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GROWER SUMMARY

Headline

In the second year of the project, there were indications from fungicide screening suggesting the possibility of a wider choice of products for green beans in the near future.

Some differences in varietal tolerance to Botrytis pod rot were again found and the results of two years work are beginning to show robust differences.

Background and expected deliverables

Yield and quality loss of green beans for fresh market or freezing can be caused by Botrytis pod rot. Fungicide applications are costly and timing is precise. There is a limited range of approved products and repeated use increases the risk of resistance. There is little information on varietal tolerance to the disease.
New candidate fungicides will be screened during the life of the project. Checks on the resistance status of *Botrytis cinerea* will be examined and differences in varietal tolerance of a range of green bean types will be tested.

Action points for growers

- Avoid applying sequential sprays with the same fungicide products**.**

Summary

In the second year of this three year project, a fungicide screening trial indicated that useful control of Botrytis pod rot in green beans could be obtained from two new fungicide products. However disease pressure was low and further evaluations are necessary before firm conclusions can be made.

Infection in commercial crops was low and fewer isolates of *Botrytis cinerea* were tested for resistance, however this year there none of the isolates showed insensitivity to vinclozolin.

Several varieties exhibited good tolerance to Botrytis pod rot in a variety screen.

SCIENCE SECTION

Introduction

Pod rot caused by *Botrytis cinerea* can cause yield loss and reduce the value of the produce by blemishing. Disease development is influenced by weather conditions, but control relies on the use of a fungicide programme with a very limited range of products.

The project is aimed at producing a strategy for disease control by an evaluation of varietal tolerance to the disease and the efficacy of both currently approved and candidate fungicides. In addition, an investigation will establish the status of fungicide resistant populations of *Botrytis cinerea* in dwarf green beans.

Materials and Methods

Varietal tolerance

Varieties were drilled in disease observation plots at Thornhaugh, Cambs and Rushford near Salford Priors, Worcs. in 2004. At Thornhaugh the plot length was 10m and contained four rows of plants at a row spacing of 30cm. At Salford Prior each plot was 5m in length and contained two rows of each variety with 30cm row spacing. At both sites, each variety was replicated 3 times in a randomised block design.

The site details were as follows:

Site 1 Thornhaugh, PGRO Trial ground, Peterborough, TF 078007
sowing date: 24th May 2004 Soil type: fine sandy loam.

Site 2 Rushford, Evesham Road, Salford Priors, Worcs, SP 055501
Sowing date; 1st July 2004. Soil type: sandy loam.

Twenty one varieties were sown at each site. They represented different pod types to reflect their usefulness for both processing and fresh market. The varieties and pod types were as follows:

very fine	fine	medium	large	flat
Masai	R 9241	Laguna	Green Arrow	SB4251 (wax)
	Cerdon	BB 2174		Baroma
	Jackpot	BB 2175		Moncayo
	Bravo	Nomad		BB 2160
	Lasso	Scuba		Astun
	Albany	Boston		Artemis
		Cadillac		

Crop husbandry followed standard practice. At the freezing stage, 10 plants from each plot were selected at random and the pods examined. The number of pods infected with *Botrytis* was expressed as a % of the total and a mean value per plant calculated for each plot.

Fungicide evaluation

Two replicated and randomised field trials were carried out in commercial crops of beans at Neaches Farm, Banningham, Norfolk and Farmspeed, Southery, Cambs. Plot size was 2m wide by 5m long and sprays were applied using an Azo plot sprayer with 02 F110 fan nozzles in a volume of 200l/ha at 2.0 bar provided by propane. Sprays were applied on one or two occasions according to commercial practice. The first timing was at the very early pod stage and the second timing was 7 days later. The treatments were as follows:

Trade name	Active ingredients	Application rate	Timing	Approval status
		l/ha		
1. untreated				
2. Amistar	azoxystrobin	1.0	$T_1 + T_2$	SOLA
3. Ronilan	vinclozolin	1.0	T_1	approved
4. Ronilan	vinclozolin	1.0	T_1	approved
Rovral WP	iprodione	1.0 kg	T_2	SOLA
5. Signum	boscalid + pyroclostrobin	1.0	$T_1 + T_2$	UK registered
6. Switch (A9219B)	cyprodonil + fludioxonil	3.4	$T_1 + T_2$	France registered
7. A14111B		1.5	$T_1 + T_2$	experimental
8. A14111B		2.5	$T_1 + T_2$	experimental
9. Amistar	azoxystrobin	1.0	T1	SOLA
Rovral WP	iprodione	1.0	T2	SOLA

Each treatment was replicated four times. At the practical freezing stage, 15 plants were selected at random from each plot and the numbers of healthy and infected pods recorded. Infection was expressed as % of infected pods per plant. All data were analysed by analysis of variance. (GENSTAT).

Fungicide resistance

Samples of infected pods were taken from crops in Norfolk, Cambridgeshire and Worcestershire and *Botrytis cinerea* was isolated from each pod. Colonies were then inoculated onto potato dextrose agar (PDA) containing dilutions of azoxystrobin and vinclozolin at 100 ppm a.i. Colony diameter was measured after 5 days to indicate resistance. In 2004, disease levels in commercial crops were low and so samples were only taken from the following locations.

Field	Number/isolates	Variety	Location	Crop spray regime
1.	4	Scuba	Banningham, Norfolk	Ronilan x 2
2.	6	Nomad	Rushford, Worcs	Amistar + Rovral Flo x 2
3.	5	Torpedo	Southery, Cambs	Amistar fb Rovral WP

Results

Varietal tolerance

Botrytis infection developed well at the Thornhaugh site, but at Rushford, no significant level of infection was recorded except on the flat podded varieties. The results of the Thornhaugh site are shown in Table 1.

Table 1. Varietal differences in pod rot infection by *Botrytis cinerea.* Thornhaugh 2004

Variety	pod type	% infected pods	transformed data
Nomad	medium	0	0
Lasso	fine	0	0
Albany (PV 662)	fine	0	0
Scuba	medium	0.1	1.05
Laguna	medium	0.3	1.81
R 9241	fine	0.37	3.44
Masai	very fine	0.47	3.68
Green Arrow	large	0.57	2.5
Cerdon	fine	0.7	2.78
SB 4251	flat wax	0.7	2.78
Astun	flat	1.0	3.32
Jackpot	fine	1.17	4.98
BB 2175	medium	1.27	5.04
Baroma	flat	1.6	5.74
Bravo	fine	2.07	8.06
BB 2174	medium	2.1	6.7
Cadillac	medium	2.43	7.15
Boston	medium	3.67	11.01
Artemis	flat	4.43	11.62
BB 2160	flat	4.97	12.74
Moncayo	flat	7.03	15.06
LSD		2.67	6.5
probability		<0.001	<0.001
% cv		97.4	75.6

Most of the varieties at the Salford Priors site failed to show any infection and the data are not presented.

Fungicide evaluation

Botrytis infection at the Banningham site was sufficiently high enough to show differences in control between the treatments. Disease levels were extremely low at the Southery site and the data are not presented.

The data from Banningham are shown in table 2

Table 2. Control of pod rot by fungicides - Banningham 2004

Treatment	rate l/ha	timing	% infection by *Botrytis cinerea*	ang transformed data	% control
1. untreated			7.43	15.56	0
2. Amistar	1.0	$T_1 + T_2$	3.61	10.77	51
3. Ronilan	1.0	T_1	2.98	9.75	60
4. Ronilan	1.0	T_1			
Rovral WP	1.0 kg	T_2	3.87	11.27	48
5. Signum	1.0	$T_1 + T_2$	5.36	13.38	28
6. Switch (A9219B)	3.4	$T_1 + T_2$	3.77	11.05	49
7. A14111B	1.5	$T_1 + T_2$	1.70	5.98	77
8. A14111B	2.5	$T_1 + T_2$	4.37	11.67	41
9. Amistar	1.0	T1			
Rovral WP	1.0	T2	4.04	11.47	46
LSD			2.53	4.14	
probability			0.01	0.01	
Coefficient of variation %			41.9	25.3	

Fungicide resistance

Isolates of *Botrytis cinerea* were collected from diseased pods taken from three commercial crops of green beans in Norfolk, Cambs and Worcs during 2004. All of the crops had been sprayed with fungicides two occasions. Growth of each isolate was recorded at 2 and 5 days and the data from the 5 day count are shown in table 3. There were no indications that any of the isolates were insensitive to vinclozolin. Similarly the growth of all isolates on the azoxystrobin amended medium was inhibited, albeit to a much lesser degree, and there were no obvious differences in sensitivity between isolates.

Table 3. *Botrytis cinerea* colony growth on fungicide amended medium.

Spray programme	Field	Isolate no	Colony diameter after 5 days (mm)		
			PDA + Amistar	PDA + Ronilan	PDA
Ronilan sprayed twice	Banningham (variety Scuba)	1	44.8	0	85
		2	37.0	2.0	85
		3	33.1	0	85
		4	31.0	0	85
Ronilan + Amistar sprayed twice	Rushford (variety Nomad)	1	42.6	0	85
		2	39.8	2.2	85
		3	38.0	1.5	85
		4	36.1	0.7	85
		5	34.6	0	85
		6	38.4	0	85
Ronilan x 1 followed by Amistar x 1	Southery (variety Scuba)	1	34	0.1	85
		2	34.2	0	85
		3	49.8	0	85
		4	38.5	0	78.2
		5	36.2	0	85

Conclusions

Although the spray trials were carried out in later sown crops again, Botrytis infection was lower than expected and results should be interpreted with care. However, the fungicide screening trial confirmed the usefulness of some of the new products and all appeared to be crop safe. Differences were also evident in varietal tolerance and as the data accumulate, these will provide a robust guide for variety choice. It was not possible to find many commercial crops where Botrytis infection was established and the number of isolates tested was less than the previous year. However, the Amistar amended PDA again failed to completely inhibit growth of the isolates and this may be reflected by the poorer level of control of pod rot in the field spray trial.

The results of the trials in the last two seasons are encouraging in that new active ingredients are becoming available commercially and show promise for Botrytis control. However it is unfortunate that disease levels have not been high in order to show consistent trends in the results. In the final year of the project it is hoped that by selecting trial sites with to encompass early and late drilled beans, that the chance of disease will be more assured. There will also be the possibility of including a third site should the opportunity arise.

It has also been noted, though not in the trial areas themselves, that Sclerotinia infection is becoming more important in beans. The fungicides in the trials should also have activity against Sclerotinia

and should the disease occur in the 2005 trials then this will also be evaluated. Choice of site in high risk fields will assist in this aspect.

The development of fungicide resistant strains of Botrytis will also be further examined in 2005. The information gathered so far has already been incorporated as recommendations in the Assured Produce Protocols for Green beans

It is proposed to continue with the core list of varieties for 2005, but as new varieties become available these will replace some of the varieties that are no longer used commercially. However after three years the data will be collated and a list of fully testes varieties will be published in the PGRO Varieties of Green Beans publication for 2006.

Technology transfer

Notes on resistance strategy included in Assured Produce Protocol 2004 and 2005.
Talk given at the Vegetable Agronomists Association January 2005
Inclusion of notes in PGRO Pest and Disease Course January 2005.