Defra economic analysis report explaining the impacts of virus yellows on sugar beet production

Introduction

This annex provides detailed analysis of the economic implications of virus yellows (YV) on GB sugar beet production and outlines the methodology used to adjust for overestimation in the YV model predictions. It aims to support the decision-maker's understanding of the expected impacts resulting from YV infection where Cruiser SB is not available for use, by quantifying impacts at the grower and industry levels and highlighting uncertainties in the available data. The document comprises the following sections:

1. **Virus yellows model**: This section analyses the overestimation associated with the Rothamsted model predictions of national average virus incidence and sets out the proposed method for accounting for this overestimation if a predicted incidence threshold were to be set. Due to a lack of data and high uncertainty in the modelled relationship, our confidence in using this prediction to restrict use of Cruiser SB to a specific 'danger' is low, particularly at high predicted incidence levels.

2. **Losses to individual growers**: This section sets out the expected losses to growers in 2025 from different potential levels of virus incidence. Were the emergency authorisation for Cruiser SB not granted in 2025, we estimate that profitability, cash flow, and bankruptcy rates of sugar beet growers would remain constant until predicted incidence rose above around 77%, 80%, and 91%, respectively (after which modest increases could be expected). Note that uncertainty associated with these figures is high and does not account for the mitigating impact of crop insurance.

3. **Losses to the GB sugar industry**: This section sets out the expected losses to the sugar industry and potential supply-chain impacts in 2025 resulting from different levels of virus incidence. We estimate that British Sugar's insurance fund would not be exceeded at any level of national average realised incidence. Wider losses from substituting domestic losses with imports are likely to be variable and dependent on external factors.

4. **Background**: This section describes the historic virus levels in GB, historic GB sugar production, and impacts of virus yellows on the sugar crop.

1. Virus yellows model

The virus yellows model by Rothamsted Research provides a valuable tool to forecast potential virus levels in the UK prior to the crop being sown. As shown in the table below, high levels of virus incidence were predicted in 2020, 2022, 2023, and 2024 with lower infection levels predicted in both 2019 and 2021.

For 2019, the forecast was for around 39% incidence expected if no pest control measures were applied. In reality, the realised (observed) incidence that resulted was significantly lower than this at 1.8%, indicating foliar sprays and other IPM measures were effective in preventing infection, although this may also have been partially as a result of legacy effects of previous years' neonicotinoid usage.

For 2020, the model estimated a higher incidence estimated at 82%. The realised incidence was still lower than this at 38%, although the economic costs from this infection were high, with the cost to growers estimated by industry at approximately £43 million (approximately £413/ha[1], on average) and subsequent impact to the processor of a further £24 million.

This indicates that some control was still provided by foliar sprays and IPM measures, however, challenges in obtaining some insecticide products due to production issues potentially made control of virus yellows in 2020 more challenging.

For 2022, the model forecast an incidence of 69%. The realised incidence was low, 6.9% for crops not treated with Cruiser SB, although still higher than incidence experienced by crops that used Cruiser. This indicates that use of Cruiser is likely to have been profitable for many growers.

For 2023, the model forecast an incidence of 67.5%. The survey results suggest that incidence was very low (below 2%) for both crops from seed treated and not treated with neonicotinoids. This suggests, as in 2019, that foliar sprays were effective in controlling the level of incidence forecast. In 2023 use of Cruiser may not have provided a net benefit, on average, to growers. It's likely, however, that a subset of individual growers would have benefited from the use of Cruiser. These individual impacts are discussed in the *Losses to individual growers* section further below.

For 2024, the model forecast an incidence of 83%. The observed realised incidence for crops not using neonicotinoids was 4.1%. Again, this suggests that that foliar sprays were effective in controlling the level of incidence forecast, although farm-level survey data suggests that some growers were more successful than others in controlling incidence levels.

Table 1: Modelled vs actual virus incidence from 2019 to 2024

Year	Model incidence prediction	Action taken	Actual virus incidence	Impact on yield

[1] Roughly, 104,000 hectares of sugar beet grown in 2020: Chapter 7: Crops - GOV.UK (www.gov.uk)

2019	39%	57% of surveyed crop received 1 or 2 foliar sprays	1.8%	Little impact
2020	82%	78% of surveyed crop received 2 to 4 foliar sprays	38.1%	Yields down around 25%
2021	8.37%	74% received 1 spray, 7% two sprays.	2%	Little impact
2022	68.9%	71% of surveyed crop used Cruiser SB. 69% received 1 to 3 foliar sprays.	6.9% (non-Cruiser growers only)	Little impact
2023	67.5%	60% of surveyed crop used Cruiser SB. 56% received 1 to 3 foliar sprays.	1.1% (non-Cruiser growers only)	Little impact
2024	83%	58% of surveyed crop used Cruiser SB. 46% received 1 to 3 foliar sprays.	4.1% (non-Cruiser growers only)	Little impact

Table 1 is a table displaying data resulting from the application of the virus yellows model by Rothamsted Research, forecasting potential virus levels in the UK prior to the crop being sown. The data displays that high levels of virus incidence were predicted in 2020, 2022, 2023, and 2024 with lower infection levels in 2019 and 2021.

Figure 1: Modelled estimated virus yellows incidence without pest management against actual incidence rate without Cruiser, but with foliar sprays.

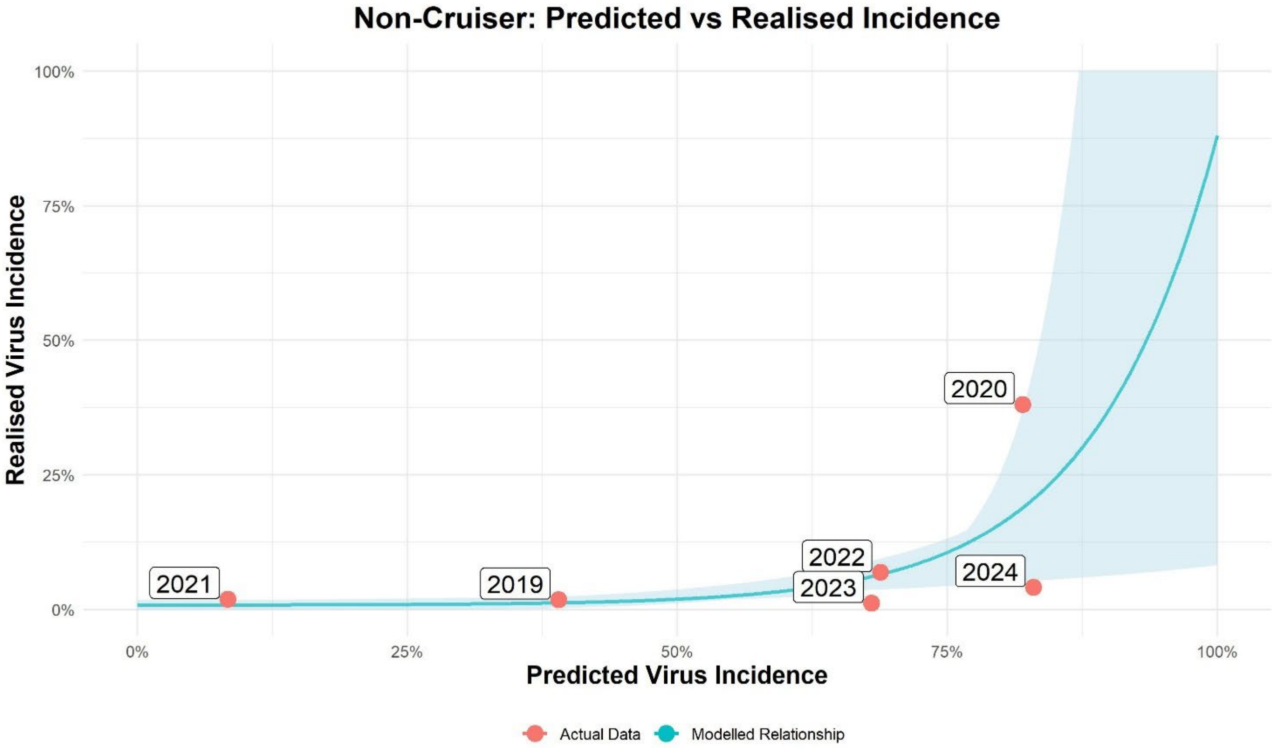


Figure 1: Modelled estimated virus yellows incidence without pest management against actual incidence rate without Cruiser, but with foliar sprays. is a line graph displaying modelled estimated virus yellows incidence without pest management against actual incidence rate based on the years 2019 to 2024. The curve shows a non-linear positive relationship between predicted and realised incidence, steeply rising between around 70 and 100% predicted incidence.

Method for adjusting for overestimation in the YV model predictions

This section outlines our recommended method for adjusting the overestimation issues identified in the YV model predictions. While the adjustment is highly uncertain, it can be used to establish predicted incidence thresholds that correspond to definitions of ‘danger’ in terms of realised incidence.

For instance, a ‘danger’ could be interpreted as the impacts to growers resulting from the historic worst-case scenario from not authorising Cruiser SB. Based on the past 6 years of data, we estimate that this is roughly equivalent to the mean realised incidence of 38% experienced in 2020. Having access to Cruiser SB in this scenario, would be expected to lead to a net benefit to sugar beet growers of £19m in 2025, relative to no access.

To establish a threshold in predicted incidence terms, the YV model's overprediction must be accounted for. Below, we illustrate how such an adjustment can be applied. The net benefit to growers from the use of Cruiser is calculated based on the balance between the:

1. Additional cost of using treated seed vs untreated seed YV management plans.
2. Avoided crop loss from using treated seed vs untreated seed YV management plans.

To calculate (1), we used data from the treatment plans used by growers in previous years, applied to 2025 prices. This resulted in **an additional cost of £8.15 per ha from using a treatment programme including Cruiser SB** compared to not using it accounting for the different use of foliar sprays between the groups. Whilst we acknowledge that this cost differential may differ depending on aphid prevalence, due to the change in the number of foliar sprays used by both treatment programmes, we do not have sufficient data to estimate these changes.

To calculate (2), we first calculated the relationship between predicted and realised virus incidence for crops with treated and untreated seed. We did this because the Rothamsted model predicts YV incidence *in the absence of pest control treatments,* which means it does not consider the mitigating impacts of seed treatment, foliar sprays, and other IPM actions that are used by growers. This 'overestimation' is seen in data for 2019, 2021, 2022, 2023, and 2024 which demonstrates virus levels consistently below the level predicted.

We then estimated the crop loss between crops with treated vs untreated seed at various levels of predicted incidence. We did this by multiplying the difference in realised incidence between the two groups by a 25% yield loss[2] and the provisional price of sugar for 2025. This gave us estimates of per hectare crop loss avoided by using seed treatment.

Finally, we calculated the net benefit by subtracting the additional cost of seed treatment programmes from the avoided crop loss derived from having seed treatment. This is shown in the diagram below, with net benefit to the industry from using seed treatment plotted against predicted YV incidence.

[2] This is based on an input from industry experts.

Figure 2: Net benefit to GB sugar beet growers from use of Cruiser by predicted incidence

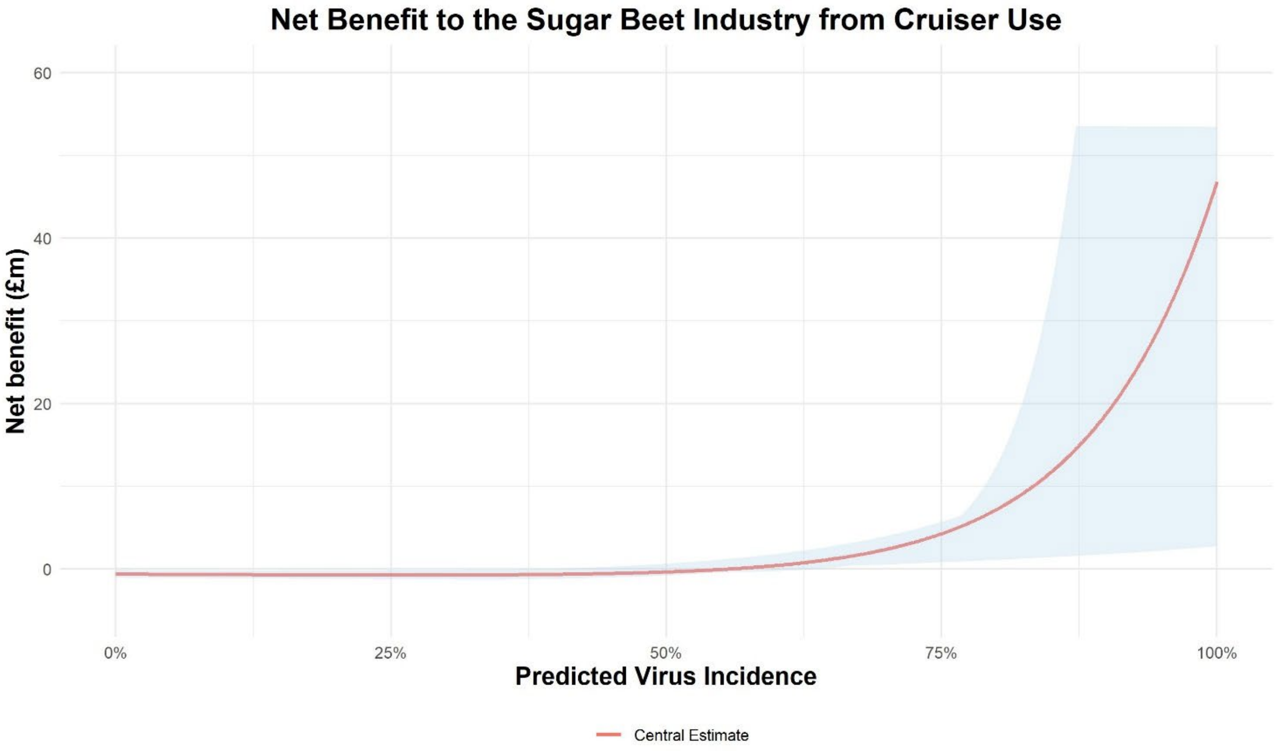
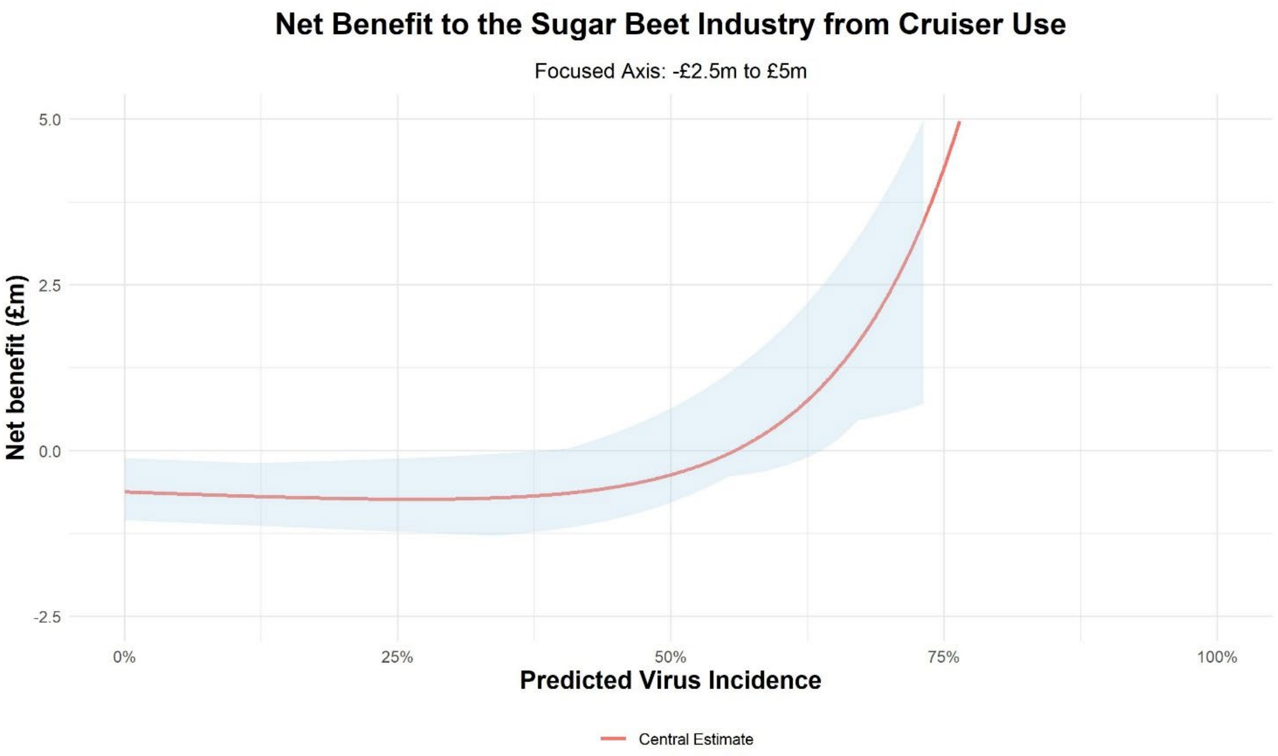


Figure 3: Net benefit to GB sugar beet growers from use of Cruiser by predicted incidence – y axis focused between -£2.5 and £5m.



Figures 2 and 3 show the same relationship – the latter is zoomed in to show the point at which net benefit from use of Cruiser SB becomes positive. The relationship shown is uncertain as it depends on the conversion from predicted incidence without measures to actual incidence with sprays. The light blue shading represents the upper and lower bound of net benefit that could be expected based on variation of virus incidence experienced in the past 6 years of data.

The change in net benefits is predominantly driven by the non-linear mapping of realised virus incidence without Cruiser SB treatment which leads to an increase in realised incidence once the predictions pass ~60% (roughly equivalent to ~3% realised incidence). This contrasts with near-constant realised incidence at all predicted incidence levels when using Cruiser SB treatment.

Uncertainty in the model

There are inherent uncertainties in making adjustments for the over-prediction associated with the YV model. This is because there are a limited number of years in which Cruiser SB has not been used to determine the relationship between predicted and realised YV incidence.

For example, in 2019, the predicted incidence of 39% led to a realised incidence of 1.8% for non-Cruiser growers. This is below the realised 'breakeven' point (estimated at ~2.6% for 2025) above which growers, on average, make a financial gain from using Cruiser. Conversely, in 2020, the predicted incidence of 82% led to a realised incidence of 38%. This is significantly higher than the breakeven point for 2025 and, as set out above, we expect that this would lead to an approximate loss of £19m in direct losses to sugar growers.

As we do not have historic data of the relationship between predicted and realised incidence between these points, we do not know with certainty the predicted incidence at which the resulting level of virus on the ground will exceed the breakeven of ~2.6% or lead to specific levels of more significant loss. To account for this, we used modelling to estimate upper and lower confidence bounds of predicted incidence for each realised incidence, based on the historic variation in incidence over the past 6 years. This is shown by the shaded area in Figures 2 and 3. For example, this shows that the breakeven point of 2.6% realised incidence is expected to arise from a prediction of between 50% and 64%.

In general terms, as realised incidence increases, the uncertainty associated with the realised to predicted relationship is likely to be higher. This is demonstrated when comparing the realised incidences following the similar predictions of 82% and 83% in 2020 and 2024, respectively. In 2020, growers experienced significant losses from a 39% average incidence whereas in 2024, the average realised incidence was only 4%.

In summary, moving towards a higher predicted incidence threshold increases the confidence that Cruiser is not used when there isn't a net benefit to industry. And moving towards the lower bound increases the certainty that the industry does not experience a loss as a result of not having access to Cruiser SB.

Caveats

Further work is ongoing to develop the virus yellows model, for example, including more localised data, although this will not be available for the 2025 season.

Overall, there is a high degree of uncertainty over how predictions of virus incidence are likely to translate into yield losses. The current threshold calculation assumes a 25% yield loss per affected plant. Therefore, as an example, a 20% realised incidence would be expected to result in yield losses of 5%.

The spatial distribution of virus levels is also likely to be uneven, as shown in the maps in the background section of this document, meaning losses for some growers could be much higher than the predicted average – see the following section for more detailed analysis on this.

In 2020, the infection rate ranged from 7% to 61% between the four factory areas, with affected growers seeing significant yield losses of up to 50%. These losses could be partially offset through the yield protection cover in 2025.

The Yield Protection Cover

The threshold calculation currently covers all lost production value. However, only a share of these yield losses will be borne by growers, with growers able to choose to protect around 85% of yield through British Sugar's Yield Protection Cover Scheme.

This may significantly reduce the impacts of extreme yield losses resulting from virus yellows, especially when virus yellows losses are stacked on top of weather-related and other causes of yield loss. Last year, 20% of the contracted area took up the scheme at £1/tonne. This year, the cover is on offer for £1.40/tonne and 12% of contracted area has taken up the offer.

Estimates for the total value of insurance payouts to sugar beet growers in 2025 are set out in Losses to the Sugar Industry in GB.

2. Losses to individual growers

As mentioned, the calculations above do not account for the variation in pest pressure across different individual growers in a given year. For example, at the breakeven point, there will be some growers that would experience losses and others that would experience gains from using Cruiser due to the differing incidence levels in individual farms.

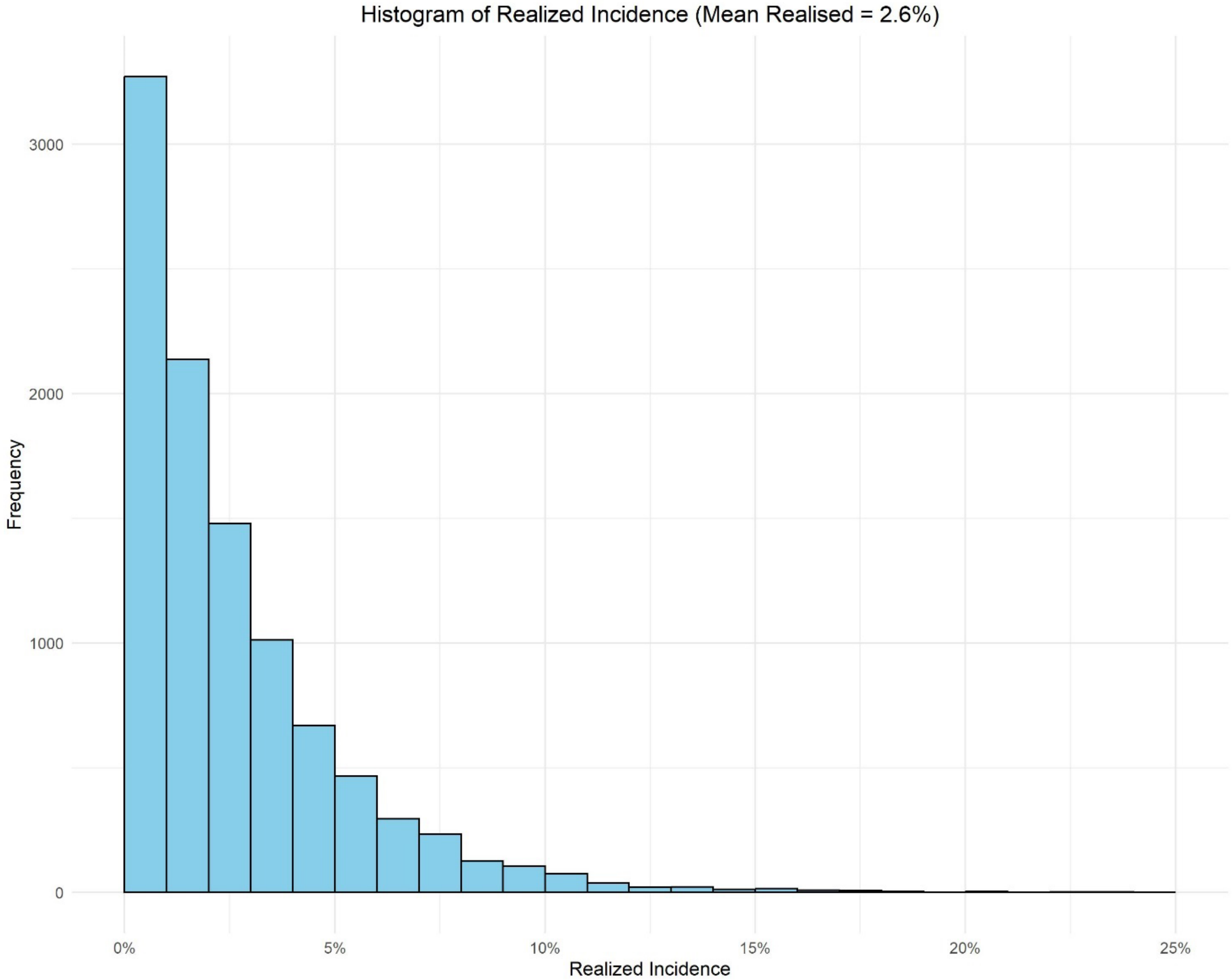
Estimation of the distribution of losses to growers

Note that this analysis is highly uncertain and should be used only as an indication of potential distribution of losses to growers.

Using farm-level data from the National Crop Survey, we have estimated the average variation of realised incidence around the national average for sugar beet grown without Cruiser SB. This allows us to predict the numbers of growers that would experience different levels of losses at a given national average of realised incidence.

For example, the average realised incidence is estimated to be ~2.6% at the economic breakeven point, but we estimate that the bottom quartile (25%) of growers would experience a realised incidence of <0.8% and the top quartile a realised incidence of >3.5% This example distribution is shown in Figure 4:

Figure 4: Histogram of realised incidence at breakeven, 2.6% mean realised incidence.



We then derived Table 2 showing a range of example mean realised incidences against the average, lower, and upper quartile revenue loss. This shows the average loss per hectare, calculated by multiplying the mean national realised incidence by an assumed yield loss of 25% per plant affected and the £32 / tonne price of sugar beet.

For each mean realised incidence, we then derived a distribution of realised incidences equivalent to the histogram above which shows the distribution for a given mean national realised incidence. From this, we estimated the 10th, 25th, 75th, and 90th percentile realised incidences and then calculated the revenue losses using the same method as above. For reference, an average yield for sugar beet is around 71 tonnes / ha, which translates to £2,307 / ha when sold at £32 / tonne.

Table 2: Estimated revenue loss per hectare by mean realised incidence and an estimate of the Rothamsted model's equivalent 'predicted incidence', shown as a range of uncertainty.

Mean national realised incidence (%)	Predicted incidence range (%)	Average loss (£/ha)	Lower 10% loss (<£/ha)	Lower 25% loss (<£/ha)	Upper 25% loss (>£/ha)	Upper 10% loss (>£/ha)
1	0 - 49	6	1	2	8	13
3	45 - 65	17	2	5	24	40
5	57 - 81	29	3	8	40	67
7	63 - 94	40	4	12	56	92
9	68 - 100	52	5	15	73	121
11	72 - 100	63	7	18	87	141
13	75 - 100	75	8	22	102	175
15	77 - 100	87	9	24	118	200
17	78 - 100	98	10	27	135	226
19	78 - 100	110	12	31	152	250
21	79 - 100	121	12	33	167	280
23	79 - 100	133	14	38	184	306
25	80 - 100	144	15	40	196	327
27	80 - 100	156	16	43	212	348
29	81 - 100	167	18	47	231	387
31	81 - 100	179	20	53	251	414
33	81 - 100	190	19	55	266	433
35	82 - 100	202	21	58	282	464
37	82 - 100	213	24	64	296	502
39	82 - 100	225	23	64	309	517
41	82 - 100	236	25	69	329	544
43	83 - 100	248	25	68	342	563
45	83 - 100	260	28	75	360	577
47	83 - 100	271	28	75	365	577
49	84 - 100	283	28	79	389	577

The losses shown here represent the cost of yield loss associated with crop damage from virus yellows for growers using a YV treatment plan without Cruiser[3]. The table shows, for example, that a mean realised incidence for non-cruiser growers of 11% is expected to lead to an average revenue loss of £63/ha, with 25% of growers experiencing a loss >£87/ha and 25% of growers losing <£18/ha.

The second column provides a range of predicted incidence thresholds which correspond to our estimate of the range of incidence the Rothamsted model would predict for each realised incidence level. Selecting a threshold towards the upper end of this range increases the confidence that Cruiser is not used when a given loss does not arise. And

[3] These losses are **not** relative to the damage that would occur had they used Cruiser **nor** the cost of using a different treatment plan.

moving towards the lower bound increases the certainty that a given loss would be avoided as a result of not having access to Cruiser SB.

Due to data limitations, we cannot estimate a similar distribution of impacts for Cruiser growers. On average, we estimate that Cruiser growers would experience 1.3%-1.4% realised incidence at mid-high pest pressure, which translates to a loss from YV of £7-8 / ha. At this level of average loss and due to the superior performance of Cruiser in controlling YV, we would expect very minimal extreme losses.

Therefore, the use of Cruiser would be expected to prevent a significant proportion of the more extreme losses experienced by the top 10% and 25% of growers shown in the table above. This benefit must be balanced against the estimated average ~£8/ha additional cost of a Cruiser treatment plan and the environmental risks presented by the use of Cruiser.

Note that this analysis does not account for the potential impact of the Yield Protection Cover on losses. The existence of this insurance may reduce the impacts of YV on the worst affected growers, especially at the highest levels of loss. As only 12% of the contracted area has taken up this insurance this year, the extent to which losses to growers would be mitigated is uncertain. Further investigation as to the extent of insurance pay-out for different predicted incidence levels is set out in the section*: Losses to the GB sugar industry.*

Impact of losses to growers on business viability

Note that this analysis is highly uncertain and should be used only as an indication of potential impacts on business viability.

This section aims to demonstrate the potential impacts of these losses on the individual businesses that grow sugar beet in GB. To do this, we looked at farm-level financial data of approximately 120 farm businesses growing sugar beet from the 2021 to 2022 Farm Business Survey for England. The year 2021 to 2022 is chosen as it is the latest year available where there were negligible impacts to yields from virus yellows or other factors, such as weather. We use this data to estimate three financial metrics:

1. **Net cash flow:** the net balance of monetary inflows and outflows across the business (including debt servicing & repayment).
2. **Farm business income (FBI):** a measure of profitability and is the net balance of total farm business revenues and costs across the business[4].

[4] includes income and costs from agriculture, diversification activities, BPS and agri-environment activities

3. **Bankruptcy:** if negative net cash flow is greater in magnitude than total liquid assets, then a state of bankruptcy is assumed[5].

Using the simulations of the realised incidence distribution above, we were able to estimate how these metrics change across the farms at differing levels of realised (and predicted) incidence.

This involved the following steps:

1. Adjust the price of sugar beet to 2025 prices in real terms (that is, adjusting for inflation)[6].

2. Repeat the steps below for 1,000 simulations:

    - Draw random samples of realised incidence from the distribution model for each predicted incidence level and each farm.

    - Convert the realised incidences to yield loss and calculate the financial metrics for each farm at each predicted incidence level once the lost revenue from yield loss is subtracted from total farm revenues[7].

    - Count the number of farms showing negative cash flow, negative farm business income, and bankruptcy at each predicted incidence level.

3. Find the mean, lower, and upper percentile counts for the financial metrics at each predicted incidence level.

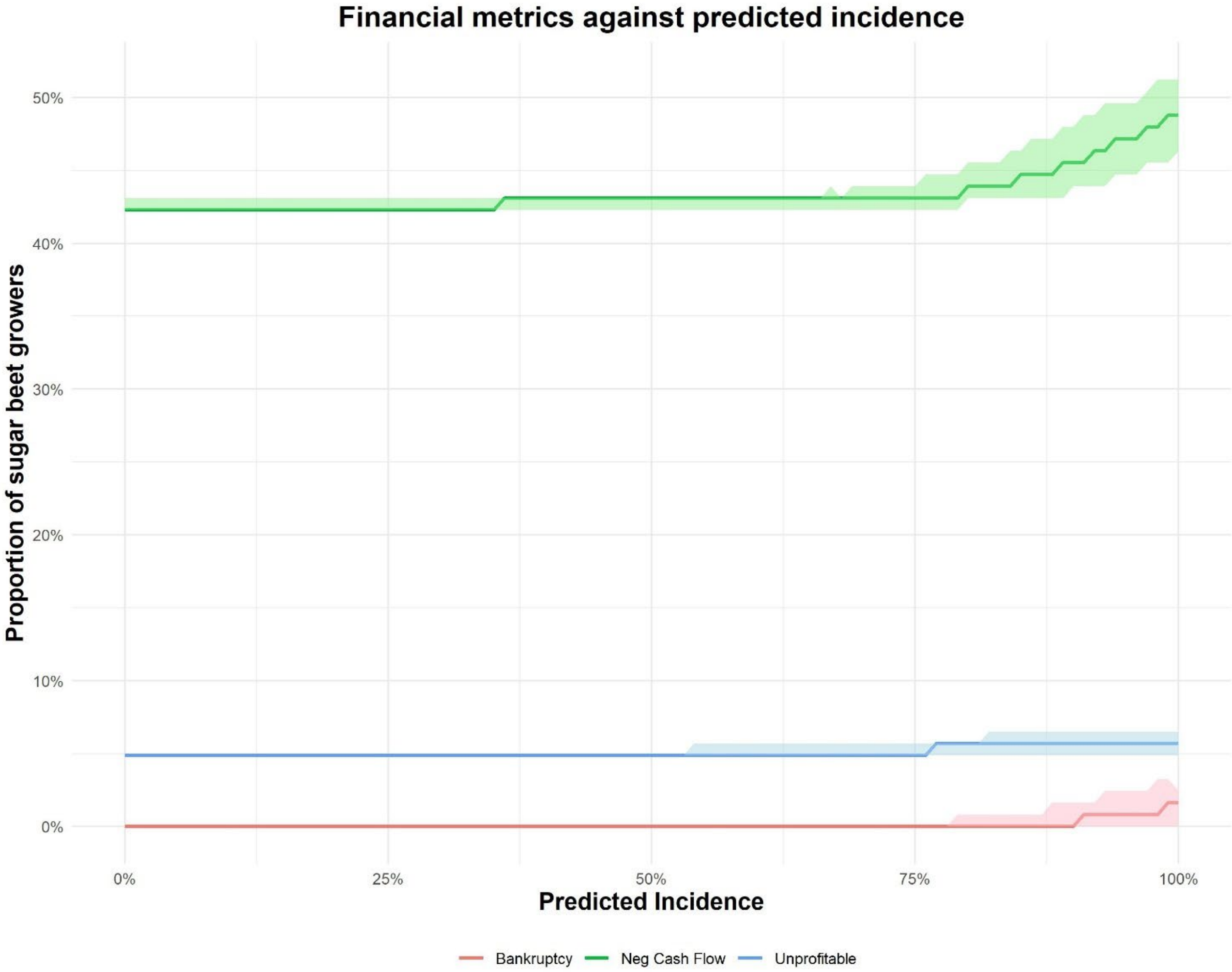
The method led to the following estimated proportions of sugar beet growers experiencing negative cash flow, unprofitability (negative FBI), and bankruptcy at each predicted incidence level. The shaded areas represent the 95% confidence interval based on 1,000 simulations.

[5] In reality, it may be possible for businesses to obtain further loans against their assets. As the analysis shows no businesses entering bankruptcy due to virus yellows, we deem this measure sufficient.

[6] Note that we do not adjust yields upwards to account for pre-existing losses in the 2021 farm business survey. This is done as we wanted to keep the farm-by-farm variation in yields to ensure we were not artificially inflating yields on farms that would be financially unviable with significant virus yellows impacts. We think this is reasonable as the incidence of virus yellows in 2021 was very low and, therefore, is likely to have had only a very small impact on yields.

[7] Note that this estimated change in revenue from yield loss does account for the reduced cost of not using Cruiser in the pest control plan as Cruiser was not authorized for use in GB in 2021. Note that the price differential between a cruiser and non-cruiser treatment plan is likely to be slightly different in 2025 than 2021, however.

Figure 5: Estimated financial metrics for non-cruiser growers, by predicted incidence.



Note that Figure 5 uses the 'central' modelled relationship between realised and predicted incidence. The shaded areas therefore capture the uncertainty associated with individual farms experiencing a given virus incidence following a given national average realised incidence, but they do not account for any uncertainty between the prediction and the national mean.

Figure 5 shows all metrics remaining constant until an increase in negative cash flow from 44% to 49% of growers starting at 80% predicted incidence. In other words, an additional 5% of growers move from positive cash flow to negative cash flow due to sugar beet losses. There is also a slight increase in the proportion of farms that are unprofitable, moving from 5% of farms to 6%, when predicted incidence reaches 77%. In other words, an additional 1% of farms become unprofitable due to sugar beet losses at that predicted incidence level. Finally, bankruptcy rates increase from 0% to 2% of farms, with the increase starting at 91% predicted incidence.

This means that, for example, were the emergency authorisation for Cruiser SB not granted in 2025 and the predicted incidence was 80%, we would expect an additional 1% of farms to switch from positive to negative cash flow, an additional 1% of farms growing sugar beet to become unprofitable, but no farms to enter bankruptcy in that year, based on central assumptions. It is important to note the following caveats to this analysis:

1. The analysis does not account for the Yield Protection Cover which enables sugar beet growers to purchase insurance to guarantee payment for at least 85% of their usual yield. This may reduce the impacts of YV on the worst affected growers, thereby preventing some of the changes in financial metrics, especially at the highest levels of loss. As only 12% of the contracted area has taken up this insurance this year, the extent to which losses to growers would be mitigated is uncertain

2. The analysis uses the 'central' modelled relationship between realised and predicted incidence. **It therefore does not account for any uncertainty between the prediction and the national mean as set out in the previous section.**

3. The estimated distribution of realised incidence is based on a small number of years of data and may, therefore, include significant bias.

4. This analysis does not account for the variation in other variables that would impact financial health of farming businesses, such as high energy prices and other input costs, weather, subsidies or any diversified activities on the farm.

5. The financial data from the farm business survey is based on 2021 to 2022 data only, which covers the 2021 harvest – this has been adjusted for the real (inflation adjusted) change in the sugar beet price, but it will not capture the change in financial positions of these businesses since 2021, nor changes to input costs relative to output revenues over this period.

6. The sample of ~120 farms from the Farm Business Survey is not weighted to be representative of the population of sugar beet farms. This may introduce some bias into the results.

3. Losses to the GB sugar industry

The sugar industry as a whole is likely to be impacted by sugar beet yield losses due to virus yellows in 2 ways:

1. Direct losses associated with reductions in revenues from yield losses.
2. Increased costs associated with filling domestic supply gaps to meet domestic demand for sugar.

Direct losses associated with reductions in revenues from yield losses and the share of losses between growers and British Sugar.

The total direct loss associated with virus yellows is estimated by summing together the value of individual farm-level losses. This total cost would be borne either by growers, or by British Sugar, who offer a crop insurance scheme to growers called the 'Yield

Protection Cover' which guarantees payment for 85% of their usual yield for a £1.40/tonne deduction in contract price, in 2025.

We know that 12% of the sown area has opted for the Yield Protection Cover in 2025[8]. It is, however, difficult to predict the proportion of these insured growers that will receive insurance payouts and the size of these payouts.

This is because:

- there is high uncertainty surrounding the levels of YV incidence that individual growers will face around a given national average (as explained above)
- other (non-YV) factors will influence yield outcomes which we cannot estimate against which insurance payouts can be made – for example, the impacts of weather
- growers that are more likely to experience high levels of loss will likely choose insurance more often, which means they are not representative of the population as a whole

We have used a series of assumptions to estimate indicative upper and lower bounds of the share of yield losses that would be absorbed by British Sugar under different predicted incidence scenarios.

In the lower bound scenario, it's assumed that the 12% of contracted area that has bought insurance is distributed equally in terms of yellow virus (YV) impacts. Additionally, these growers do not face non-YV yield loss, meaning only YV losses greater than 15% are covered by yield protection.

Conversely, in the upper bound scenario, the 12% insured area is expected to experience the worst 12% of YV impacts. Furthermore, these insured growers face more than 15% non-YV yield loss, which implies that all YV losses are covered by yield protection.

The results are shown in Table 3. Further rows can be provided on request:

Table 3: Total costs and insurance payouts associated with virus yellows in sugar beet.

Realised Incidence (%)	Predicted Incidence Range (%)	Total Cost (£m)	Lower Scenario Insurance Payout (£m)	Upper Scenario Insurance Payout (£m)
1	0 - 49	0.6	0	0.2
3	45 - 65	1.6	0.2	0.6
5	57 - 81	2.8	0.3	1
7	63 - 94	4	0.5	1.5

[8] Based on 2023 and 2024 data of uptake.

9	68 - 100	5	0.6	1.8
11	72 - 100	6.3	0.9	2.5
13	75 - 100	7.2	0.9	3.1
15	77 - 100	8.2	1	3.2
17	78 - 100	9.2	1.2	3.8
19	78 - 100	10.3	1.2	4.2
21	79 - 100	11.3	1.6	4.5
23	79 - 100	13.5	1.4	4.9
25	80 - 100	14.4	1.6	5.1
27	80 - 100	14.3	1.7	5.8
29	81 - 100	15	1.8	5.9
31	81 - 100	17.1	2.5	6.5
33	81 - 100	18.1	2.1	7
35	82 - 100	19.5	2.2	7.7
37	82 - 100	20.3	2.7	7.6
39	82 - 100	21.6	3.1	8.5
41	82 - 100	22.1	2.8	8.1
43	83 - 100	24	2.8	9
45	83 - 100	26.5	3.8	9.3
47	83 - 100	26.7	3.5	9.4
49	84 - 100	29	3.3	10.4

This table shows the total cost to the sugar beet growing industry from yield loss due to virus yellows and the lower and upper bound estimates of the cost of insurance payouts to cover these losses.

Total costs rise increasingly, moving above £5m as realised incidence rises beyond 10%. The lower bound of insurance pay-outs comprise around 10% of the total cost, with the share increasing slightly as realised incidence rises and more growers become eligible for Yield Protection Cover. The upper bound comprises roughly 35-40% of the total cost, with the share remaining roughly constant. We would expect the share to gradually drop off as mean realised incidence increases beyond 25%, as more growers hit the maximum 100% incidence.

In 2023, the fund for Yield Protection Cover was £28.5M for a 95,000ha crop[9]. This suggests that the virus yellows losses shown above could likely be absorbed. Due to financial information being commercially sensitive, we are not able to say what losses industry would be able to sustain in a given year. It is also not clear whether payouts would continue to be honoured in the event of total yield losses exceeding the fund set aside for 2025.

[9] 2023 sugar beet price increases by 48%, with options for yield protection and cash advances - Crop Production Magazine (cpm-magazine.co.uk)

Import costs of substituting for reduced domestic supply

In the scenario that Cruiser SB is not authorised for use, there could be a shortfall in domestic sugar production, especially in higher pest pressure scenarios.

We have estimated the total domestic shortfall in sugar beet production associated with virus yellows when not authorising Cruiser SB at different predicted incidences in Table 4.

Table 4: Estimated GB sugar beet production shortfall due to virus yellows when not using Cruiser SB, by predicted incidence.

Realised Incidence (%)	Predicted Incidence Range (%)	GB Sugar Beet Shortfall (kt sugar beet)	Domestic Supply Gap (kt sugar, assuming 16% sugar content)
1	0 - 49	17	3
3	45 - 65	52	8
5	57 - 81	86	14
7	63 - 94	121	19
9	68 - 100	155	25
11	72 - 100	189	30
13	75 - 100	224	36
15	77 - 100	258	41
17	78 - 100	293	47
19	78 - 100	327	52
21	79 - 100	362	58
23	79 - 100	396	63
25	80 - 100	431	69
27	80 - 100	465	74
29	81 - 100	500	80
31	81 - 100	534	85
33	81 - 100	568	91
35	82 - 100	603	96
37	82 - 100	637	102
39	82 - 100	672	107
41	82 - 100	706	113
43	83 - 100	741	119
45	83 - 100	775	124
47	83 - 100	810	130
49	84 - 100	844	135

Historic data suggests that this domestic shortfall would be substituted by (a) imports of white sugar from the EU and / or (b) imports of raw cane sugar from non-EU countries that would then be refined domestically.

If the sugar harvest in the EU is good, shortfalls in GB production may be met by EU production. The UK pays a slight premium for imported EU sugar, so prices of sugar and their related products could increase slightly. If the EU harvest is also bad, shortfalls in production could be met by imports of raw cane sugar or refined white sugar from non-EU suppliers. Tighter global sugar supplies and recent weather patterns have meant that markets are sensitive, and world prices have been historically high. This volatility could impact the price that the UK would need to pay for imported sugar. There are a number of different import regimes that are used by sugar traders in the UK to import using preferential access quotas, but as import demand increases, available quotas may be exhausted, until importers must pay the full MFN[10] tariff which for sugar is £280 per tonne for raw cane and £350 per tonne for white sugar. This would increase prices of sugar and their related products.

Due to the uncertainty associated with predicting the price of sugar imports, it is not possible to robustly estimate the cost premium associated with importing sugar to substitute for domestic shortfalls in production. However, it's possible that costs could be significant if the EU harvest is poor and import demand is already high.

As manufacturing and retail contracts tend to be agreed before the national yields are known, it's unlikely that any increased cost due to import substitution would lead to changes in prices in the short-term. In the long-term, any losses in this year may lead to higher sugar prices in subsequent years.

The majority of sugar in the UK is not sold at retail[11], but price increases to wholesale sugar can increase input costs to other products. It is very difficult to estimate how significant the impact would be on manufactured foods as it depends on how the relative proportion of sugar as an input and other input costs (e.g., energy costs) may change.

It is likely that if the harvest across Europe is very good then the marginal impact on price of yield losses due to virus yellows will be small[12]. However, if the European market remains in a large deficit[13], then considerable imports from outside the European market may be needed to meet consumption. In this case it is likely that there will be an impact to the GB sugar industry but this will depend on a wide range of factors which are not possible to fully capture in this analysis.

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[10] Most Favoured Nation (MFN) tariffs are non-discriminatory rates charged on imports (excludes preferential tariffs negotiated under free trade agreements and other schemes).

[11] The UK food sector is classified into retail, manufacturing, wholesaling, and non-residential catering. Our current estimate is that around 10-15% is sold directly to consumers at retail

[12] There are slightly improved yield expectations for sugar beet in Europe this season but it is still early in the season and uncertain (JRC Publications Repository - JRC MARS Bulletin - Crop monitoring in Europe - September 2023 - Vol. 31 No 9 (europa.eu)

[13] As was the case in 2022 to 2023.

4. Background

Historic Infection Levels

The impact of virus yellows is highly variable from year to year. There was a high infection level in 2020 but a low level in 2021 following a relatively cold winter. In the absence of low winter temperatures, we would expect a moderate to high level of virus yellows infection in 2025.

Figure 6: 2019 % Infection

1.8% average

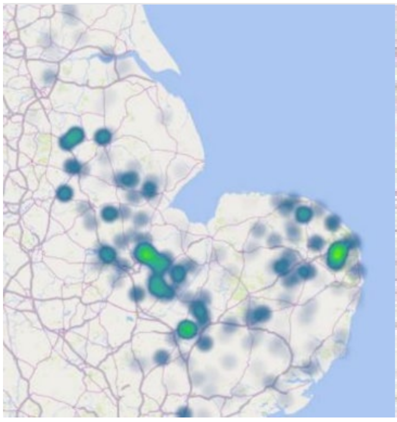


Figure 74: 2020 % Infection

38% average

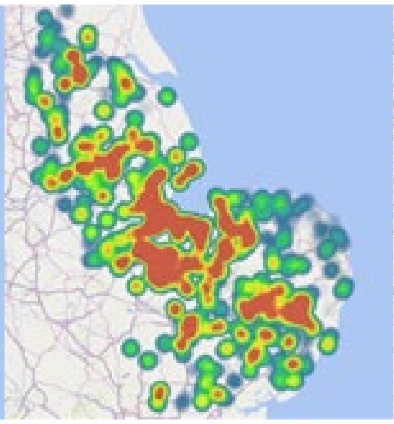
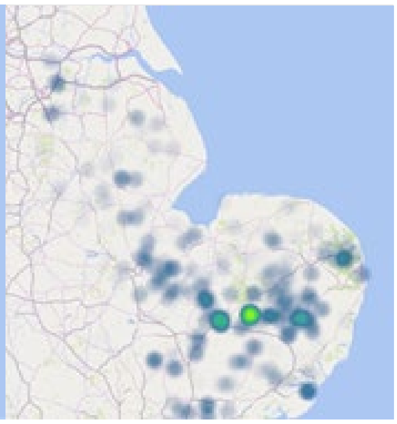


Figure 85: 2021 % Infection

2% average



Figures 6 to 8 display the average infection rate between 2019 to 2021. We do not have sufficient data on the 2022 and 2023 infection rates to provide a spatial distribution due to adverse weather conditions affecting identification of the virus in some areas. At this stage, British Sugar were also unable to provide an equivalent chart for 2024.

Figures 6, 7 and 8 are heatmaps of the percentage infection across the East of England in 2019, 2020: and 2021, respectively on a scale from 0 to 100%. Figure 6 shows in 2019, when average infection was 1.8%, that there were several isolated areas of identified infection but all were at the lower half of the scale. Figure 7 shows in 2020, when the average infection rate was 38%, much more widespread infection with areas merging together to mainly form larger contiguous zones and a significant amount of area at close to 100% infection rate. Figure 8 shows in 2021, when the average infection rate was provisionally estimated at between 1.5% and 2%, a similar pattern to Figure 6 but with fewer areas towards the middle of the scale.

UK sugar beet production

The area grown for 2024 was estimated at 102,000 hectares, which represents 2% of the UK's total croppable area[14]. Area grown has been in overall decline since the mid-1990s and well before the introduction of neonicotinoid restrictions.

The majority of sugar beet is grown in the east of the UK and the area grown decreased slightly in 2021 and 2022 but looks to have recovered in 2023 and 2024. The applicant expects a slightly lower area to be grown in 2025 due to the relative reduction in sugar prices relative to other crops.

Figure 9: Area grown of sugar beet over time, per thousand hectares.

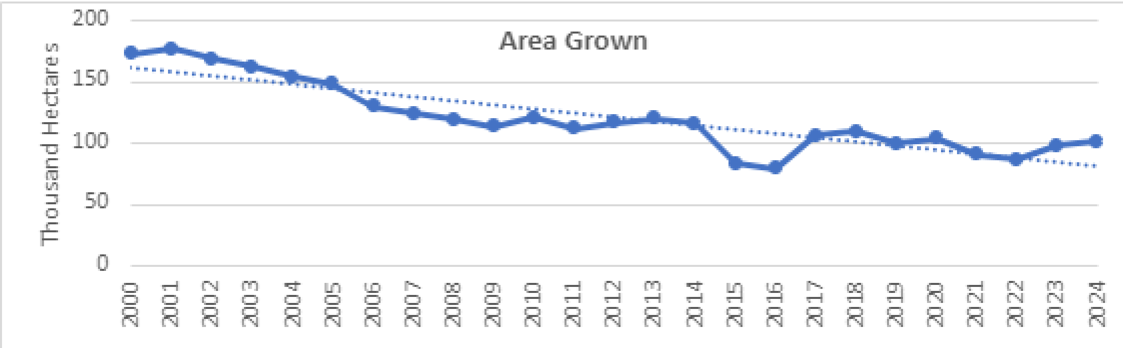


Figure 99 is a trendline showing the area grown of sugar beet over time, per thousand hectares. Axis begins in 2000 and ends in 2024. The trendline shows that the overall area grown has declined since 2000.

Impacts of virus yellows on 2019 crop

Overall, evidence suggests that there was limited impact of the virus yellows on sugar beet production for 2019. The national incidence for virus yellows was low at 1.8%, limiting the effect on yield and subsequent financial losses were therefore likely to be low for most growers. This was only slightly higher than average realised incidence rate (with pest management) from 2011 to 2016 of 0.6%.

Based on the assumption of a 25% yield loss per affected plant provided by industry, this incidence would translate into production losses from virus yellows of less than £1 million, and this is still substantially less than the estimated cost of applying neonicotinoid seed treatments.

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[14] Based on 2022 data.

The emergency authorisation for Biscaya[15] and the application of Tepekki[16] will have provided some control for aphids (which carry virus yellows), and consequently will have limited any impacts of virus yellows.

Around 57% of the crop surveyed was sprayed with one or two sprays. It is also possible that further control was provided by legacy effects from previous usage of the neonicotinoid seed treatments, however, the impact of this would diminish with time.

Impacts of virus yellows on 2020 crop

The impacts of virus yellows on the 2020 crop were much greater than in 2019. The national incidence for virus yellows was 38.1% with numerous sources of infection. This was the highest level of infection since the 1970s. However, this was still lower than the predicted virus incidence of 82%.

The volume of sugar beet production was down around 23% compared with 2019. The applicant has stated that they estimate that the costs to growers in the 2020 season was approximately £43 million and subsequent impact to the processor of a further £24 million.

Costs to processor were mainly from lower margins resulting from increased fixed costs per tonne of sugar produced due to decreased production, the cost of sugar imports required to honour existing customer commitments and increases in other production costs due to beet quality.

It is likely that the warm, dry spring encouraged an early and sustained migration of large numbers of aphids to build up in spring crops such as sugar beet. The British Beet Research Organisation (BBRO) maps of aphid density also show a strong increase in aphid prevalence in the east of England.

This was clearly demonstrated by the data from the Brooms Barn trap (one of the main traps in the east of England for the Rothamsted insect survey) with around 4,000 peach-potato aphids trapped in 2020, around 3 times higher than the previous peak.

The early timing of aphid flight is also particularly problematic, as the crop is highly vulnerable and alternative control methods are less effective at this point.

A national sugar beet crop survey indicates that 78% of surveyed crop received between 2 and 4 sprays.

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[15] Biscaya contains the active substance Thiacloprid which is classified as a neonicotinoid but is only of moderate toxicity to honeybees.

[16] Contains active substance flonicamid which is not a neonicotinoid and is of low toxicity to honey bees.

While Biscaya was authorised by a separate emergency authorisation, there were production issues which may have limited its use. Furthermore, the legacy impacts of neonicotinoids were expected to diminish from 2019 to 2020.

Impacts of virus yellows on 2021 crop

Evidence indicates that infection rates were around 2%, with minimal losses for growers experienced (well below the cost of seed treatment) as in 2019. The cold winter reduced aphid populations and therefore the model forecasted an incidence of around 8%, meaning the 9% economic threshold (set at a level that did not account for errors in the prediction model) was narrowly not met.

Evidence suggests that more than 90% of growers were prepared to use seed treated with neonicotinoids if this threshold had been met.

Although aphid populations were typically heterogenous in their distribution and strongly influenced by many other factors such as wind strength and direction, topography, surrounding crops and field boundaries, BBRO traps show that the situation improved. For example, only 190 peach-potato aphids had been caught at the Broom’s Barn trap (compared to 4,000 in 2020).

The national sugar beet crop survey indicates that 74% of surveyed crop received only one spray and 7% received 2 sprays.

Impacts of virus yellows on 2022 crop

The finalised estimates of the average infection rates from the 2022 crop suggest a realised incidence of 6.9% for non-Cruiser and 3.8% for Cruiser growers. This indicates that seed treatment, while beneficial, turned out to have only a modest benefit for the average grower in controlling YV infections in this year. It’s likely, however, that a subset of individual growers may have experienced more significant benefits from the use of Cruiser.

The predicted incidence from the Rothamsted model (68.9%) exceeded the raised threshold of 19%, meaning seed treated with neonicotinoids was authorised for use in 2022. Evidence suggests that 71% of growers used treated seed. The national sugar beet crop survey shows that, of those using treated seed, 42% did not apply a spray and 57% applied only one spray. Of those not using treated seed, 34% applied only one spray and 42% applied at least 2 sprays.

Impacts of virus yellows on 2023 crop

Finalised estimates of the average infection rates from the 2023 crop show an incidence of around 1% for growers both seed treated and seed untreated groups of growers. This indicates, again, that seed treatment may not have been necessary to control YV infections in this year for the average grower. It's likely, however, that a subset of individual growers would have experienced benefits from the use of Cruiser.

The predicted incidence from the Rothamsted model (67.5%) exceeded the raised threshold of 63%, meaning seed treated with neonicotinoids was authorised for use in 2023. Evidence suggests that 60% of growers used treated seed. The national sugar beet crop survey shows that, of those using treated seed, 60% did not apply a spray and 35% applied only one spray. Of those not using treated seed, 41% applied only one spray and 38% applied at least2 sprays.

Impacts of virus yellows on 2024 crop

The 2024 crop experienced infection rates of 4.1% for growers not using neonicotinoids and 3.4% for those that did. The predicted incidence from the Rothamsted model (83%) exceeded the raised threshold of 65%, meaning seed treated with neonicotinoids was authorised for use in 2024.

Evidence suggests that 58% of growers used treated seed. The national sugar beet crop survey shows that, of those using treated seed, 72% did not apply a spray and 26% applied only one spray. Of those not using treated seed, 39% applied only one spray and 33% applied at least 2 sprays.

Outlook for 2025 crop

As discussed above, the impact of virus yellows is highly variable from year to year. The impacts on growers in 2019, 2021, 2022, 2023, and 2024 represent the lower bound for potential impacts.

It is likely that the impacts seen in 2020 represent an effective upper bound, with the levels of aphids described as 'unprecedented' by the applicant, trap data much higher than previous levels and data back to the 1970s showing no example of the forecast for virus yellows significantly exceeding the 2020 rate.

Growers are likely to have 2 foliar sprays available to control YV – Teppeki and Insyst. Our analysis suggests that these methods, alongside other IPM actions, will be effective in managing predicted virus incidence up to around 60%. At some predicted incidence of at least 50%, we expect that foliar sprays and other IPM measures will not be able to sufficiently contain aphid numbers to prevent yield losses that could be interpreted as significant. Where this point will be in 2025 is highly uncertain and will likely depend on several factors that are not captured in the predicted incidence model.

The continuation of the Yield Protection Cover for this year – which will guarantee a payment for 85% of growers' contracted output – will mitigate some of the potential losses for the individual growers who choose to purchase the cover.