BYC Report 2020/21

The BYC provides a unique opportunity to put commercial crops under the microscope in order to monitor their performance against that predicted by the UK sugar beet growth model. A massive vote of thanks is due all the BYC growers who allowed their crops to be followed in such a challenging year.

Unfortunately, it is a truism that often it is in the face of adversity that we learn the most, leading to us identifying some interesting trends in the 2020 data. However, interactions between the different factors such as dry soil conditions, virus yellows and foliar disease have made it an especially complicated task to analyse data. Crops tended to be in one of two groups: either performing well where there was a low incidence of virus yellows or poorly where the incidence of virus yellows was higher. To a degree, it was a season of extremes and we should be mindful that many of the average values reported mask this wide range.

Thanks also go the BBRO BYC team of Conor Perry, Georgina Barratt, Francesca Broom and Toby Townsend (now ADAS). Thanks also are due to the BYC Steering team for their invaluable guidance.

Hope you find this of interest.

Simon Bowen

Some key facts and figures from the 2020 BYC crops:

- **Overall Yields –** the average drilling & emergence dates were 28th March and 14th April . Nine crops were harvested before the end of October and 11 after January 2021. BYC crops returned an average yield of 74.3t/ha (15.9% sugar content) but the range was 48-102t/ha**.**
- **Predicted yields-** based on the model, the estimated average potential yield was only 98.5t/ha. This was 21t/ha lower than average potential yield of the three previous BYC seasons, highlighting the impact of the weather alone in 2020 (dry spring, summer drought, dull and wet autumn).
- **Actual yields as a percentage of their potential -** these ranged from 45-100% with an average of 75%.
- **Virus and yield –** 46% of crop had a virus yellows incidence >30%. The average yield difference between these and those with lower virus incidence was 20.9t/ha (25.1%).
- **Plant populations -** were lower (average 89,000 plants/ha) than previous seasons. Data clearly showed that higher plant populations were associated with better yields and a lower incidence of virus yellows symptoms. Crops with a plant population above the optimum of 100,000 plants/ha yielded on average 24% higher than other crops.
- **Soil types** - 53% of the 2020 BYC fields were sandy loams, 40% were clay or silt loams and 7% were organic soil types. The average yield of the two main soil types were broadly similar (sands/sandy loams 75.8t/ha, clays & silts 71.8t/ha). Plant populations were slightly lower on clay-based soil types.
- **Canopy cover –** canopies were slow to develop in the dry spring conditions with only an average of 76% crop cover at the end of June and in most cases less than the predicted canopy cover and the target of 100%. The average canopy cover pre-harvest was 65%

- **Use of organic manure** - 19 (67%) of the BYC crops in 2020 received organic manure. Seven of these also had an overwinter cover crop. The average plant population in crops which received organic manures was 94,368 plants/ha. This was 14% higher than crops where no organic manure was applied. The average plant population of crops where both organic manure and a cover crops were used was 100,280 plants/ha. On average, June crop cover was 11% higher and yields higher by 32% in crops where organic manure had been applied. Additionally, of crops where organic manures were applied only 15% had >30% incidence of virus yellows compared to 77% of crops where no organic manure was applied.
- **Irrigation** – 7 (25%) of the BYC crops were irrigated in 2020. This was more than usual in the BYC. Most irrigated crops had 2-3 applications in the spring and the early summer, providing an average of 50-60 mm in total. The average effect of irrigation was to increase established plant population by 4%, canopy cover by 14% and yield by 12%. Only 2 of the 7 irrigated crops had a virus yellows incidence of >30%.
- **Variety effects** - there were 13 different varieties grown across the 28 crops, so it was not possible to analyse varietal performance.
- **Autumn yield production-** the model (in the absence of virus yellows and foliar disease) indicated that there was limited opportunity for crops to increase yield in the autumn due to the wet and overcast weather. The growth model estimated this as only an additional 14t/ha potential yield between the end of October and end of campaign. The actual yield increase achieved was 10t/ha.
- **Foliar disease -** Moderate or severe foliar disease was recorded in 42% of the BYC crops. From pre-harvest photos, cercospora appeared to be the main foliar disease present. On average 2 spray fungicide programmes were used but appeared not to be very effective. The difference between crops with high and low level of cercospora and foliar disease was less than expected (6%).
- **Virus yellow & foliar disease -** of the crops which had moderate or high levels of foliar disease, a high proportion also had a virus yellows incidence of more than 30% of the crop, suggesting there was an interaction. The average yield difference between crops with mod/severe foliar disease levels and high or low virus yellows incidence was 11.9t/ha.

Virus yellows and cercospora symptoms (left) and poor late season canopy growth (right)

The table below is an example, showing the performance of a crop compared to the 2020 average and the previous three BYC years. When comparing values, remember this is the average of a wide range.

BYC year	Plant population '000/ha	Canopy cover (end of June) % crop cover	Yield Adjusted t/ha	Sugar content %	Potential yield (t/ha) (% achieved in brackets)
2017	99,800	92	96.5	17.4	130 (74%)
2018	100,500	86	90.1	17.3	120 (75%)
2019	98,000	90	90.0	17.0	108 (83%)
2020 average	89,000	76	74.3	15.9	98 (76%)*
					* Range 45-100%
Your 2020 crop	76,000	72	65.4	15.2	67.5

Your crop was assessed with 30-60% virus yellows in the early summer and having a moderate level of foliage disease and a pre-harvest canopy of 60%

In this section, we've tried to answer some key questions raised by the data.

Does better plant population and uniformity within field result in lower virus yellows incidence?

Plant population was a key driver of yield performance in 2021.The data indicates that higher plant populations were associated with lower virus yellows incidence and higher yields. Plant populations were measured in the late spring, so it is unlikely that this was due to plants dying as the season progressed. Assessment of fields with lower plant populations typically showed fields to be very variable and patchy rather than fewer plants uniformly across the field. This is highlighted by two 2020 BYC fields below. Poorer areas of plant population tended to be associated with different soil types/more cloddy seedbeds and soil compaction.

Previous research has shown that lower plant populations are linked to a higher incidence of virus yellows (Heathcote, 1974) and aphids are known to be more attracted to visual contrast, especially between green crop and soil (Doring, 2014) Virus transmission has also been shown to be greater around gaps and patches (Davis *et al*, 2009) In 2020, aphids migrated into crops in March/April when crops were just emerging and the difference between areas of high and low populations were greatest.

Good seedbed production is key to plant population and dry springs, especially following wet winters are incredibly challenging but are becoming more frequent. There were too many different combinations of cultivation approaches used in the BYC to allow a meaningful analysis of the different approaches but minimising cultivations and movement of rapidly drying soils ahead of drilling was considered to result in less cloddy seedbeds on heavier land. Being flexible and prepared to vary our cultivation approaches to preserve moisture and in our choice of seed rate is important. Using a higher seed rate when the forecast is for an early aphid migration and/or using variable rate drilling approach to address high moisture deficits area of field (different soil types) is worthy of consideration.

What is behind the large response to the use of organics manure and irrigation?

Whilst the BYC is not a rigorous test of cause & effect and other factors may be involved, the use of organic manure and irrigation improved plant populations and earlier canopy development. The associated lower virus incidence may in part be due to the higher and more uniform plant populations making crops less visible to aphids as well supporting faster canopy growth in June, masking early symptoms and earlier mature plant resistance. Previous BYC results have also strongly associated the use of organic manures with improved soil resilience to stress. This will be in part due to better moisture retention in the soil but also possibly with improved plant vigour and health. The large yield increase of 19.7t/ha where organic manures/cover crops were used, compared to the smaller yield response of 9t/ha with irrigation, indicates that the response is not down to better water availability alone.

Why was cercospora infection so severe?

The 2020 data indicates an interaction between virus yellows and foliar disease, with an increased susceptibility to foliar disease/more severe symptoms associated with a higher incidence of virus yellows. Cercospora symptoms were very evident and progressive from about mid-late August onwards, resulting in rapid leaf senescence and causing foliage to senesce in October. It is possible that it was easier for Cercospora to infect and develop on plants with virus yellows symptoms, and consequently leaf senescence may have been faster. The data indicates the effect of foliar disease on yield *per se* was not as significant as expected. Presumably, the virus-infected plants were already yield constrained significantly and there was relatively little additive yield reduction.

This is the first season where cercospora has been this prevalent in the UK and high temperature and humidity in mid-August was associated with the more severely affected fields. It was not possible to identify clear strategies that were more successful in controlling the disease, especially as most crops received two-fungicides. Analysis of application dates indicates that the interval between the first and second applications was too long, allowing the disease to establish and develop rapidly (perhaps faster where virus yellows was prevalent) A greater risk-based approach is required and BBRO will be providing a new cercospora risk information in 2021. There was no clear impact of variety on cercospora susceptibility in the data.

Why no autumn yield production, what happened to sugar levels?

The poor autumn weather (especially the lack of sunshine, high rainfall leaving some fields with saturated soils) clearly restricted the opportunity for much autumn yield improvement in 2020. Previous BYC seasons have shown this to be worth an additional 30-40% of yield but in 2020 this was only 15%. The impact of virus yellows and foliar diseases on canopy cover in the autumn was highly evident and a factor (average of 65% crop cover pre-harvest). A notable feature from the pre-harvest BYC crop visits was the occurrence of canopy regrowth, especially where virus yellows and cercospora symptoms had been severe. This process would have mobilised and utilised sugar from the root, impart explaining the low sugar levels recorded (average 15.9%) Crops had little opportunity to replenish and replace this sugar due to the poor weather but also due to progressive virus and disease on the new growth. Protecting leaf re-growth with fungicides may be something that we need to consider. It was not possible to identify trends between canopy vigour, varieties, and later yield production in 2020 but previous BYC seasons have shown that this can be important.

2020 was the 4thyear of the 5 -year BYC project. In 2021, we will continue to monitor BYC crops, especially with existing BYC growers. The BYC has been instrumental in developing a new on-line Beet Yield Tracker (BYT) tool which will allow all growers to compare actual crop performance with the potential. Keep an eye out for details from BBRO.
