Reducing residues in strawberries through integrated pest and disease management in commercial UK production systems

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Background UK Strawberries

- **UK produces 96,000 T of strawberries per year with a value of £ 220,000,000**
- **Polytunnel production - pros and cons**
- **MRLS and retailers**
- **Biological and chemical controls**

Project aim

Develop and evaluate alternative, sustainable, non-pesticidal methods for managing pests and diseases with the aim of greatly reducing (by >50%) pesticide use whilst not compromising fruit yield and quality.

HortLINK project

- ADAS Jointly with East Malling Research
- Funded by Defra, HDC and a large consortium
- 5 year project
- First three years development of IPDM techniques for 6 pest and disease targets
- Year 4 and 5 integrated these with a whole strawberry program






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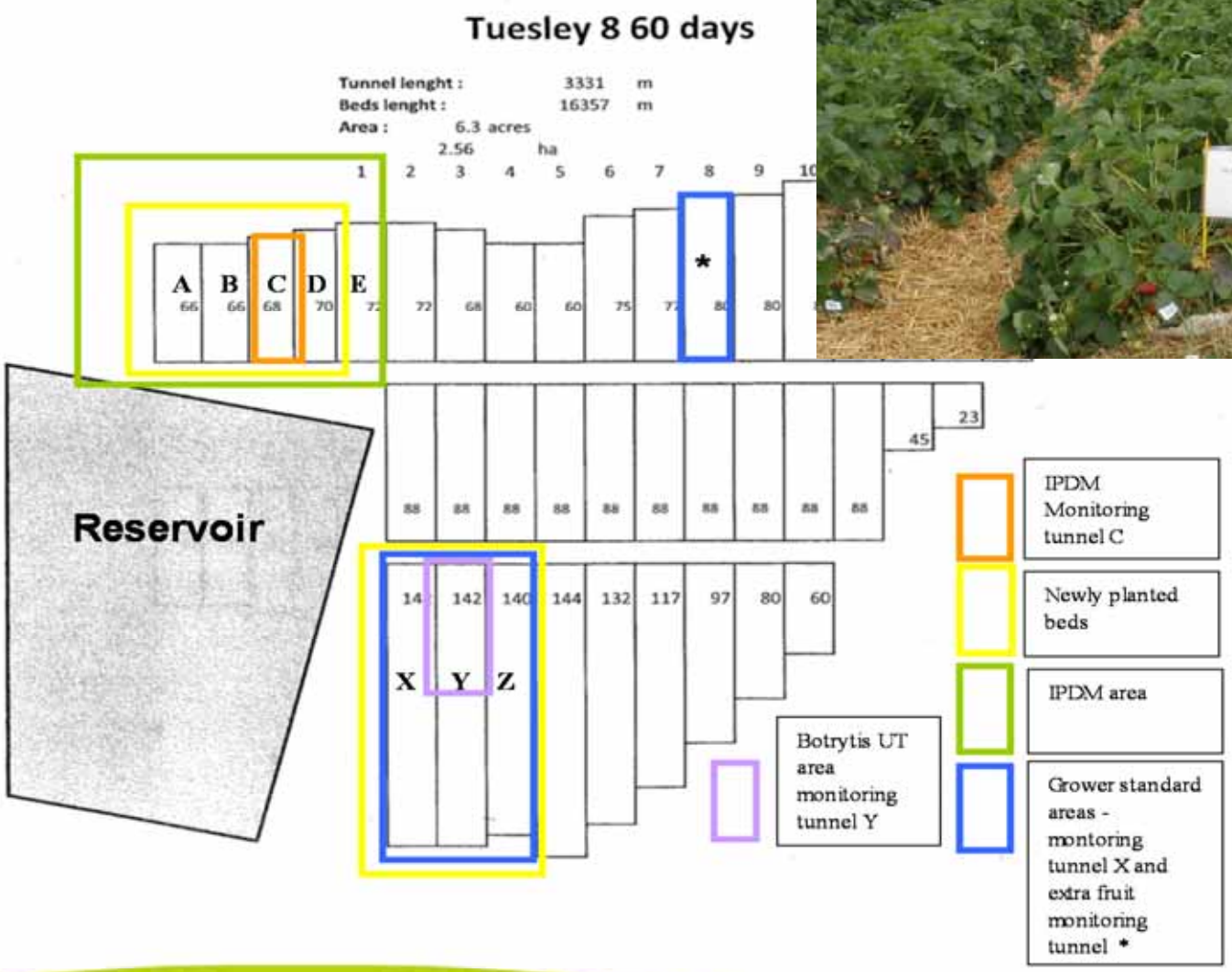
Treatments and sites

5 sites over 2 years

- 3 sites to compare each year
- 2 June bearer and 1 Everbearer each year
- Slightly different strategies employed on each site but basic IPDM approaches consistent

2011		
Site 1	**Site 2**	**Site 3**
Surrey	Kent	Kent
June bearer – Elsanta in soil	June bearer – Sonata table top in coir	Everbearer – Amesti in soil
IPDM + Bumble bees	IPDM + BOTEM and extra trapping	IPDM + BOTEM/Honey bees Alyssum trap plants and bug vaccing
2012		
Site 1	**Site 4**	**Site 5**
Surrey	Kent	Kent
Main season – Elsanta in soil	June bearer – Elsanta table top in coir	Everbearer – Amesti in soil
IPDM + Bumble bees	IPDM + BOTEM and extra trapping	IPDM + BOTEM/bumble bees Alyssum trap plants and bug vaccing

Trial design



Non replicated systems comparison

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What was done

- **Reduction of initial inoculum**
- **Development of risk-assessment system for better timing of management practices**
- **Increased use of BCAs and natural products during flowering.**

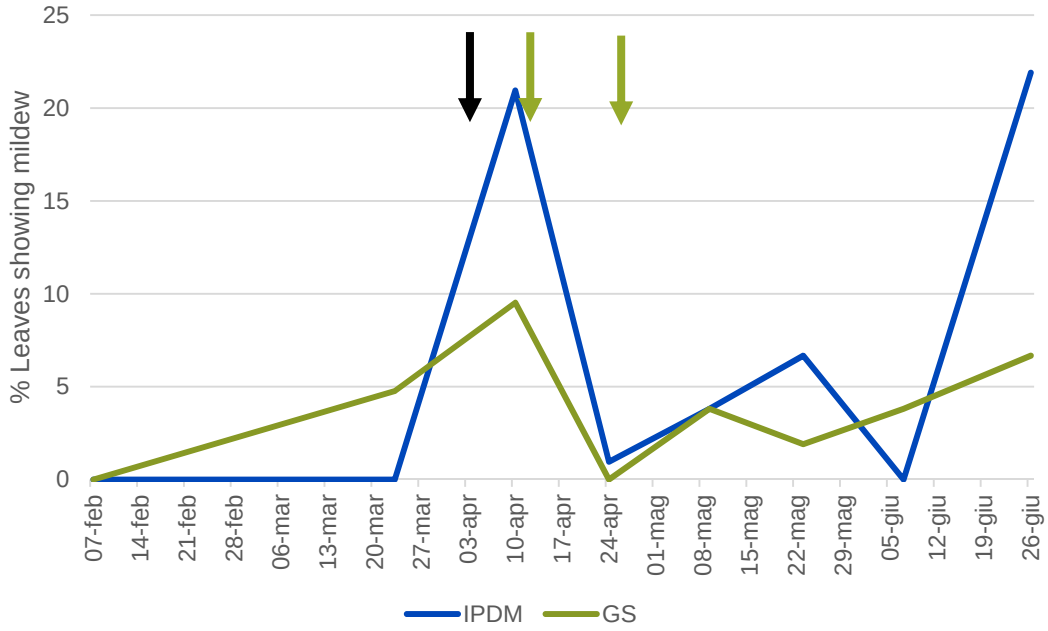
Diseases - Powdery Mildew

Approach

- Utilise forecasting model – developed by Fera amended by EMR
- Temperature and humidity loggers in field – 30 minute recordings
- Powdery mildew prediction model to time protectant and curative sprays
- Field monitoring to support
- Out of season fungicide applications – clean up inoculum

All 5 sites used this approach

Diseases - Powdery Mildew



Results

2012 early season crop with a low mildew pressure. Higher but not damaging levels of mildew observed with model timed applications

Site 1 - 2012 IPDM - 1 fungicides and 2 Potassium bicarbonate applications compared with 7 fungicides in GS

High pressure sites spray coverage and hygiene critical to success

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Diseases - *Botrytis*

Approach

- BOTEM disease forecasting model prior to and after flowering to trigger Prestop or Serenade ASO applications
- *Bombus terrestis Audax* bumble bees vectoring Prestop Mix (*Gliocladium catenulatum)* through flowering

2 sites each year used this approach

- Tight hygiene through harvest removing all waste fruit

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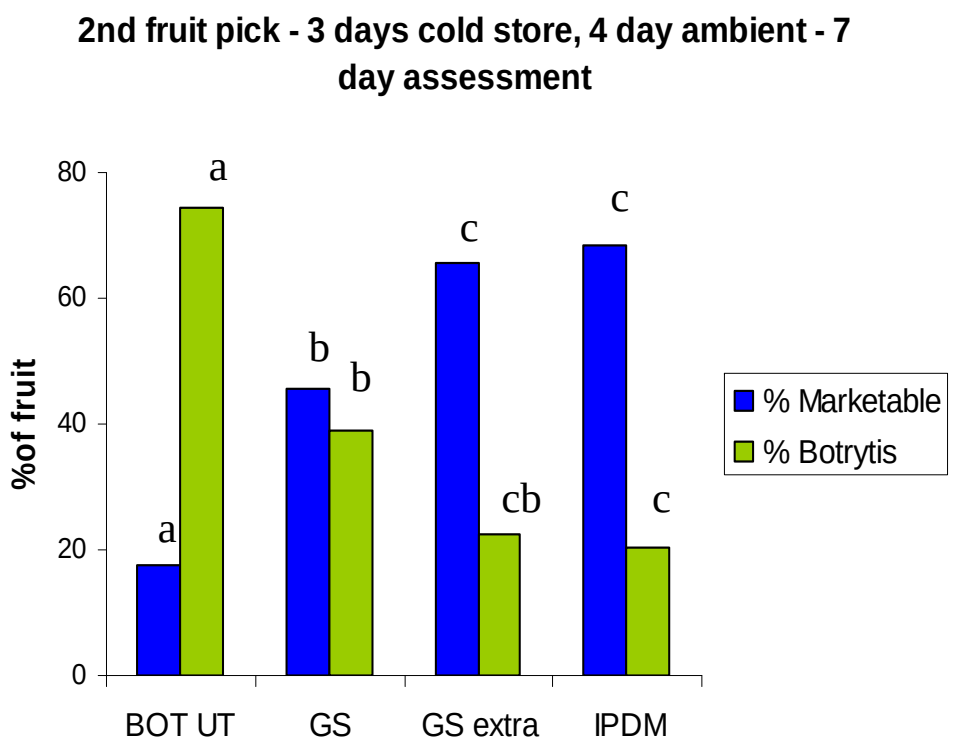
Diseases - *Botrytis*



- Site 1 Bees in 2012 ~ 960g Prestop Mix delivered per ha over a 9 wk flowering period by bees
- Site 4 BOTEM in 2012 triggered 4 fungicides and 2 BCA's in IPDM tunnels
- Grower standard in both cases received 11 fungicides against *Botrytis* in the same period

Equivalent and in certain cases lower levels of fruit *Botrytis* observed in samples of IPDM fruit after incubation across all sites and years

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Pests – Capsid bugs

1.) *Lygocoris pabulinus* and *Lygus rugulipennis* - pheromone trapping systems

Results

Successfully trapped the pest – low numbers detected did not reach a threshold for control

2.) Alyssum trap plants and bug vaccing 2011/2

Results

Establishing the Alyssum and timing flowering correctly along with set up of bug vac hindered this approach in 2012

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Pests - Aphids

1.) Autumn thiacloprid (Calypso) applications

2.) APHIDSURE fragaria aphid parasitoid mix
1 tube/200m^2 3 releases at 3 wk intervals

Results

Mixed results in both years

Most success was achieved where the parasitoids were introduced preventatively 1 to 2 wks after the plants started growing

Strategies for early forced crops under fleece need to be examined – temperature consideration

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Pests – Strawberry blossom weevil

White cross vane supertraps and pheromone lures + PV2

36/ha over the IPDM area

Results

SBW successfully trapped at all sites - low numbers and little damage observed

Threshold for control was not reached thus there was no unnecessary pesticide application for this pest

Other Pests – Two-spotted spider mites

TSSM – Post harvest insecticide and *Phytoseiulus persimilis* 10/m^2 at first sign of pest

WFT and Tarsonemid - *Neosieulus (Amblyseius) cucumeris* sachets 1 every 2 m of bed, supplemented with loose product as required

Already widely adopted but integration with a more complete IPM strategy appeared to give at times better control of these pests in IPDM plots

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Yield – Site 1

weight in kg for 70 m length, 5 bed tunnel

Date	Class 1	Waste	% Class 1
IPDM	601.6	160.9	78.9
GS	602.7	472.5	56.1
Bot UT	518.6	548.1	48.6
Field total 2.5 ha	54 tonnes	15.6 tonnes	77.5

All but 1 site equivalent or better % class 1 fruit

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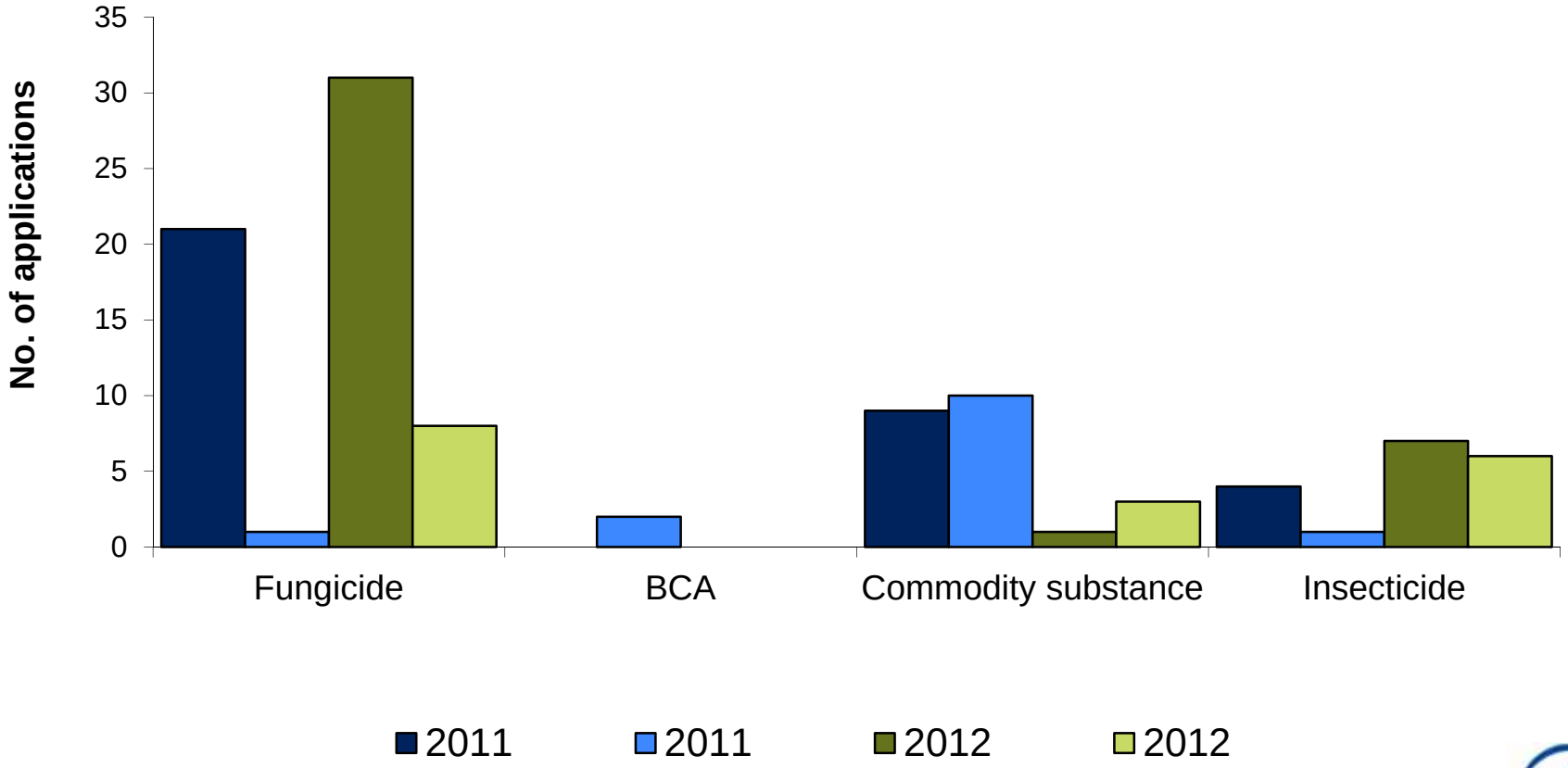
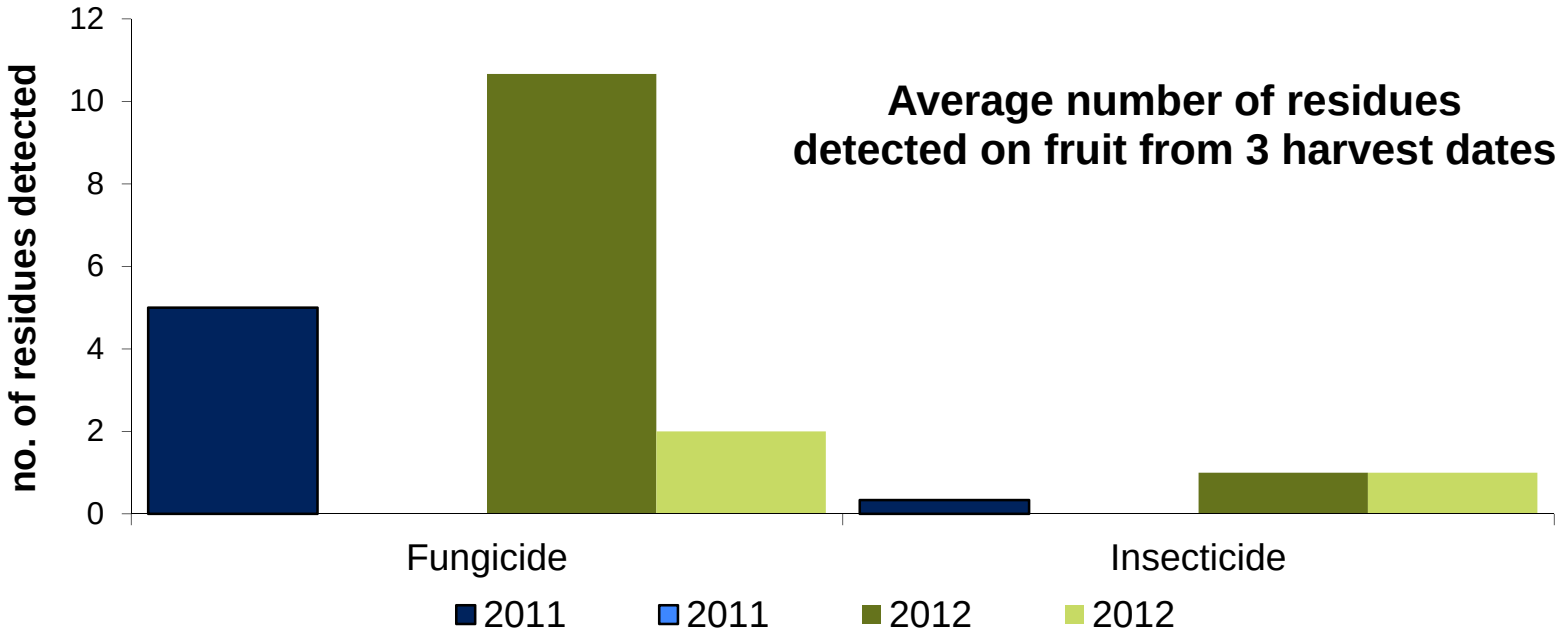
Comparison of number of pesticides applied for IPDM & GS at Site 1 2011-12

- **Far fewer pesticides applied over two years**



Pesticide residues Site 1 2012

- No residues detected above MRL's at any site
- At site 1 on average 80% fewer residues detected on fruit from IPDM tunnels over 2 years.
- Majority of residues detected in GS were from fungicides against *Botrytis*
- Similar trends of reduced residues observed at other sites in 2012



Residue analysis - Site 1 2012

	MRL mg/Kg	Residue levels for IPDM and Grower tunnels (mg/kg)					
		18-May		27-May		12-Jun	
Chemical		GS	IPDM	GS	IPDM	GS	IPDM
Azoxystrobin	10	0.10		0.02		0.01	
Boscalid	10	0.14	0.01	0.07		0.04	
Buprimate	1			0.06		0.01	
Cyprodinil	5	0.10	0.02	0.04		0.02	
Fludioxonil	3	0.07		0.03		0.02	
Iprodione	15	0.19	0.02	0.12		0.10	
Kresoxim Methyl	1	0.01					
Myclobutanil	1	0.05		0.02		0.01	
Primicarb	3			0.04			
Pyraclostrobin	1	0.05		0.01			
Pyrimethanil	5	0.45	0.05	0.27		0.17	
Quinoxyfen	0.3	0.01	0.01				
Fenhexamid	5	0.16	0.01			0.24	
Pirimicarb	3	0.06					
Thiacloprid	1	0.04	0.04			0.01	0.01

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Cost differences – compared with standard UK program

Target pest/disease	Approach	Cost/ ha/ annum £ (excl VAT)
Botrytis	Bee vectored Prestop Mix	+ £ 115 (31% ↑)
BOTEM model and timed fungicide applications	Variable depending on weather conditions	+/-
Powdery mildew	Timed applications to forecast model - Variable depending on disease pressure and weather	2012 season - £404 (45%↓)
Aphids	Aphid parasitoid 6 wasp mix	+ £ 1,731 (1,558% ↑)
Strawberry blossom weevil	Grid of 36 bucket traps and lures per hectare.	+ £ 449 (375%↑)
Two spotted spider mite	High introduction rates of Phytoseiulus persimilis	+ £ 404 (580% ↑)
Capsids	Green cross vane bucket traps and blue sticky traps for	+ £ 86 (324% ↑)
Western flower thrips and tarsonemid mites	N. cucumeris ABS release sachets, followed by loose product	+ £ 325 (62%↑)
Earwigs	Insect barrier glue on table top legs	+ £ 94 (115% ↑)
Net cost change		**+ £ 2,800 (104 % ↑)**

Strawberry = £50,000 /ha (gross)

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Summary

- IPDM components need to be tailored to individual crop and site risk
- Monitoring is key

- Overall IPDM appears more successful for early and mid season June bearer crops
- However as the season progresses and with Everbearer crops the pest and disease pressure can build rapidly and IPDM strategies can become overwhelmed.

- Results over 2 years and 5 sites support the use of IPDM to manage pests and diseases
- IPDM strategies used appeared to be as effective as the host grower's standard practices. Fruit quality and yield was maintained with far fewer detections of pesticide residues in fruit.

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