10
Late defoliation	Early lifting	40	15.2	52 (57)	653	3
	Mid lifting	95	16.7	67 (73)	703	1
	Late lifting	100	17.4	74 (80)	640	11
	Early defoliation + late lift	40	17.1	71 (77)	711	4
SED (22 df)			0.9	9.2	40.9	6.7
Significance						
Year 1 treatments			***	***	NS	NS
Year 2 treatments			*	*	NS	NS
Interaction			NS	NS	NS	NS

Table 4 Overall percentages of bulbs with large narcissus fly larvae and bulb rots at the conclusion of the experiment

	Percentage of bulbs with			
Variety	Larvae	Base rot	Neck rot	Whole-bulb rot
Carlton	0.5	0.9	0.4	1.1
Dutch Master	0.9	1.2	1.0	0.9
Golden Harvest	0.8	1.4	0.3	1.7
Ice Follies	0.6	0.1	0.1	0.1

Table 5 Incidence of large narcissus fly larvae and bulb rots (all rot types combined) by the conclusion of the experiment

Treatment		% bulbs with larvae				% bulbs with rots			
Year 1	Year 2	Carlton	Dutch Master	Golden Harvest	Ice Follies	Carlton	Dutch Master	Golden Harvest	Ice Follies
Untreated	Early lifting	0	1	0	0	1	1	8	0
	Mid lifting	0	0	0	0	0	1	3	0
	Late lifting	0	1	0	0	1	5	1	0
	Early defoliation + late lift	0	2	0	1	0	4	4	0
Early defoliation	Early lifting	0	0	0	0	0	1	2	0
	Mid lifting	0	1	1	1	2	2	3	0
	Late lifting	1	2	2	1	1	2	2	0
	Early defoliation + late lift	2	2	3	2	0	3	2	0
Late defoliation	Early lifting	0	0	0	0	8[a]	2	4	1
	Mid lifting	0	0	0	0	0	6	4	0
	Late lifting	1	1	1	0	0	5	4	0
	Early defoliation + late lift	1	1	2	1	1	5	4	1

[a]Nearly all rotted bulbs occurred in one replicate of this treatment

Table 6 Flower bud numbers based on bulb dissections at the conclusion of the experiment

Treatment		Carlton		Dutch Master		Golden Harvest		Ice Follies	
Year 1	Year 2	Per 100	Per kg	Per 100	Per kg	Per 100	Per kg	Per 100	Per kg
Untreated	Early lifting	89	47	67	29	83	39	114	55
	Mid lifting	83	39	53	23	71	36	93	53
	Late lifting	91	42	47	22	91	36	87	57
	Early defoliation + late lift	98	44	59	26	79	35	96	55
Early defoliation	Early lifting	58	38	45	22	49	28	99	51
	Mid lifting	60	32	28	11	37	21	85	53
	Late lifting	59	30	34	15	53	26	88	47
	Early defoliation + late lift	77	39	40	20	61	31	81	45
Late defoliation	Early lifting	70	37	66	29	65	34	112	51
	Mid lifting	77	39	41	18	59	31	85	48
	Late lifting	87	39	51	25	74	35	91	48
	Early defoliation + late lift	85	41	47	23	66	30	95	54
SED (22 df)		8.2	3.3	13.7	4.5	14.1	5.0	7.8	3.9
Significance									
Year 1 treatments		***	***	*	**	***	**	NS	*
Year 2 treatments		*	*	NS	*	NS	NS	***	NS
Interaction		NS	NS	NS	NS	NS	NS	NS	NS

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