Horticultural crops grown using temporary covers and plastic mulches: Effects on pesticide use, fate and exposure

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Temporary crop covers

Objectives

- To determine the nature and extent of temporary crop cover use in the UK, identifying any trends that are present.
- To determine the likely impacts of temporary crop covers on the fate and exposure of surface water and groundwater to pesticides.
- To produce a “change in risk” matrix and highlight possible areas for further investigation.

Outline

- Types of crop cover used in the UK
  - Implications for exposure of surface water and groundwater to plant protection products (PPPs)
- Key findings across 9 crop groups
  - Brassicas; legumes; leafy, stem and fruiting vegetables; root and tuber crops; soft fruit; top fruit; ornamentals.
- “Change in risk” matrix
- Conclusions, areas for further investigation

Temporary crop covers

- Plastic mulches
- Fleece
- Polythene covers
- Temporary tunnels (e.g. Spanish tunnels)
- Mesh / net covers
- NB: permanent structures (e.g. glasshouses, permanent tunnels) not considered

Plastic mulches (1)

- Weed control
- Prevents strawberry runners from rooting

- Strawberries (80%; 3900 ha)
- Fruiting vegetables (90%; 700 ha)
- Runner beans (90%; 150 ha)

Plastic mulches (2)

- Herbicides: potential for decreased exposure
  - Lower usage due to reduced weed pressure
  - Cover protects residual herbicide from rainfall
- Insecticides and fungicides: increased exposure
  - Applied over covers; runoff from plastic surface
    - Into surface water
    - To uncovered areas (→ drainage, leaching)

Fleece/polythene covers (1)

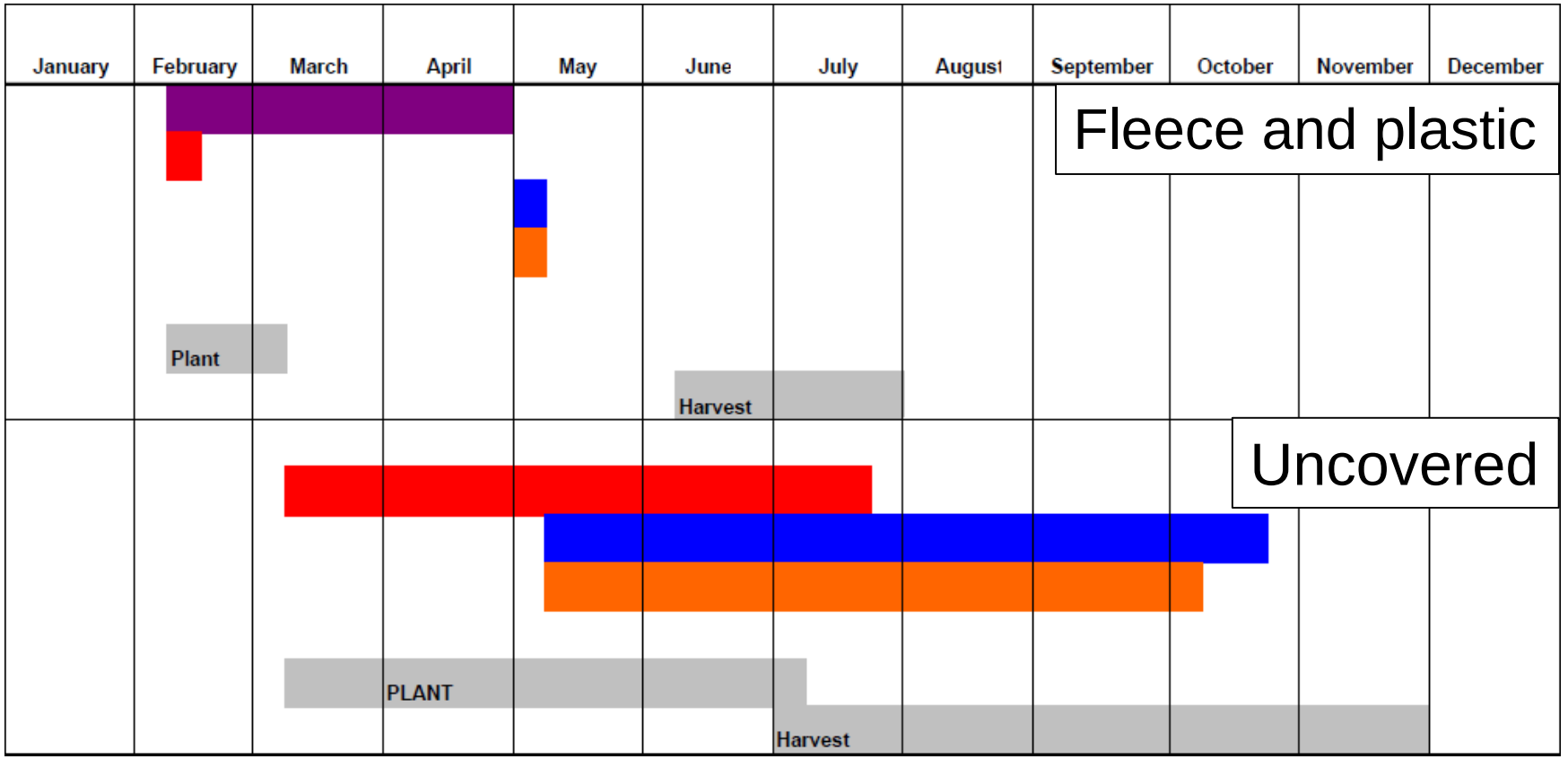
- Earlier production
- Multiple crops in one season

- Root and tuber crops (up to 20%)
- Brassicas (10%; 2050 ha)
- Leafy vegetables (18%; 1450 ha)

Fleece/polythene covers (2)

- Increased exposure as a result of treating multiple crops in a single year with PPPs
  - Drift, runoff, drainage, leaching
  - Consider crop rotation as a whole when assessing risk
- Increased exposure as a result of earlier applications of PPPs, especially herbicides
  - Drainflow period: October-April
  - Consider soil properties

Crop calendar: broccoli / calabrese



Temporary tunnels (1)

- Protection from variable weather extends harvest
- May allow double-cropping for strawberries and raspberries

- Strawberries (75%; 3690 ha)
- Raspberries (70%; 1230 ha)
- Asparagus (15%; 364 ha)

Temporary tunnels (2)

- Overall, exposure is likely to be reduced
  - Protection from rainfall
    - Reduced runoff, drainage and leaching
  - Physical barrier to spray drift (if sides closed)
- Use of tunnels may alter pest pressure
  - Powdery mildew aided by warmer temperature
  - But *Botrytis* is easier to control if fruit is protected from rain

Assessing change in risk

- Multiple types of crop cover may be used
  - e.g. strawberries: 80% mulch, 75% tunnels
- Risk matrix: 25 crops across 9 crop groups
  - Area grown under each combination of covers in UK
  - Effects of covers on exposure via drift, leaching, drainage and runoff
  - Exposure considered separately for herbicides, fungicides and insecticides

“Change in risk” matrix

Basic crop	Time of production	Type of cover	Estmated area covered (ha)	Pesticide class	Exposure pathways			
					Air/drift	Leaching	Drainage	Runoff
Carrot	Early	Plastic with holes	2,140	Herbicide	3,4,12,17	3,4,12,17	3,4,12,17	3,4,12,17
				Fungicide	10,13	10,13	10,13	10,13
				Insecticide	10,13	10,13	10,13	10,13
	Maincrop (stored in field over winter)	Black plastic mulch and straw for overwintering	2,252	Herbicide			13	
				Fungicide	2	2	2	2
				Insecticide	2,9	2,9	2,9	2,9
				Maleic hydrazide	19	19	19	19
		Straw for overwintering	1,689	Herbicide			13	
				Fungicide	2	2	2	2
				Insecticide	2,9	2,9	2,9	2,9
				Maleic hydrazide	19	19	19	19

- Roots and tubers
  - Increased exposure predicted
    - Overwintering, multiple crops, application closer to drainflow period
  - Significant area grown under covers (10500 ha across all roots and tubers)

Trends

- Degree to which crop covers are used is currently static for most vegetable crops
  - However the use of tunnels in the production of asparagus and cherries is increasing
- Recent increases:
  - Use of nets to protect swedes, turnips and babyleaf
  - Most strawberries and raspberries now grown under Spanish tunnels

Conclusions and recommendations (1)

- For most crops, only a small area is grown under temporary crop covers in the UK (total <24000 ha across 25 crops)

- Use of temporary crop covers is static or has now reached a plateau for most crops in UK
  - Exceptions: asparagus, cherries

Conclusions and recommendations (2)

- For many crops, temporary covers may decrease the risk of exposure
  - e.g. tunnels reduce drainage, runoff etc

- However, there is an increased risk of exposure following applications to roots and tubers, which account for 10500 ha in the UK

Conclusions and recommendations (3)

- Development of modelling scenario for roots and tubers? Assess opportunities for further data collection etc

- Extensive crop calendars reported provide a basis for representing temporary crop covers in modelling
  - Application timing
  - When is rainfall excluded by the cover?

Thank you

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