Project Title:	Narcissus: overcoming the problem of soil sickness with particular reference to the Isles of Scilly
Project number:	BOF 50
Project leader:	Andrew Tompsett
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The results and conclusions in this report are based on an investigation conducted over one year. The conditions under which the experiment was carried out and the results obtained have been reported with detail and accuracy. However because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial product recommendations.

Contents

Grower Summary

Headline

This project seeks to establish, by survey, some of the causes of soil sickness. Also, since there have been good reports from Holland on the effectiveness of *Tagetes patula* (French Marigolds) in controlling certain soil-borne pests and diseases of bulbs, this technique will be compared with the standard soil fumigation treatment employed by growers.

A survey of sites showing symptoms of "soil sickness" for soil borne nematodes is reported.

Background

Trenoweth Horticultural Centre (formerly Trenoweth R&D) is supported by 25 fee paying narcissus growers on the Isles of Scilly. These growers were invited to notify the centre of problems they were experiencing of patches of "soil sickness" in their crops.

Past analysis and experience suggest that such problems are usually sde to a build up of pathogens in the soil the most commonly supposed to be *Pratylenchus* in combination with root rotting fungi. However, past experience suggests that precise diagnosis is difficult.

In order to focus control measures more precisely, this project was set up to identify the causes of "soil sickness" as a prelude to further work on control measures which could include soil sterilants and bio-fumigant plants.

Summary of results and main conclusions

The majority (60%) of sites showing symptoms of soil sickness confirmed the presence of the nematode *Pratylenchus* and many of the samples also had the fungus *Cylindrocarpon* confirmed on the roots. These are the two agents generally regarded as causing soil sickness. This information forms a base line for further study and will enable us to identify a suitable trial site for further work.

The greatest value will be in selecting a site or sites for trials on control measures during 2003 and 2004 and in monitoring nematode populations on some of the sites after commercial control measures (eg Telone) have been applied by growers.

Financial benefits

It is too early to quantify these.

Action points for growers

It is too early in the project to define any grower action points.

Science Section

Introduction

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In order to focus control measures more precisely HDC BOF 50 seeks to identify the causes of "soil sickness" as a prelude to further work on control measures which could include soil sterilants and bio-fumigant plants.

Methods

A total of 11 growers reported problem sites and a total of 20 sites and 37 soil samples were studied. Advice was provided by Central Science Laboratory (CSL) who undertook the examinations for both nematodes and where feasible fungi in bulb and root samples.

Although the primary object was to identify primary nematode pathogens, in some cases bulbs with rotted roots were enclosed with the "bad" soil sample. These were examined and cultured for fungal pathogens. The extent of root rotting was also noted although the process of lifting and despatch often removed most senescent root.

Of the 20 sites, 16 provided an opportunity to compare "good" and "bad" areas of the crop. The remaining 4 were considered to be "bad" overall.

Notes and maps exist for each site as a guide to future action on the sites. Cases 1-6 were sampled in the 2001 growing season and the rest in 2002.

Results

The following table sets out the laboratory results obtained from both "good" and "bad" areas.

The grower's names are coded for confidentiality. The keys to cultivars and fungi are attached.

There are 10 headings for nematode genera or species and another annex shows the relevance of these for crop damage as far as it is known. We are grateful to CSL for this guidance.

The nematode count was per 200g soil sample.

In every case this was taken from a mixed sample of at least 500g taken from some 20, 2cm diameter cores 0-15cm deep, from the bulb ridges, on each site.

Key to nematodes

Prat. Pratylenchus sp. (Root lesion nematode)

P.penetrans and *P Neglectus* are widely associated with plant root disease problems. The former is the more aggressive. Feeding facilitates the entry of root rotting fungi. The figure of 28 Pratylenchus per 200g (case 3) is thought to be at a damaging level. However the soil test may not accurately indicate the numbers present, many of which may be in the roots. Populations in cases 3, 7, 9, 10, 13, 15, 16, 17, 18, 19 could all be significant. The population in 13 "bad" is particularly high. Where a "good" plot is shown to have more nematodes that the "bad" the explanations may be as a result of the loss of root in the "bad" area leading to a population decline. Or, it may mean that secondary fungi had not yet affected the site.

Trich. Trichodorus sp. (Stubby root nematode)

Trichodorus species stunt roots but are not thought to be highly dangerous. They are virus vectors e.g. tobacco rattle virus.

Roty. Rob. Rotylenchus robustus (Spiral nematode)

This is a known root pathogen in horticultural crops and some counts were present in the survey. On site 9 the high count of 199 was in conjunction with another spiral nematode (*Heliocotylenchus*) which is not however considered to be very damaging. Case 16 also had a high count.

Roty. Good Rotylenchus goodeyii (Spiral nematode)

A common species in Britain which feeds on the outside of roots and is not considered a pest species event at the high count of 300+. However, the nematologist comments that high populations of a range of species all add to the feeding pressure in the root zone and may be significant in certain circumstances.

Helio. Heliocotylenchus sp. (Spiral nematode)

A common genus which can be present in large numbers without causing much harm. The fact that case 13-good had 750+ H. varicaudatus supports this view.

Para. Paratylenchus sp. (Pin nematode)

Pathogenic when present in high numbers. In case 17 a count of 19 was not likely to be damaging although in this case and in case 13 the numbers are considered sufficient to add to the overall nematode effect on the plants.

Longi. Longidorus sp. (Needle nematode)

A virus vector. Only one found in this survey.

Cysts

Host specific and of no importance here. Possible Potato cyst juveniles.

Roty. Pumil. Rotylenchus pumilus (Spiral nematode)

Similar to R. goodeyii. One "good" site (case 8) had 30 which was not considered significant.

Merl. Merlinius sp. (Stunt nematode)

Few found and not important.

Reports from CSL frequently referred to the combined effect of a range of species when present in high numbers.

Key to Cultivars

Sol. = Soleil d'Or, W.L = White Lion, S.V. = Scilly Valentine, R.C. = Royal Connection, Y.C. = Yellow Cheerfulness, W.C. = Winston Churchill, P.W. = Paper White, H.T. = Hugh Town, Cheer. = Cheerfulness, Tah. = Tahiti.

Key to fungi present in roots

R. = Rhizoctonia sp. F. = Fusarium sp. C. = Cylindrocarpon sp. P. = Penicillium T. = Trichoderma sp.
N.R. = Neck rot, B.R. = Basal rot
Eelw. = Stem and bulb eelworm.

The most important of the above fungi is *Cylindrocarpon* which is a recognised root rotting disease often gaining entry via nematode feeding. Past report have sometimes classified this fungus as *Nectria* sp.

Assessment of results

Of the 20 sites, 12 (60%) reported Pratylenchus.

Of these 12 sites, 6 showed a positive correlation between the Pratylenchus population and the state of the crop on the site. However, there were 4 where the "good" area showed more Pratylenchus than in the "bad". However, as had been pointed out this may not be totally unexpected when considering the complex relationships present. Site 7 which was "bad" overall carried a high count and similarly site 2 a low level.

The sites showing the most credible relationship between Pratylenchus count and crop growth were 7, 10, 13 and 15. Of these Cylindrocarpon was present in two whilst the other two had severe root rot the cause of which was not identified.

Of the 8 sites showing no Pratylench, (Nos. 1, 4, 5, 6, 8, 11, 12, 14) none offered any convincing explanation as to the cause.

The situation relating to Pratylenchus can best be summarised as follows:

Not present on the site	Present with correlation Population/crop	Present with no correlation	Present on overall "bad" site High count	Present on overall "bad" site Low count
Site 1	9	3	7	2
4	10	17		
5	13	18		
6	15	20		
8	16			
11	19			
12				
14				

Fungal isolations

Isolations were sometimes inconclusive but 11 of the 20 sites showed Cylindrocarpon. This included many of the "bad" sites where Pratylenchus occurred, but not all, since sites 13 and 15 were exceptions.

The presence of Rhizoctonia (sometimes quoted as most likely R. solani), *Fuarium solani* and *Subgutinians* may be of interest as they are opportunistic pathogens. Penicillium and Trichoderma were sometimes present but of little importance. The specific Basal rot fungus (*Fusarium oxysporum*) was not confirmed. This fungus does not normally attack the tazetta group of narcissi mostly represented here.

Conclusions

The above information tends to confirm previous findings in that it appears that *Pratylenchus* and *Cylindrocarpon* are fairly widespread and probably account for most cases of "soil sickness". However, some cases of root loss clearly have other causes which were not identified in this study. Perhaps the status of other nematode species may need to be reconsidered in certain circumstances. The current work to date confirms much of our previous understanding of the problem. The information forms a base line for further study and will enable us to identify a suitable trial site for further work. Individual growers who will be notified of these results will benefit from the information obtained.

The greatest value will be in selecting a site or sites for trials on control measures and in monitoring nematode populations on some of the sites after commercial control measures (eg Telone) have been applied by growers.

Future work (beyond 2002)

The BOF 50 plan was to continue to monitor sites and establish trials of control measures.
It is proposed:

1. That opportunity be taken to re-sample selected sites after commercial treatments in 2003 or 2004.
2. That any opportunity to test "new" sites showing obvious "soil sickness" be taken
3. That a plan be drawn up to test control measures on a selected site or sites.

Proposal 3 will need to be considered carefully with grower approval and with the certainty that the necessary protocols and security can be observed. "Off" islands sites as opposed to St Mary's, would be more costly to administer. The following are potentially good sites:

Site 3 has been used for a previous trial to compare Telone and Tagetes minuta.
Site 7 is "bad" overall and therefore potentially useful.
Likewise "site 10" has and extensive "bad" area
Sites 13 and 15 could be considered depending on the pattern of the problem. This is available on site records.

The Directors of Trenoweth Horticultural Centre (THC) seek permission to continue the work for a further 2 years under HDC funding.

HDC BOF 50 Results 2001/2002. Nematodes per 200g soil

Case	Grower	Var.	Good/ Bad	Prat.	Trich.	Roty. Rob.	Roty. Good.	Helio.	Para.	Longi.	Cyst.	Roty. Pumil.	Merl.	Fung.	% root rot	Notes
1	1	Sol	Good				56									
		Sol	Bad											R.F.		
2	2	Sol	Bad	2	4		4	10	2							
3	3	W.L.	Good	28												
			Bad	11					1		8					
4	4	Sol	Good			24			1							
		Sol	Bad					55								
5	5	Sol	Bad					12	4							
6	5	S.V.	Bad					88						R.		
7	6	R.C.	Bad	42				8	2					C.		
8	1	Sol	Good									39				Eewl.
		Sol	Bad				36							C.R.		
9	6	Y.C.	Good	1	6	199							1	C.P.		
		Y.C.	Bad	13	1	87			2					C.F.P.		
10	6	W.C.	Good	12	4	27			1				2		5-10	
		W.C.	Bad	65	3	79			13				1	C.F.P.	50-90	
		W.C.	Bad	13	3	32							4	C.F.P.		

Case	Grower	Var.	Good/ Bad	Prat.	Trich.	Roty. Rob.	Roty. Good.	Helio.	Para.	Longi.	Cyst.	Roty. Pumil.	Merl.	Fung.	% root rot	Notes
11	7	R.C.	Good		3			23						C.F.	1-5	
			Bad												10-75	NR.BR.
12	7	P.W.	Good					203						C.F.	2-5	
		P.W.	Bad					154						C.F.	10-50	NR.
13	6	P.W.	Good					750+						C.T.	2-6	
		P.W.	Bad	171	1			14	34					F.T.	85-90	
14	6	H.T.	Good					500						T.	3-10	
		H.T.	Bad		7			500+						T.	90-95	NR.
15	8	W.L.	Good				91		1		2				0-3	
		W.L.	Bad	82			153								60-90	NR.
16	9	W.C.	Good			14				1					0-1	
		W.C.	Bad	14		119									1-2	
17	10	Cheer	Good	67			250+		6		1			C.		
		Cheer	Bad	4			16		19					C.P.		
18	10	Tah.	Good	43			300+	100						C.		
			Bad	28			300+							C.		
19	11	Sol.	Good	1				5						C.	10-75	
		Sol.	Bad	11				161						F.	75+	
20	11	Sol.	Good	1										C.		
		Sol.	Bad		1			23						C.F.		

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