Feature

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Five years of the Beet Yield Challenge

What have we learnt about closing the yield gap?

Over the Past 5 years, the Beet Yield Challenge (BYC) has been one of BBRO's key on-farm activities. Back in 2017, we challenged growers to compare their actual yield to the potential yield in one of their fields. The field potential was estimated using a sugar beet yield model which uses the soil type for each field to determine the potential yield and as such it provides a useful benchmark for comparing crops on different soil types. Additionally, by collecting information and making some key assessments such as plant population, crop cover and foliar disease levels, this allowed us to potentially pinpoint key areas where yield may have been lost compared to the model estimate.

Fig. 1. BYC was not all about size!

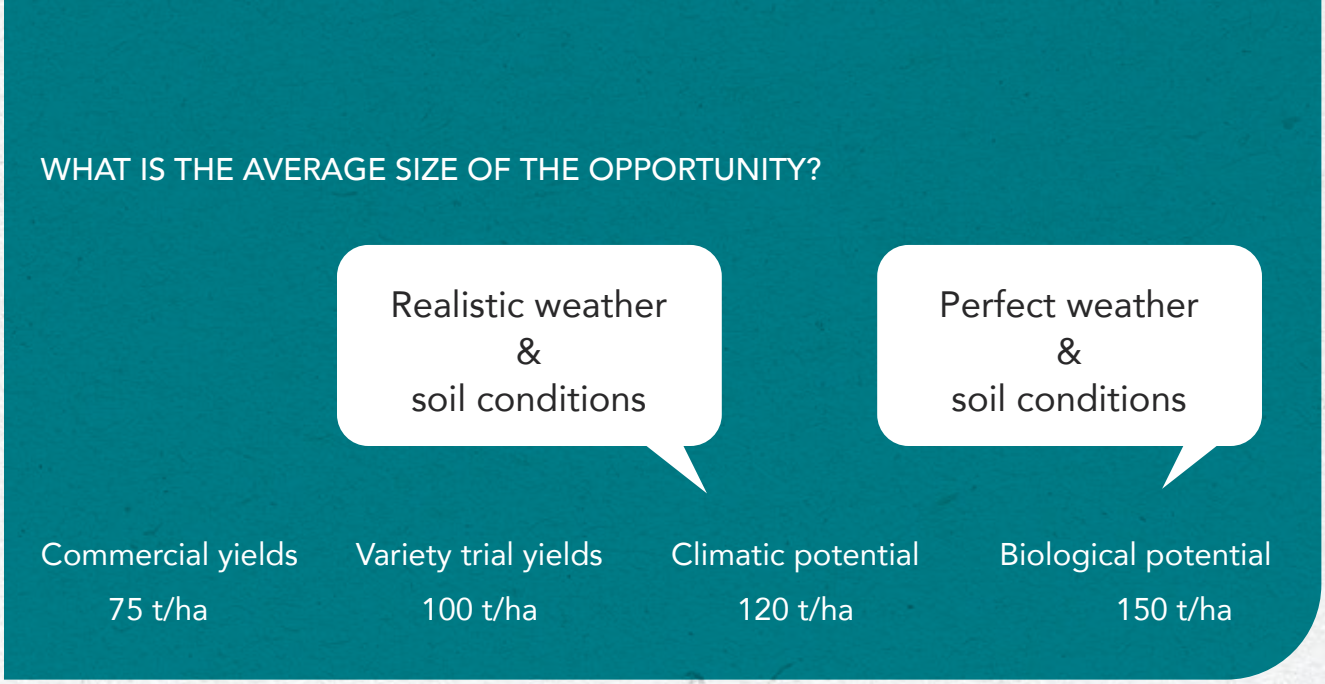

Fig.2. A focus on the opportunity to close the gap on crop yield potential. This was the scope of the BYC back in 2017

Fig.3. Close attention to detail provided small wins for growers searching for higher yields.

2021 was the last year of the Beet Yield Challenge (BYC) project and in this article, we review what we have learnt from the 150-or-so crops which have been under the BYC microscope. Importantly, what were growers who achieved a higher proportion of their potential yields doing differently?

The table below (Fig. 4.) shows the range of values across the five years. It shows the range of yields and average yields achieved in each of the five years and not surprisingly this reinforces seasonal weather effects as well as the impact of the virus yellows and the cercospora epidemic in 2020. It also shows the range and average potential yield estimated for each of the five years. Remember the potential yield assumes ideal seedbed conditions, optimum plant population and healthy growing canopies but it will reflect any weather effects such as drought and low sunshine levels.

What do the potential yields tell us?

- Over the 5 years BYC crops achieved between 45% to over 100% of their estimated yield potential. Remember that the BYC did not select growers from a stratified representative sample of growers, it was an open invitation to all. It is a truism that growers who participated in BYC were motivated by wanting to improve yields and many were already producing above average yields. Additionally, the majority of crops in the BYC tended to be later harvested (growers recognising that this was how more yield can be produced).
- On average, growers were achieving 80% of their potential yield.
- The seasonal weather impacts have been clear across the five years (see below) Drought in the form of both dry springs and summer moisture stress have had impacts on crop potential, something climatologists say we need to expect more frequently. However, the ability of the sugar beet crop to recover yield in the autumn when weather is favourable has been clearly demonstrated in the BYC and is a strategic advantage of the crop.
- In some cases, especially in 2021, crops out-performed the growth model in terms of yield production, returning higher yields than estimated. This suggests that there is further unexplored potential yield to be gained. The model is based on data from crops and experiments that had much earlier harvest dates. We believe that with changing factors such as warmer autumns, our ability to keep canopies healthier into the autumn, changing variety properties and improving soil health, the potential of the sugar beet crop is greater than previously considered.

Year	Yield range yield t/ha (remember that these are average of early-late harvests)	Average actual yield achieved t/ha	Averaged potential t/ha	Range of actuals as % of potential yield	Average of potential yield achieved %
2017	71-128	96	131	56-96	73%
2018	54-122	90	119	52-91	75%
2019	61-106	90	108	55-100+	83%
2020	48-102	74	98	45-95	75%
2021	65-120	96	81	65-95	>100%

Fig. 4. A summary of the actual and potential yields 2017-2021

Season	Key growing conditions
2017	A good growing season, returning the highest potential yield of the 5 years.
2018	Drought in July and August restricted potential yield although some ideal autumn growing conditions allowed crops to recover.
2019	Late drought in July and August restricted potential yield although some autumn growing conditions allowed recovery. Wet conditions in late autumn resulted in foliar diseases such as cercospora developing.
2020	Low potential yield demonstrating the effect of a dry spring and severe summer drought. About 20% less yield potential due to drought alone. Remember the model does not include the impact of virus or cercospora.
2021	Fantastic growing season. High plant populations, rapid canopy development and relatively low levels of foliar diseases. One of the dullest Augusts on record limited sugar production and estimated yield potentials. Healthy canopies provided some great recovery into the autumn. One crop producing more than 20t/ha sugars!

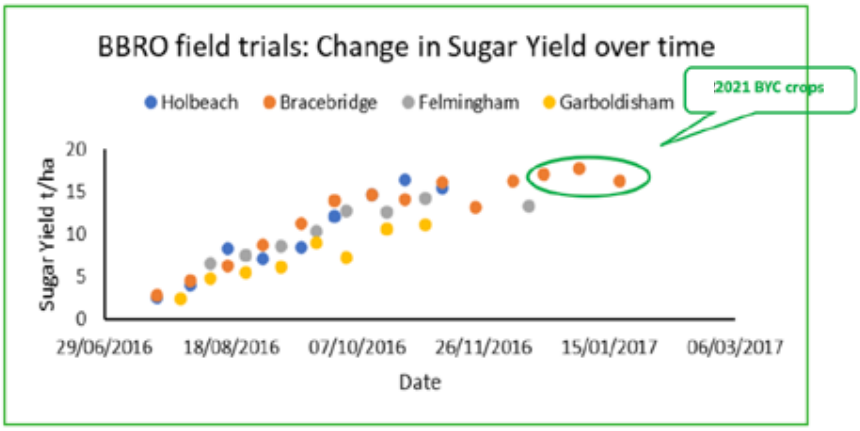

Fig. 5. BYC results challenge the potential of autumn yield progression, suggesting more autumn yield potential is possible.

What are the key areas where growers were achieving more of their yield potential?

- Optimising autumn yield production. Whilst the model is possibly underestimating the yield potential here, it is one of the key areas where yield was won or lost. Remembering that many BYC crops were later harvested. Selecting suitable varieties and maintaining full canopies in conjunction with targeted fungicide protection were key to unlocking yield potential in the autumn.
- Achieving the optimum plant population of 100,000 plants/ha and driving early canopy growth These are both consistent factors across the five years for ensuring crop potential is fulfilled.

A very clear observation from the BYC data is not about drilling by date but cultivation and drilling when conditions are right. A run of dry springs during the 5 years indicates that we must focus on preserving soil moisture. Many BYC crops drilled later into better seedbeds outperformed earlier crops drilled into poor seedbeds.

It is difficult to be prescriptive about the best cultivation strategies as there was a wide range deployed by growers from minimum tillage regimes to traditional ploughing with multiple cultivation passes. However, there is the beginnings of a trend to 'less is more' when it comes to cultivations, especially in dry years. Eliminating compaction behind wheels was also key to achieving uniformity across fields.

Selecting the optimum seed rate field by field to offset establishment losses is key and there has been some interesting conversation with BYC growers about novel approaches such as strip tillage, variable rate drilling or simply identifying the more challenging areas of fields and managing these differently. Growers who were prepared to be more flexible in their strategy tended to have better plant populations.

Resilience to and recovery from drought. Drought was a feature of three of the five BYC seasons and even where the yield potential of dry soils was modelled, some crops fared much worse than others. The use of manures, cover crops, and the retention and incorporation of straw were all associated with better yields following drought conditions and the impact of these were clearly related to farms which had been deploying these strategies for longer. In 2020 these factors were also shown to have an on impact on virus yellows as the better moisture retention is the early dry soil conditions is thought to be related to resulting better plant populations and making crops less attractive to aphids. The ability of sugar beet to recover from drought and re-grow canopies is a strategic advantage over other crops and a tool we need to deploy more effectively. Ensuring canopies are healthy prior to drought and having good soil health are key to supporting recovery.

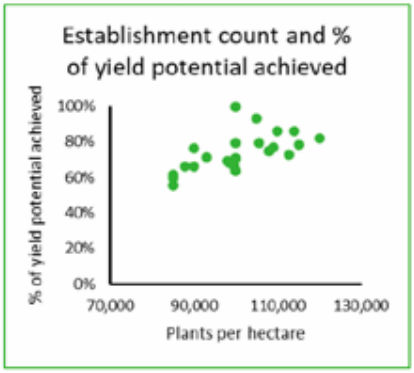

Fig. 6. *2017 BYC crop showing plant population against % of potential yield achieved.*

A final postscript:

In each year of the BYC, we have looked to recognise and congratulate those growers achieving the highest proportion of their potential yield on both a factory area basis and by an overall annual national award. However, the BYC organisers would like to thank and congratulate all the growers who have participated and have been prepared to open their crops up to such scrutiny. It has been a powerful learning process, sometimes confirming and reminding us of what good practice looks like, but also identifying new areas for further attention.

Fig. 7 *The BYC has shown recovery from drought is a key strategic tool to holding on to potential yields*

If there is one single common denominator and message from BYC it is that attention to detail pays dividends when it comes to fulfilling crop potential.

With a 5-year average yield potential of 110t/ha, it's certainly a prize worth chasing.