

Introduction

The use of cover crops before sugar beet is becoming increasingly popular in the UK. When choosing cover crops it is important to consider the both the risks and benefits of each species. One such risk is the ability of the cover crop to host Virus Yellows and contribute to green bridging into the following sugar beet crop.

Aphids survive mild winters, which the UK has experienced in recent years. This overwintering risk is heightened by increased use of cover crops which act as a winter host. Although timely destruction ahead of the following beet crop is advised, any green matter remaining post destruction provides a potential source of virus. Aphids migrating into the crop can quickly acquire Virus Yellows from the cover crops and transfer it into young sugar beet.

Materials and methods

A grower survey conducted in 2023 was used to select the most commonly grown cover crop species used ahead of sugar beet. The 22 most popular species from this survey were tested for their ability to host the three yellowing viruses alongside a sugar beet control.

Plants were grown in Conviron Gen 1000 growth cabinets on 16 hour days at 18/22°C. At 3 weeks old the plants were inoculated with aphids carrying each of the 3 yellowing viruses, Beet yellows virus (BYV), Beet mild yellowing virus (BMV) and Beet chlorosis virus (BChV). Aphids fed on the cover crop species for 7 days before being sprayed off with acetamiprid. The infected plants were then allowed to grow for a further 5 weeks.

During the inoculated period aphid feeding was scored based on how many aphids were present and actively feeding on the plants. At the end of the 6-week infection period each plant was tested using ELISA.

Species		Aphid feeding score	BYV	BMV	BChV	Overall score
Berseem clover	(<i>Trifolium incarnatum</i>)	4	N	H	M	M
Black oat	(<i>Avena strigosa</i>)	1	N	N	N	N
Brown mustard	(<i>Brassica juncea</i>)	1	N	H	N	M
Buckwheat	(<i>Fagopyrum esculentum</i>)	3	N	N	L	L
Chicory	(<i>Cichorium intybus</i>)	1	L	H	H	H
Cocksfoot	(<i>Dactylis glomerata</i>)	2	N	H	H	H
Cornflower	(<i>Centaurea cyanus</i>)	1	L	H	H	H
Crimson clover	(<i>Trifolium incarnatum</i>)	4	L	N	H	M
Forage rape	(<i>Brassica napus</i>)	5	N	H	M	H
Flax	(<i>Linum usitatissimum</i>)	0	N	H	L	M
Italian ryegrass	(<i>Lolium miltiflorum</i>)	1	N	H	L	M
Rye	(<i>Secale cereale</i>)	2	N	M	N	L
Lucerne	(<i>Medicago sativa</i>)	3	N	L	L	L
Fodder/Oil radish	(<i>Raphanus sativus</i>)	4	N	N	L	L
Phacelia	(<i>Phacelia tanacetifolia</i>)	1	M	H	H	H
Red clover	(<i>Trifolium pratense</i>)	4	N	H	H	H
Stubble turnip	(<i>Brassica rapa</i>)	5	L	N	N	L
Sugar beet	(<i>Beta vulgaris</i>)	3	H	H	H	H
Sunflower	(<i>Helianthus annus</i>)	2	N	M	N	L
Tillage radish	(<i>Raphanus sativus</i>)	4	N	N	L	L
Vetch	(<i>Vicia sativa</i>)	2	N	H	H	H
White mustard	(<i>Sinapis alba</i>)	1	N	L	L	L
Yarrow	(<i>Achillea millefolium</i>)	3	L	H	H	H

Figure 1- Virus host risk scores determined from ELISA testing and aphid feeding scores used to determine an overall risk score.
N- no risk, L- Low risk, M- medium risk, H- High risk
Aphid feeding score 0-5 scale



Figure 2- Cover crops: Buckwheat, crimson clover, mustard, forage rape.

Results and discussion

The percentage of plants which tested positive on ELISA was used to determine a level of virus hosting risk foreach of the three yellowing viruses.
0%- No risk
10-20%- Low risk
30-40%- Medium risk
>50%- High risk

The control options on farm do not currently vary based on which virus is present in the crop. In light of this an overall virus score which considered the hosting risk of all three yellowing viruses and aphid feeding risk was produced.

Results were combined with agronomic information and other pest and disease risk factors to create a table (figure 3). This was published and issued to growers in a cover crop guide to aid farm decisions when selecting cover crops to use ahead of sugar beet.

Eight cover crop species were identified to be high risk meaning extra caution needs to be taken to ensure all green matter is fully destroyed before the sugar beet is drilled. If destruction is likely to be challenging, it is advised to grow a lower-risk cover crop.

Agronomic Factors	Cover Crop Species	Fodder/Oil Radish	Tillage Radish	Stubble Turnip	Forage rape	Brown Mustard	White Mustard	Black Oat	Rye	Italian ryegrass	Vetch	Crimson clover	Egyptian/ Berseem clover	Red clover	Phacelia	Buckwheat	Sunflower
	Binomial name	<i>Raphanus sativus</i>	<i>Raphanus sativus</i>	<i>Brassica rapa</i>	<i>Brassica napus</i>	<i>Brassica juncea</i>	<i>Sinapis alba</i>	<i>Avena strigosa</i>	<i>Secale cereale</i>	<i>Lolium multiflorum</i>	<i>Vicia sativa</i>	<i>Trifolium incarnatum</i>	<i>Trifolium alexandrinum</i>	<i>Trifolium pratense</i>	<i>Phacelia tanacetifolia</i>	<i>Fagopyrum esculentum</i>	<i>Helianthus annuus</i>
	Recommended sowing date (following cereal crop)	Jul-Sep	Jul-Sep	Jul-Aug	Jul-Aug	Jul-Sep	Jul-Sep	Jul-Sep	Jul-Sep	Jul-Sep	Jul-Aug*	Jul-Aug*	Jul-Aug*	Jul-Aug*	Jul-Sep	Jul-Sep	April-June
	N fixer	Y/N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N
	Option to graze	Y/N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
	Biomass produced	Low-High	Medium	Medium	Medium	Medium	Medium	High	High	High	Medium	Low	Low	Low	High	High	High
	Improves soil structure	Y/N	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	N	Y	N	Y
	Rooting depth	Shallow-Deep	Deep	Deep	Deep	Shallow	Shallow	Shallow	Medium	Shallow	Shallow	Medium	Shallow	Shallow	Medium	Shallow	Medium
	Frost resistance	Low-High	Medium	Low	High	Medium	High	Low	Medium	High	High	Medium	High	Low	High	Medium	Low
	Volunteer risk	Low-High	Low	Low	Low	Low	Low	High	Low	Low	High	Low	High	Low	High	Low	Low
Pests & diseases	Ability to control in sugar beet	Low-High	High	High	High	High	High	High	High	High	High	High	High	High	Low	High	High
	Seed cost	£ - £££	££	££	££	£	£	£	£	££	£	££	££	£££	££	£	£££
	Standard sowing rate (kg/ha)	15	7.5	5	10	5	20	20-75	50-70	30-35	85	15	12.5	15	10	70	25
	BCN host	Y/N	Y**	Y	Y	Y	Y	N	N	N	Y	N	N	N	N	Y	N
	FLN host	Y/N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	V/V host risk***	None-High	Low	Low	Low	High	Medium	Low	None	Low	Medium	High	Medium	Medium	High	High	Low
	Aphid risk****	Low-High	High	High	High	High	Medium	Medium	Low	Low	Medium	High	High	High	Low	Medium	Medium
Pests & diseases	Wireworm host risk	Low-High-Reduces	High	High	High	High	Low	Low	High	High	Low	Low	Low	Low	Low	Reduces	High
	Slug host risk	Low-High	High	High	High	High	Low	Low	High	High	Low	Low	Low	Low	Low	Low	Low
	Leatherjackets	Low-High	Low	Low	Low	Low	Low	Low	High	High	Low	Low	Low	Low	Low	Low	Low
	Pollen/Nectar source	Y/N	N	N	N	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y

*Can be sown later but N fixation may be limited ** Use of resistant varieties can help manage BCN. If using a brassica cover crop on fields with suspected BCN infestations, you must use a resistant example. If looking for detail on each species as possible. However, performance will depend on a range of factors, such as sowing date, autumn conditions, companion species, sowing rate and method of destruction. The details we have outlined for each species are general observations for when each type is grown under optimal conditions.

Figure 3- BBRO cover crop guide