Defra economic analysis report explaining adjustments to the breakeven threshold and impacts of yellows virus on sugar beet production

Infection Levels

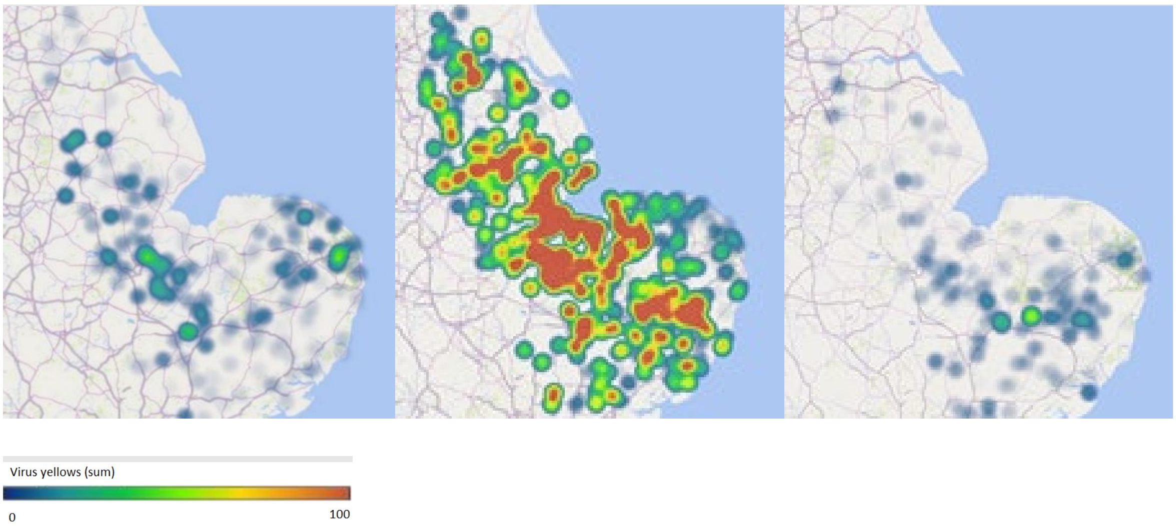
The impact of yellows virus (YV) is highly variable from year to year. There was a high infection level in 2020 but a low level in 2021 following a relatively cold winter. In the absence of low winter temperatures, we would expect a moderate to high level of YV infection in 2024.

Figures 1 to 3: average yellows virus infection rate from 2019 to 2021

Figure 1: 2019 % Infection 1.8% average

Figure 2: 2020 % Infection 38% average

Figure 3: 2021 % Infection 2% average



Figures 1 to 3 display the average infection rate between 2019 and 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.

Figures 1, 2 and 3 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 1 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 2 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 3 shows in 2021, when the average infection rate was provisionally estimated at between 1.5% and 2%, a similar pattern to Figure 1 but with fewer areas towards the middle of the scale.

Yellows virus model

The yellows virus (YV) 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, and 2023 with lower infection levels predicted in both 2019 and 2021.

For 2019, the forecast was for around 0.39 incidence expected if no pest control measures were applied. In reality, the realised (observed) incidence that resulted was significantly lower than this at 0.018, indicating foliar sprays and other integrated pest management (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 0.82. The realised incidence was still lower than this at 0.38, although the economic costs from this infection were high, with the cost to growers estimated by industry at approximately £43 million (approximately £413 per hectare (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 YV in 2020 more challenging.

For 2022, the model forecast an incidence of 0.689 but extreme dry weather at the time of the survey means that a finalised estimate of realised incidence was not produced due to difficulties in identifying disease. Results suggest that incidence was low (roughly 0.06) for crops not treated with neonicotinoids, 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 0.675 but we have not yet received an official estimate of the actual incidence with which to compare. Initial results suggest that incidence was very low (below 0.02) 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 it may therefore have transpired that 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.

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

Table 1: Modelled versus actual virus incidence from 2019 to 2023

Year	Model incidence prediction	Action taken	Actual virus incidence	Impact on yield
2019	0.39	57% of surveyed crop received 1 or 2 foliar sprays.	0.018	Little impact
2020	0.82	78% of surveyed crop received 2 to 4 foliar sprays.	0.381	Yields down around 25%
2021	0.0837	74% received 1 spray, 7% two sprays.	0.02	Little impact
2022	0.689	71% of surveyed crop used Cruiser SB. 69% received 1 to 3 foliar sprays.	0.06 (estimate, non-Cruiser growers only)	Little impact
2023	0.675	60% of surveyed crop used Cruiser SB. 56% received 1 to 3 foliar sprays.	0.011 (estimate, non-Cruiser growers only)	Little impact

Table 1 displays data resulting from the application of the yellows virus 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 and 2023, with lower infection levels in 2019 and 2021.

Figure 4: Modelled estimated yellows virus incidence without pest management against actual incidence rate without Cruiser, but with foliar sprays

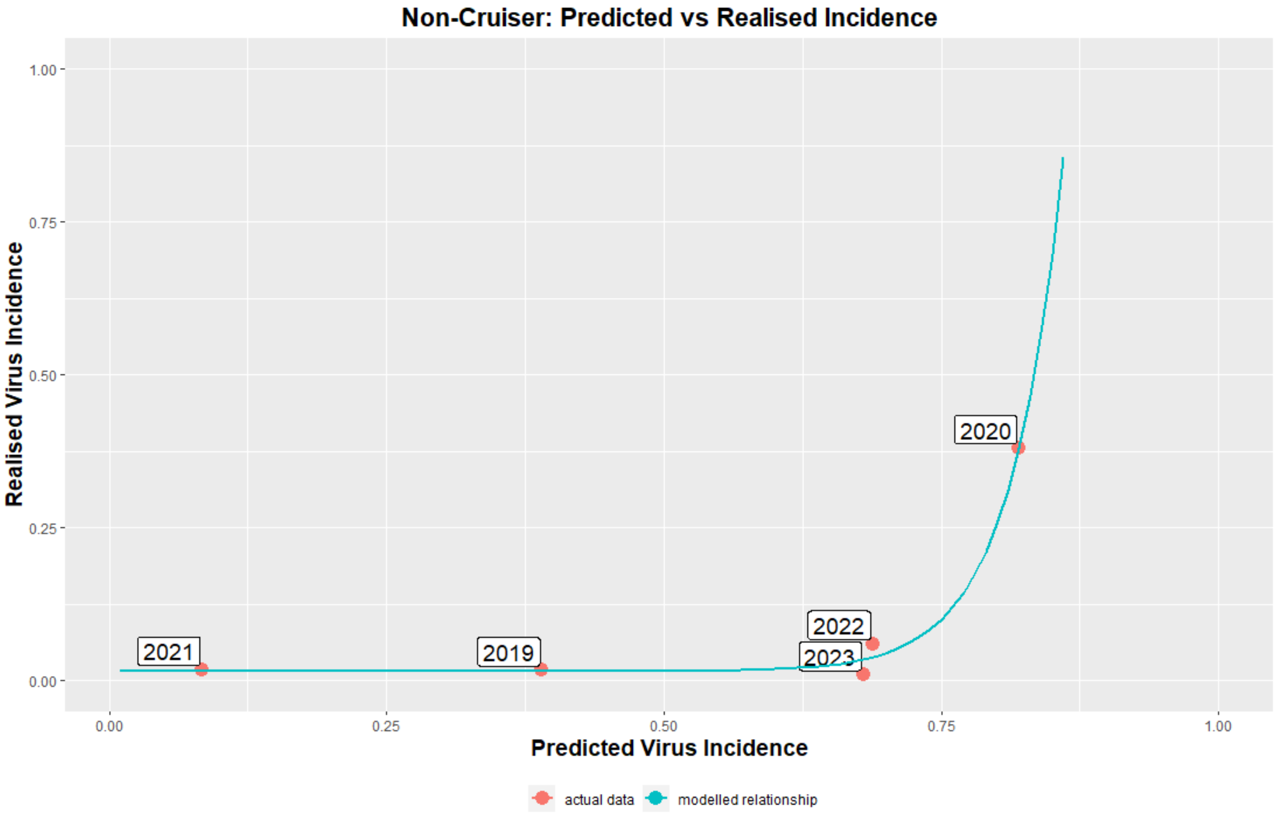


Figure 4 is a line graph displaying modelled estimated yellows virus incidence without pest management against actual incidence rate based on the years 2019 to 2023.

Method

We estimate that, for 2024, the 'threshold' of yellows virus (YV) incidence above which sugar beet farmers will start to experience losses will be approximately 0.024. This is the level of 'observed' or realised YV incidence that is actually experienced by growers on average above which there is a net financial loss from not being able to use Cruiser SB.

The following section sets out our recommended method for adjusting the threshold (see Annex A) for the problems of overestimation of the YV Model prediction that we have identified above. This adjustment moves the breakeven threshold from approximately 0.024 to 0.64.

This adjusted breakeven threshold 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 2023, applied to 2024 prices. This resulted in **an additional cost of £10.16 per ha from using a**

treatment programme including Cruiser SB vs not, 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, and 2023 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 2024. 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 5: Net benefit to sugar beet growers in Great Britain from use of Cruiser by predicted incidence

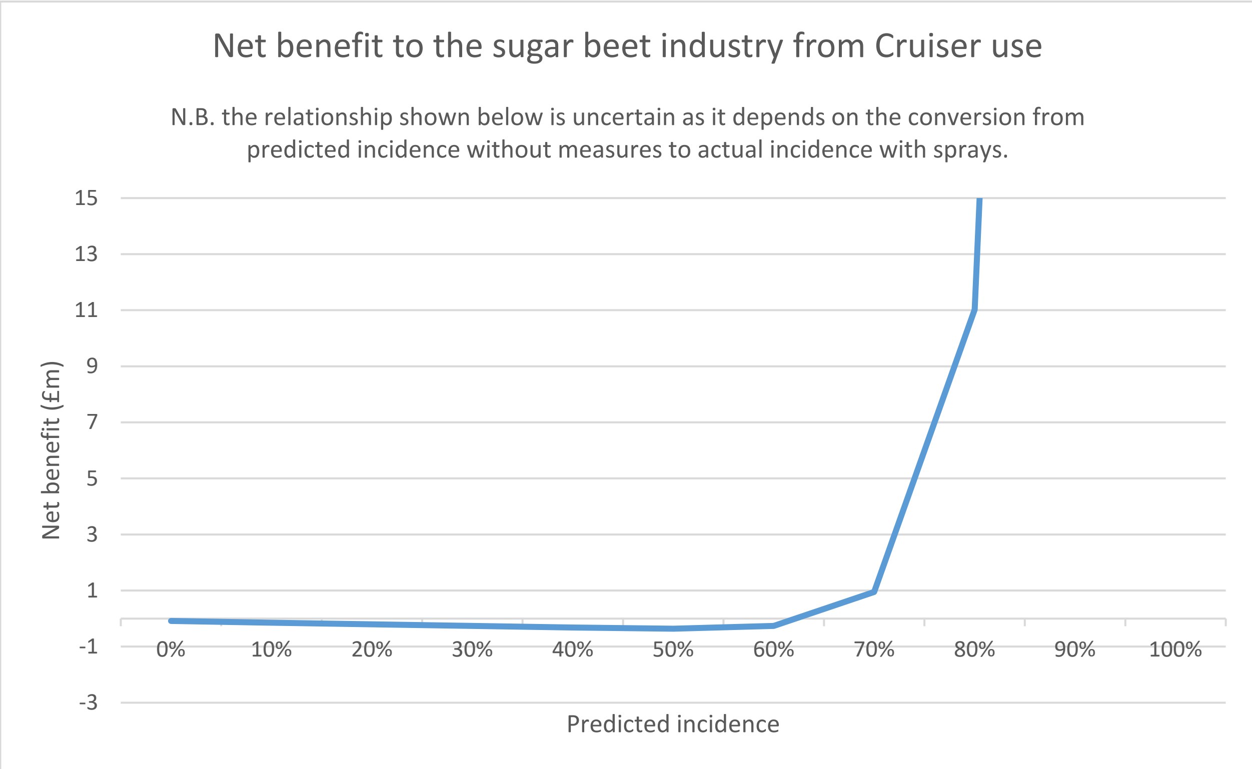


Figure 5 is a line graph displaying net benefit to the sugar industry from Cruiser SB plotted against predicted YV incidence.

The change in net benefits is predominantly driven by the non-linear mapping of realised virus incidence without Cruiser SB treatment which leads to a sharp increase in realised incidence once the predictions pass approximately 0.6 (roughly equivalent to approximately 0.02 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 0.39 led to a realised incidence of 0.018 for non-Cruiser growers. Given that the realised incidence was below the approximately 0.024 realised (equivalent to 0.64 predicted incidence) breakeven threshold that has been identified for 2024, we would consider the breakeven threshold not met if the same incidence were to be realised in 2024.

In 2020, the predicted incidence of 0.82 led to a realised incidence of 0.38 for non-Cruiser growers. Given that the realised incidence was above the approximately 0.024 realised breakeven threshold identified for 2024, we would consider the breakeven threshold met if the same incidence were to be realised in 2024.

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 approximately 0.024. We have estimated this point to be 0.64 (as shown above) but historic data suggests that it could range between 0.38 and 0.82.

It must be acknowledged, however, that the breakeven threshold may still fall outside this range as realised outcomes to a given pest pressure may differ between years.

In summary, moving towards the upper bound 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 YV model, for example, including more localised data, although this will not be available for the 2024 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 0.2 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 first page 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 0.07 to 0.61 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 2024.

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 80% of yield through British Sugar's Yield Protection Cover Scheme.

This may significantly reduce the impacts of extreme yield losses resulting from yellows virus, especially when yellows virus losses are stacked on top of weather-related and other causes of yield loss. Last year, however, only 13% of growers took up the scheme at £1.50/tonne. This year, the same cover is on offer for £1/tonne.

Estimates for the total value of insurance payouts to sugar beet growers in 2024 are set out in 'Losses to the Sugar Industry in Great Britain'.

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 threshold, 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 approximately 0.024 at the economic breakeven point, but we estimate that the bottom quartile (25%) of growers would experience a realised incidence of less than 0.007 and the top quartile a realised incidence of more than 0.033 This example distribution is shown in the chart below:

Figure 6: Histogram of realised incidence at breakeven, 0.024 mean realised incidence

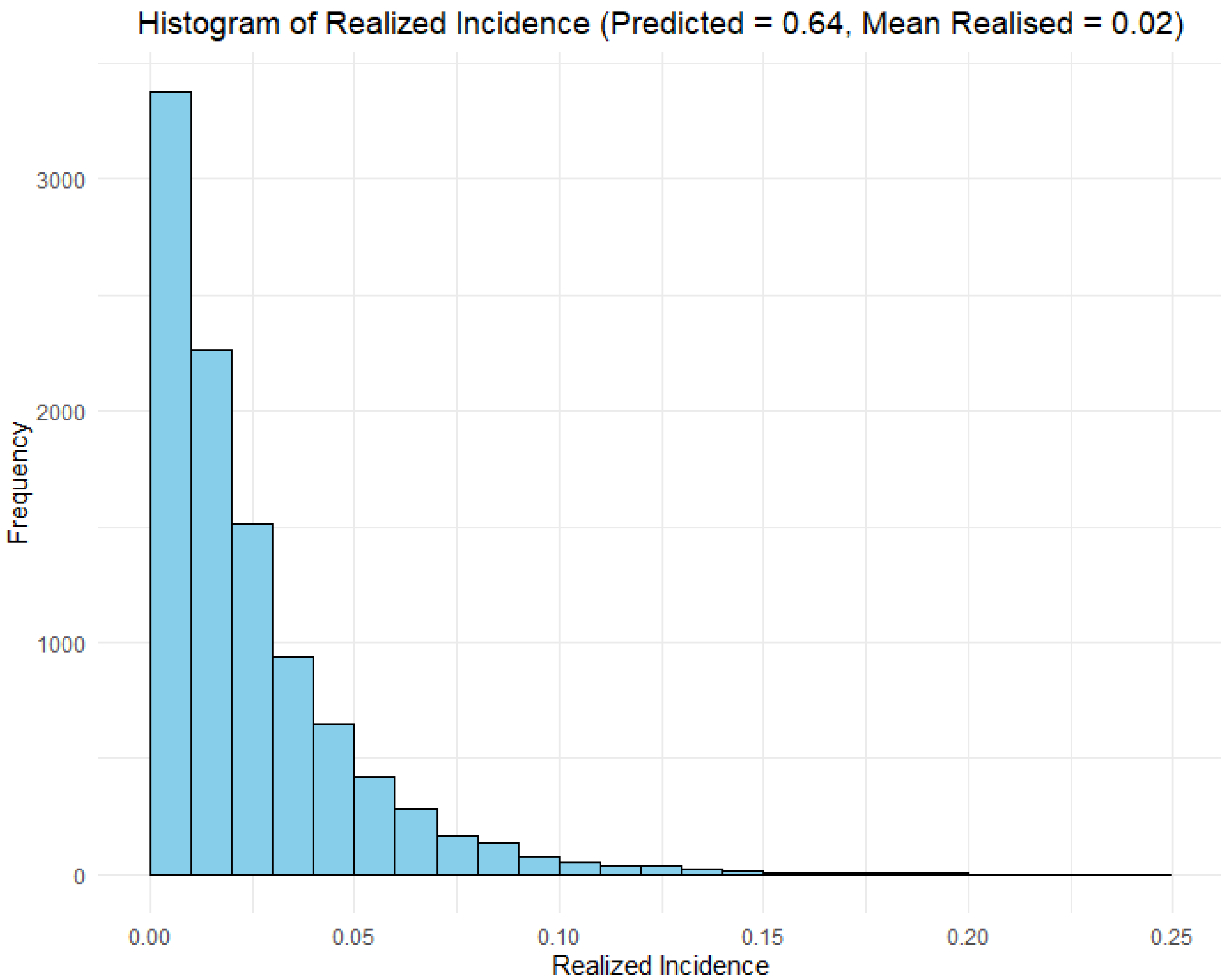


Figure 6 is a histogram that visually represents the distribution of realised incidence at breakeven. The histogram peaks at 0.00 realised incidence and falls exponentially, with a mean realised incidence of 0.024. It provides insights into the variability of incidence values across different scenarios or observation.

We then derived the following table showing a range of example predicted incidences at and above the breakeven against the average, lower, and upper quartile revenue loss. We first translated each predicted incidence into a mean realised incidence using the model explained in the 'Yellows virus model' section above and in Figure 4. This enables us to calculate the average loss per hectare by multiplying the mean realised incidence by an assumed yield loss of 25% per plant affected and the £40 / 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 2.4% mean 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 (unaffected) yield for sugar beet is around 87 tonnes / ha, which translates to £3,480 / ha when sold at £40 / tonne.

Table 2: Estimated revenue loss per hectare by predicted incidence

Predicted incidence	Mean realised incidence	Average loss (£/ha)	Lower 10% loss (<£/ha)	Lower 25% loss (<£/ha)	Upper 25% loss (>£/ha)	Upper 10% loss (>£/ha)
0.64	0.02	21	2	6	29	48
0.65	0.03	23	2	7	31	52
0.66	0.03	25	3	7	35	58
0.67	0.03	27	3	8	38	63
0.68	0.04	31	3	9	43	72
0.69	0.04	35	4	10	48	77
0.70	0.05	40	4	12	54	92
0.71	0.05	46	5	13	62	106
0.72	0.06	53	5	15	73	123
0.73	0.07	62	7	18	87	143
0.74	0.08	74	7	20	102	171
0.75	0.10	88	9	25	122	203
0.76	0.12	105	11	29	143	238
0.77	0.15	126	13	35	172	282
0.78	0.18	152	16	43	211	353
0.79	0.21	184	20	54	259	427
0.80	0.26	224	23	65	313	509
0.81	0.31	273	29	78	381	627
0.82	0.38	333	38	99	461	782
0.83	0.47	406	42	115	558	870
0.84	0.57	497	53	144	692	870
0.85	0.70	609	61	166	839	870

The losses shown here represent the cost of yield loss associated with crop damage from YV for growers using a YV treatment plan without Cruiser[3]. The table shows, for example, that a predicted incidence of 0.64 is expected to lead to a mean realised incidence for non-cruiser growers of approximately 0.02 and an average revenue loss of £21/ha, with 25% of growers experiencing a loss more than £29/ha and 25% of growers losing less than £6/ha.

[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.

Due to data limitations, we cannot estimate a similar distribution of impacts for Cruiser growers. On average, we estimate that Cruiser growers would experience 0.013 to 0.014 realised incidence between 0.64 and 0.78 predicted incidence, which translates to a loss from YV of £11 to £13 / 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 £10/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. This is unlikely to significantly affect the results above (especially in the 0.6 to 0.75 range) because the historic uptake of this insurance has been low (less than 15%), and losses must exceed 20% before the insurance can be claimed. Further investigation as to the extent of insurance pay-out for different predicted incidence levels is set out in the section: 'Share of crop sales revenue between growers and industry'.

Finally, also note that the reliability of these estimates is likely to reduce as predicted incidence increases and as we look towards the very worst-off group of farms. This is due to limitations in the modelling of the distribution.

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 Great Britain. To do this, we looked at farm-level financial data of approximately 120 farm businesses growing sugar beet from the 2021/22 Farm Business Survey for England. The year 2021/22 is chosen as it is the latest year available and because of the negligible YV impacts in the 2021 sugar beet crop. 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, Basic Payment Scheme (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 2024 prices in real terms (i.e., 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 in Figure 7 represent the 90% confidence interval based on 1,000 simulations.

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[5] In reality, it may be possible for businesses to obtain further loans against their assets. As the analysis shows very few businesses entering bankruptcy due to yellows virus, 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 yellows virus impacts. We think this is reasonable as the incidence of yellows virus 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 Great Britain in 2021. Note that the price differential between a cruiser and non-cruiser treatment plan is likely to be slightly different in 2024 than 2021, however.

Figure 7: Estimated financial metrics for non-cruiser growers, by predicted incidence

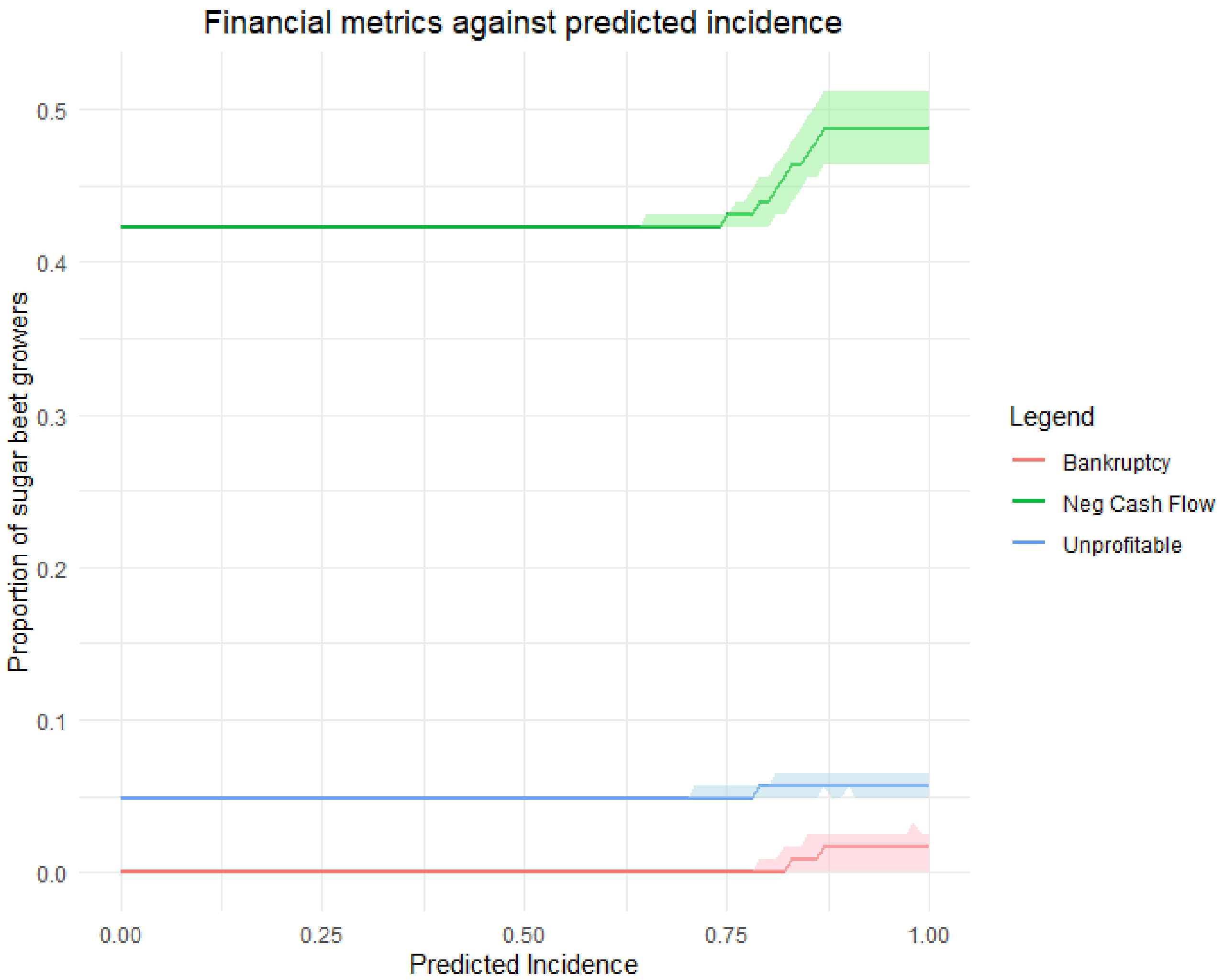

Figure 7 is a line chart that shows how the estimated proportion of sugar beet farms facing bankruptcy, negative cash flow and unprofitability changes with predicted incidence. The shaded areas represent the 90% confidence intervals.

This chart shows all metrics remaining constant until an increase in negative cash flow from 0.43 to 0.49 of growers between 0.75 and 0.88 predicted incidence. There is also a slight increase in the proportion of farms that are unprofitable (approximately 0.01) when predicted incidence reaches 0.79. Bankruptcy increases to approximately 0.02 from 0.83 to 0.87 predicted incidence.

This means that, were the emergency authorisation for Cruiser SB not granted in 2024, we would expect a small proportion of farms to switch from positive to negative cash flow, and very small number of farms growing sugar beet to become unprofitable and enter bankruptcy in that year if predicted incidence rose above around 0.79.

It is important to note the following caveats to this analysis.

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

2. 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.

3. The financial data from the farm business survey is based on 2021/22 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.

4. The sample of approximately 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.

Losses to the Sugar Industry in Great Britain

The sugar industry as a whole is likely to be impacted by sugar beet yield losses due to yellows virus (YV) in two 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 YV 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 80% of their usual yield for a £1/tonne deduction in contract price, in 2024.

We expect that between 10% to 20% of non-cruiser growers will opt for the Yield Protection Cover in 2024[8]. It is, however, very 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).

[8] Based on 2023 data of uptake.

- 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 10% of growers buy insurance. These insured growers are distributed equally in terms of YV impacts. Additionally, these growers do not face non-YV yield loss, meaning only YV losses greater than 20% are covered by yield protection.

Conversely, in the upper bound scenario, 20% of growers are assumed to purchase insurance. These growers are expected to experience the worst 20% of YV impacts. Furthermore, these insured growers face more than 20% non-YV yield loss, which implies that all YV losses are covered by yield protection.

The results are shown in the table below.

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

Predicted incidence	Total cost (£ million)	Lower scenario insurance payout (£ million)	Upper scenario insurance payout (£ million)
0.64	2.1	0	1.1
0.65	2.2	0	1.2
0.66	2.4	0	1.3
0.68	3	0	1.6
0.70	3.9	0	2
0.72	5.2	0	2.7
0.74	7.3	0.1	3.8
0.76	10.3	0.2	5.4
0.78	14.9	0.5	7.7
0.80	21.6	1	11
0.82	30.4	1.7	14.7
0.85	45.8	3.1	17.1

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

Total costs rise increasingly, moving above £20 million as predicted incidence rises beyond 80%. The lower bound of insurance pay-outs comprise less than 5% of the total cost, with the share increasing as predicted incidence rises and more growers become eligible for Yield Protection Cover. The upper bound comprises roughly 50% of the total cost, with the share remaining constant until dropping off beyond 0.8 predicted incidence, as more growers hit the maximum 1.0 (100%) incidence.

Last year, the fund for Yield Protection Cover was £28.5 million for a 95,000ha crop[9]. This suggests that the YV losses shown above could likely be absorbed, especially with predicted incidence of less than 0.8. 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 2024.

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 YV when not authorising Cruiser SB at different predicted incidences in the table below:

Table 4: Estimated sugar beet production shortfall in Great Britain (GB) due to yellows virus when not using Cruiser SB, by predicted incidence

Predicted incidence	GB sugar beet shortfall (kilo tonne sugar beet)	Domestic supply gap (kilo tonne sugar, assuming 16% sugar content)
0.64	51	8
0.65	56	9
0.66	61	10
0.68	76	12
0.70	98	16
0.72	131	21
0.74	182	29
0.76	259	41
0.78	375	60
0.80	551	88
0.82	819	131

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

Historic data suggests that this domestic shortfall would be substituted by (a) imports of refined white sugar from the EU (tariff-free between EU and UK) and/or (b) imports of raw cane sugar from non-EU countries that would then be refined domestically[10].

If sugar harvest in the EU is good, shortfalls in Great Britain production may be met by EU production, with minimal impact on prices. If the EU harvest is also bad – as happened in 2022/23 – shortfalls in production could be met by imports of raw cane sugar from non-EU suppliers. At low volumes there is sugar available from competitive exporters at, or close to, the global price of sugar[11]. As import demand increases, these quotas fill up and so either imports from less competitive sources or quotas with in-quota tariffs[12] have to be used, therefore increasing the price of sugar imports. Eventually if all these preferential sources have been used, imports would have to pay the full most-favoured nation (MFN) tariff which for sugar is £280 per tonne for raw cane and £350 per tonne for white sugar.

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[13], 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 (for example, 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 yellows virus will be small[14]. However, if the European market remains in a large deficit[15], 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

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[10] Once refined, white sugar from beet and cane is identical and substitutable.

[11] The existing Autonomous Tariff Quota (ATQ), for 260kt of raw cane sugar, is the lowest cost as it is open to all countries and has zero tariffs. There are a range of other quotas also available for UK and EU companies to import but they are restricted either by the country they cover or include an in-quota tariff.

[12] Such as the CXL quota which has an in-quota rate of £82.01/€98 per tonne.

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

[14] 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).

[15] As was the case in 2022/23.

the sugar industry in Great Britain but this will depend on a wide range of factors which are not possible to fully capture in this analysis.

Background

UK Sugar Beet Production

The area grown for 2023 was estimated at 98,500 hectares, which represents 2% of the UK's total croppable area[16]. 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. The applicant expects a similar area to be grown in 2024.

Figure 86: Area grown of sugar beet over time, per thousand hectares

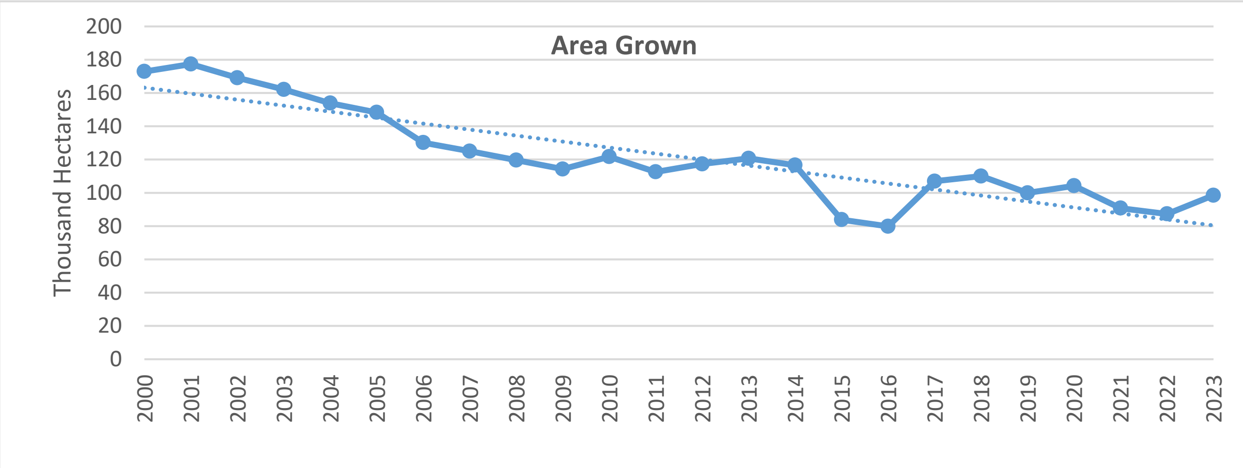

Figure 8 is a trendline showing the area grown of sugar beet over time, per thousand hectares. Axis begins in 2000 and ends in 2023. The trendline shows that the overall area grown has declined since 2000.

Impacts of yellows virus on 2019 crop

Overall, evidence suggests that there was limited impact of the yellows virus (YV) on sugar beet production for 2019. The national incidence for YV 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%.

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[16] Based on 2022 data.

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

The emergency authorisation for Biscaya[17] and the application of Tepekki[18] will have provided some control for aphids (which carry YV), and consequently will have limited any impacts of YV.

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 yellows virus on 2020 crop

The impacts of yellows virus on the 2020 crop were much greater than in 2019. The national incidence for yellows virus 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 shows 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 two and four sprays.

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

[18] Contains active substance flonicamid which is not a neonicotinoid and is of low toxicity to honeybees.

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 would be expected to diminish from 2019 to 2020.

Impacts of yellows virus 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% two sprays.

Impacts of yellows virus on 2022 crop

We do not have finalised estimates of the average infection rates from the 2022 crop. This year was exceptional for dry, hot weather, leading to significant yellowing of crop not caused by YV. This introduced challenges in identifying the presence of YV with a suggested false positive rate over 30% (this is usually closer to 5%).

Despite these challenges, indicative estimates from crop surveys suggest that incidence was relatively low across both seed treated and seed untreated groups of 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 two.

Impacts of yellows virus on 2023 crop

Finalised estimates of the average infection rates from the 2023 crop are not available. Indicative estimates from crop surveys suggest that incidence was relatively low across 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 least two.

Outlook for 2024 crop

As discussed above, the impact of yellows virus (YV) is highly variable from year to year. The impacts on growers in 2019, 2021, 2022, and 2023 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 YV significantly exceeding the 2020 rate.

Growers are likely to have three foliar sprays available to control YV – Teppeki, Insyst, and Movento (pending emergency authorisation approval). Our analysis suggests that these methods, alongside other IPM actions, will be effective in managing predicted virus incidence up to 64%. At some predicted incidence more than 64% but less than 82%, we expect that foliar sprays and other IPM measures will not be able to sufficiently contain aphid numbers to prevent significant yield losses. Consequently, we estimate that the benefits of using seed treatment to control virus infection will outweigh the additional financial cost of following a seed treatment programme.

The continuation of the Yield Protection Cover for this year – which will guarantee a payment for 80% of growers' contracted output – will mitigate some of the potential losses for the individual growers who choose to purchase the cover.