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Summer Open Days 2016
Don’t forget to take advantage of the 2016 Summer Open Days which promise to provide an excellent opportunity to hear the latest technical presentations, and to meet industry colleagues and trade exhibitors.

Wissington
21st June
Skylark Garden Centre
Wimblington
Cambs

Bury St. Edmunds
23rd June
Garboldisham
Suffolk

Canter
28th June
Morley
Wymondham
Norfolk

Newark
30th June
Hibaldstow
Brigg
Lincs

BASIS / FACTS
CP/43853/1516/g
2 CPD points (1CP, 1E)

NRoSO
NO461497f
2 CPD points

Cover picture courtesy of Farming Photography


Industry update from British Sugar,

**British Sugar update**

With the 2015/16 campaign coming to an end with Newark closing their weighbridges on 13th February it is very pleasing to report that despite a rather cold spring in 2015 the national crop yielded very well, resulting in the third highest yield on record, the second highest was in 2011/12 with the record to date achieved last year, in 2014/15.

As we know, achieving high beet yields is crucial for us to compete as an industry in an increasingly competitive sugar market place. So another impressive result is exactly what we needed to continue the upward trend in yields that we have seen over many years. With the yields of alternative crops flat lining at best it is great to see the efforts of growers, seed breeders and the British Beet Research Organisation (BBRO) continuing to play major roles in this continuing success story.

The recent winter BBRO meetings, during the first week in February, highlighted there remains lots of opportunities to drive sugar beet crop growing to new levels of productivity and further increase the competitiveness of the sugar beet crop on farm. Keen interest and support in the BBRO’s programme of work, including the projects being conducted by BBRO sponsored PhD students, demonstrated the support growers have for the research programme and that there is a pipeline of expertise developing within the industry.

With regards to the 2016/17 crop the focus must again be on maximising the yields that can be achieved. The BBRO and British Sugar’s area mangers are at hand to support you in that aim so please take the opportunity to ask for their help as required.

As we look to the future, the two recent seasons of reduced crop area will normalise our sugar stock levels and

**BBRO update**

We have had a busy start to the season both off and on the field. Our recent Technical Events were well received with over 400 attendees. It was great to be able to engage directly with growers and advisers, with the question session creating some interesting results, helping to inform us of the challenges faced by growers. One of the questions presented and later discussed was on the potential of cover crops; it was interesting to hear growers mixed views on the subject. BBRO is undertaking some research in this area but whilst this is very much in its infancy we currently have no scientific evidence to support media claims. We will, however, continue to gather robust data on the effect of cover crops on the establishment, growth and yield of the crop in UK conditions and will keep you informed of progress. Other areas of particular importance to growers were the impact of leaf miner and the occurrence of downy mildew and BCN. These are areas we are currently researching along with field scale work on fertiliser placement. Growers were positive in their response to a BBRO Annual Report which we will be working on shortly for release in June. This will include project summaries and key outcomes for industry. Check out page 12 for a full review of the Technical events or visit our website to see some of the presentations (www.uksugarbeet.co.uk).

Engaging with growers and advisers is becoming increasingly more important to us and I would like to introduce you to, and welcome Simon Bowen to BBRO in the role of Knowledge Exchange and Yield Progression lead. Simon brings a wealth of knowledge and experience to BBRO and will further strengthen our science and KE team. This is a key role in ensuring BBRO works directly with the grower base. You can find out more about Simon on page 31.

Whilst we are tackling many of the challenges of growing sugar beet there are some practical elements that can make a real difference to yield. Getting things right from the start can really boost establishment which is why we were pleased to work with colleagues at Kverneland, Ger mains and Easton & Otley College to promote good seed bed establishment and

**NFU update**

The next generation

Most of you will have read Ian Piggott’s opinion piece earlier this year in the Farmers Weekly on how attracting the next generation is everyone’s job. He clearly outlined that the whole supply chain needs to engage with young people in order to mobilise innovation. This engagement is something that NFU Sugar and British Sugar have been working on for the last six years through the Sugar Industry Programme and as I write this piece another 14 growers and industry representatives are completing their course.

SIP participant Stuart Laws who grows sugar beet in Norfolk outlined his experience of the programme – “As a long term grower the SIP has provided an invaluable insight into the wider sugar beet industry. Whilst engaging with organisations such as the NFU, BBRO, British Sugar, SES Vanderhave and Ger mains we have seen how policy decisions both home and abroad are influenced and also how research and science are leading to improvements in seed, crop health and yield. It has been a very worthwhile experience and has shown in detail what influences on-farm decisions from outside the farm gate.”

Mark Waling who grows sugar beet in Cambridgeshire described his thoughts on the course, “The programme has enabled me to get an in-depth understanding of what happens ‘behind the scenes’ of the beet industry – technically, commercially and politically. I’ve made some great contacts across the industry, which stands us in good stead for the future. The element that stands out for me was the visit to Wissington, purely for the scale of the place and to see where all our hard work comes to fruition!”
The SIP group has media training which was put to full use when the BBC joined them on their trip to Brussels in January. Young growers had the chance to tell the BBC East Sunday Politics show about how their businesses would be affected if the UK votes to leave the EU. These skills help the sugar industry to represent itself in a media spotlight that is putting the industry under increasing scrutiny. The official application process will open later this summer but if you are interested in taking part then please email diane.armitage@nfu.org.uk.

Pamela J. Forbes
NFU Chief Sugar Adviser

BBRO and NFU

will negate the need for contracting holidays. Therefore, all current growers, whether taking contract holidays or not in 2016, will be given the opportunity to grow their full tonnage from 2017. We have also been exploring, with the NFU and growers, the possibility of some additional contracting options for growers being available in future. Those discussions will continue over the coming weeks and we will inform you of the outcome as soon as we can but this progress is a clear demonstration of how our industry is working together towards a more collaborative post quota environment.

The debates and coverage in the media regarding the role of sugar in nutrition continue to feature regularly so please remember that our ‘Making Sense of Sugar’ website has lots of factual information to balance the debate. The website provides information on food labels, clarifies some of the confusion behind sugars and dispels some of the myths as well as helping consumers with tips on healthy eating and staying active. To find out more please visit www.makingsenseofsugar.com and for all the latest campaign news follow www.twitter.com/senseofsugar.

It just remains for me to wish you all the best for a very successful, high yielding 2016/17 season.

Colm McKay
British Sugar
Agriculture Director

Out in the field we are busy preparing almost 7,000 trial plots, most of which will be taken to yield and processed through our own trials tarehouse. It is worth noting that our specialist tarehouse facility has now processed over 44,000 trials since its launch in 2011. This has been an excellent investment for the UK industry, providing robust, quality data in an efficient and cost effective manner. Some of our trial plots will be developed into demonstration sites for our June Open Days and other activities, forming a key feature of our knowledge exchange programme. Further details of the Open Days can be found on page 43.

Colin MacEwan
Head of BBRO

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drill use through our operator training courses. More of these will be planned for Spring 2017 incorporating other drill manufacturers. We will also be involved in the next Advanced Sugar Beet Course run by ATP under the direction of Dr. Debbie Sparkes of Nottingham University.

During the next few months BBRO will be developing a new suite of research programmes based on crop recovery. This will involve a close look at the machinery involved in lifting and transporting the crop, impact of handling, potential varietal differences and overall logistics and timeline from field to factory flume. This work will be led by Colin Walters and adds a new dimension to our current portfolio of research work in the UK. However, we are ever mindful of the international platform and advancements in new technology elsewhere; some of which may bring positive impacts for the UK industry. BBRO will be evaluating these advancements and claims, such as ALS technology and seed pellet developments, to ensure the UK market has the best proven technology available.

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BRITISH sugar beet review

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Highlights from the 75th Congress of the IIRB in Brussels

The IIRB winter congress, held in Brussels on 16th-17th February 2016, involved 287 registered delegates from across the world. This article aims to summarise the 19 presentations that were given, covering a broad range of topics relevant to sugar beet production.

A talk from Christer Sperlingsson (Nordic Sugar company) gave a perspective on how Nordic sugar aims to reduce the yield gap, with similar focus on small changes in sugar beet production, to improve efficiency. He used the example of sugar beet with smaller grooves to show how this change could result in lower dirt tare, better storage and easier factory processing. He also suggested good farm management can improve yield without increasing costs. A further talk on the Nordic beet region was given by Robert Olsson from NBR (the Nordic sugar beet research institute), who outlined a yield gap case study from Sweden and Denmark; a selection of beet fields were closely monitored, including records of field activities, weather data and soil analysis for nutrients and pests. Using a growth model, potential yield could be calculated and compared to actual yield. Plots within the field were hand-harvested to show harvest loss within each field, so this could also be included in analyses. It was suggested that improvements in management, including soil fertility, drilling date and losses at harvest, could have reduced the yield gap in the fields studied.

Christa Hoffmann (IfZ: the German sugar beet research institute) offered a viewpoint from Germany on yield potential. She highlighted the options to increase campaign length, but this will need varieties with increased cold tolerance and early canopy expansion. Further benefits could be gained by developing more efficient varieties with more of the dry matter partitioned to sugar rather than leaves, which may also improve the water use efficiency of the crop. Further research on water use was presented by Debbie Sparkes from The University of Nottingham, who outlined an ongoing project funded by the BBRO. The project has three main research aims, the first of which focuses on understanding and overcoming limitations to water uptake by the sugar beet crop. Even with the UK climate, drought can cause up to 25% loss in yield, and research suggests that sugar beet have limited access to water from depth. The other parts of the project focus on improving nutrient uptake and improving crop establishment.

Challenging the yield gap for sugar beet

The opening session focused on the yield gap between potential yield and actual yield. The first speaker was Martin van Ittersum (Wageningen University), who discussed the growing demand for food leading to a need for a 60% yield increase by 2050, suggesting that a reduction in demand is also necessary alongside an increase in production. He presented a global model which simulates yield gaps for different crops using local data and evaluation, and enables a more detailed analysis of the causes of yield gaps to be done.

Vincent Laudinat (ITB: the French sugar beet research institute) focused on the French sugar beet yield gap. France is the 7th largest producer of sugar in the world, but nevertheless still experiences a gap between actual and potential yield, with large variability between the French regions. The ITB in France aims to decrease the yield gap by focusing on a few key points, including optimising fertiliser use, choosing the right varieties, optimising crop protection, and improving cleaning, storage and transport to factory.

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Philippe Rousseau from Syngenta gave a breeder’s perspective on unlocking the potential of sugar beet. He talked about the future challenges to sugar beet production, including a volatile market and changes in crop protection technology and legislation. He also emphasised some future possibilities, such as diversification of sugar beet uses and improving technology
leading to advances in breeding and seed care. The final talk in this session demonstrated new technology from Strube, using CT scanning over time to investigate seed germination. Antje Wolff discussed how this technology can be used to measure seed vigour and germination, with implications for the environment, seed pelleting and seed priming.

Mechanical weed control – how far can we get?

With the recent restrictions of herbicide use across many countries, there was increased interest in alternative weed control methods. A session was dedicated to mechanical weed control, a method not commonly used in sugar beet production in recent times, but Cédric Roger (ITB) discussed how technology improvements are making this method more viable in the sugar beet crop. Christoph Kunz (University of Hohenheim) presented his research into the effectiveness of mechanical hoeing in sugar beet, and concluded that the limiting factors were weeds growing close to the crop, and the weather restricting machinery use. However, in combination with a reduced herbicide programme, mechanical hoeing was an effective method of weed management. Further field trials were presented by Joakim Ekelof (NBR) who concluded that damage from mechanical hoeing was ameliorated by the use of guided row cleaners and was outweighed by the benefits from removal of weeds. Although spraying was still seen as the best solution for high yield, mechanical hoeing may be the best option when weeds still remain in the field after spraying, and may be used more frequently as spraying restrictions increase.

Keeping one step ahead of pests and diseases

The second day of the conference opened with a session on pests and diseases, chaired by Mark Stevens. The development of disease resistant sugar beet was prominent in the presentations. Christine Kenter (IfZ) discussed Cercospora control in Germany, where they are screening varieties for traits that show resistance to the pathogen. This work is necessary due to the increase in fungicide resistance in Cercospora. Gary Secor (North Dakota State University) presented a study into fungicide resistant strains of Cercospora, which showed no difference in infection rates leading to advances in breeding and seed care. The final talk in this session demonstrated new technology from Strube, using CT scanning over time to investigate seed germination. Antje Wolff discussed how this technology can be used to measure seed vigour and germination, with implications for the environment, seed pelleting and seed priming.

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of susceptible and resistant sugar beet varieties, with high levels of resistant Cercospora. He suggested that further genetic improvements are needed to protect the crop from fungicide resistant strains. Mark Varrelman (IZF) focused on damping-off disease in sugar beet, again looking for genetic resistance in sugar beet varieties. He used microscopy to help identify the right time in the disease cycle to collect data on which genes are expressed in diseased sugar beet, aiming to use these genes in promoting disease resistance.

The session then moved from diseases to pests, with André Wauters (IRBAB: the Belgian sugar beet research institute) who discussed how different canopy sizes affected the evaluation of beet cyst nematode (BCN) tolerant varieties. His field trials showed clearly that tolerant varieties, which have high leaf canopies, shaded neighbouring sugar beet plants which had lower leaf canopies. There was also a clear reduction in nematodes when resistant varieties were grown alongside susceptible varieties. He recommended the sampling of central rows, to make sure the shading effects seen on edge rows do not affect results. Melanie Hauer (IZF) discussed the ability of BCN tolerant varieties to maintain yield through compensatory root growth. She presented work investigating the maintenance of nutrient and water uptake in tolerant varieties with BCN infection but, due to the overall variation in both BCN infection and environmental factors, this was not seen in field experiments, although tolerant varieties did maintain yield when infected by BCN.

**Quality and storage of beet**

A technical session focused on the storage and handling of sugar beet, with an emphasis on reducing harvest losses. Guy Legrand (IRRAB) presented recommendations for standard practices in long-term beet storage trials, which would help to identify small percentage differences in sugar loss between storage methods. This talk was followed by a presentation by Martijn Leijdekkers (IRS: the Dutch sugar beet research institute) who explained the routine use of a biosensor to monitor invert sugar content of beet samples in The Netherlands. This helps to identify low quality beet deliveries, and to highlight the agronomic factors which lead to it, including frosts affecting unprotected clamps, and high temperature affecting covered clamps during warm weather. Sugar is also lost when damaged beet are put into storage, as rot and mould can spread more easily. Lastly in this session, Stefan Dirks (University of Bonn) presented research into the physical differences between sugar beet varieties and how this influences beet handling and processing. He described punch tests, cutting tests and crushing tests used to assess sugar beet strength, and reported on field trials which are used to investigate the influence of location on the strength of the root.

**Open session**

The conference ended with an open session, which was a platform for discussion of new technology and research relevant to sugar beet production. Julián Ayala (AIMCRA: the Spanish sugar beet research institute) introduced a case study of solar-powered irrigation in Spain. Solar power is used to decrease the costs of irrigation, making higher yield benefits possible at lower costs. More opportunities for technical improvements were presented by Suzanne Blocallie (ITB) who demonstrated an internet tool which aims to improve assessment of harvesting equipment; ‘Perfbet’ is an interactive tool, which gives information on harvesting equipment including fuel consumption and the effect of speed on performance, to help decision making.

Klaus Bürcky presented research into the increase in sugar beet yield over the last 20 years, and the subsequent effects on nutrient uptake. Sugar yield measured by Südzucker in Germany has increased by over 30 % in that time. He used data for the nutrient content of the beet top and root from over that period, to investigate changes in nutrient uptake, as yield increased. The data showed that nutrient uptake remained stable for nitrogen, phosphorus and potassium over the years of the study, but that allocation has moved from the root to the beet tops, making nutrient use efficiency greater.

The session closed with Andreas Loock (KWS), who summarised the considerations taken by sugar beet breeders in the hunt for the ‘perfect beet’. He discussed the difficulties of looking, within a population, for a single plant which represents the best combination of traits. However, with technology improvements increasing speed of trait selection, and new gene pools to select from, improvements in sugar beet varieties can still be made.

In addition to the oral presentations there were two poster sessions featuring over eighty posters. These covered topics as diverse as seed quality, tillage and irrigation systems, treatment and monitoring of pests and diseases, and sugar beet nutrition. Three posters showing BBRO-funded work were included in the poster session; these featured the spore ID project which uses novel diagnostic tools and disease modelling to help decision making, a pre-breeding programme used to speed up the introduction of virus yellow resistance into UK sugar beet varieties, and a project linking early rooting traits to nutrient uptake, aiming to improve nutrient uptake in UK varieties.

The congress was a great success, with many useful discussions from the international participants both on stage and during the breaks. The next IRB congress will be held in Normandy, France in June 2018.
More uses for your sugar beet drill

By Philip Ecclestone, British Sugar plc

For well over fifty years, the mechanical precision drill has been the predominant method of sowing pelleted sugar beet seed, and its use on most farms has been restricted to that single spring use. Pneumatic drills generally were used only where other crops were to be drilled. In the last few years, there has been considerable interest in the precision-drilling of other row crops, largely driven by their increase in area and the potential saving in seed costs offered by accurate placement of single seeds; maize grown mainly as a raw material for anaerobic digesters is a prime example. This article looks at the potential to further utilise mechanical sugar beet drills, particularly for oilseed rape, a popular break crop in the arable rotation.

For many crops, the ultimate objective of drilling is the placing of single seeds at a consistent and accurate spacing and depth. For sugar beet particularly, this is essential to produce roots of a uniform size for a high-yielding, easily harvested crop, so the relatively low speeds at which precision drills operate is tolerable. However, for most other crops, a compromise is possible because total precision, though it might be desirable, is not essential, and faster methods of sowing are acceptable. Mechanical precision drills use cell wheels or seeding discs in which the hole sizes are set to accommodate a certain seed size. As these are manufactured from metal, changing to another seed size is quite a considerable expense. However, pneumatic drills use air to retain seed of variable size on a seeding plate before they are ejected for placement in the soil. This technique, though generally less accurate in terms of seed spacing, is less expensive over a range of crops than cell wheels would be. One crop in particular that could be drilled using a mechanical precision drill set up for sugar beet is oilseed rape. A number of sugar beet growers grow both crops, sometimes in the same rotation, so an opportunity exists.

Oilseed rape has been grown commercially in the UK since the 1970s, and various methods, including ploughing and
minimum tillage, through to direct drilling, have been used to establish the crop. With the changeable weather conditions in late summer and the early autumn, particularly evident in the last few years, the seeds of many oilseed rape crops are now ‘dribbled-in’ while the field is sub-soiled. Although this method is convenient in changeable weather, seed placement is rather hit-and-miss, as seeds can be placed at various depths from 3 cm to 30 cm. Therefore, there has been considerable interest in improving the establishment of oilseed rape to help increase yields; one idea is to precision sow and place seeds at a target spacing and depth. On the continent, particularly in France where the cereal harvest is earlier than in the UK, there is enough time after combining for a large proportion of the oilseed rape crops to be drilled using precision drills of either mechanical or pneumatic types; seed rates have been reduced, and cost savings have been made.

In 2014, Mark decided that, if conditions were suitable after harvesting the previous winter wheat crop, he would sow seeds as usual with the sub-soiler on half of a field and, on the other half, he would cultivate and precision drill. After the precision drill, the plant stand was more regular and, with full leaf cover, the crop seemed less attractive to pigeons compared to the other half of the field. With the even crop, the timing of nitrogen application and sprays was a lot easier, but there appeared to be no significant difference in yield at harvest in 2015. This may be due to there being too few seeds after the precision sowing to give sufficiently high plant numbers compared to the sub-soiled area where the plants were more numerous and better-branched, bearing many pods. However, the precision drill required only 1 kg/ha of seed compared to well over 5 kg/ha with the sub-soiler approach, and Mark was suitably encouraged and is looking to fine-tune the system. He is convinced this is the route to go because it will avoid the loss of moisture and the damaged soil structure that can be caused by sub-soiling in late summer. Mark believes that timing of drilling is critical in late August and early September, and you have to be flexible, changing your approach to suit the weather conditions, which can be changeable and were particularly so in 2015 when the sub-soiler was used on the whole area. Having disc coulters already on the drill, coupled with a desire to cultivate less, Mark is looking to combine precision drilling with strip-tillage, and have another go in 2016.

A uniform oilseed rape crop resulting from precision drilling.

A British sugar beet grower who has been keen to exploit precision drilling of oilseed rape is Mark Rollinson who farms near Sleaford and at Donington near Boston. In total, he farms 400 ha, predominantly cereals, mainly winter wheat particularly at the Sleaford farm, with sugar beet, potatoes, oilseed rape and vining peas; on the silt soils at Donington, vegetables also are grown. Mark went into partnership with a neighbour to update the sugar beet drill a few years ago. This, coupled with wanting to improve the yield of their oilseed rape, got Mark pondering the possibilities of precision drilling as the new drill, a Vicon Synchro-drive, has better soil-engaging parts and is very accurate in terms of spacing and depth-control when used to drill sugar beet.

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To coincide with the interest in oilseed rape precision drilling, strip-tillage (Ref. 1) is being evaluated and used by some growers in the UK as an alternative primary cultivation system to ploughing, minimum tillage or direct drilling. Although strip-tillage was first developed in the USA, a number of manufacturers have developed equipment for use with the variable soil types and generally less extreme weather that prevails in Europe. The use of strip-tillage coupled with global positioning systems (GPS) means that the precision drill can be matched accurately to the tilled strips when precision drilling...
It is imperative, as it is with sugar beet seed, that oilseed rape seed is of uniform size and most growers will specify this if they are contemplating precision drilling.

Systems need to be adaptable as, sometimes, the weather conditions may not be suitable, particularly if the weather is on the wetter side and the optimum drill window is passing.

There remains a need to look at seed rates to obtain the optimum established plant populations, as oilseed rape can compensate immensely when temperatures rise and days lengthen in the spring.

As a more regular plant layout is established, pigeon grazing seems to be less of an issue as there is less bare area for them to land in.

With the newer precision drills, headland control is a useful feature because plant bunching on the headland is virtually eliminated.

Precision drills can be used separately or in conjunction with strip-till or a minimum tillage approach.

Lessons learned so far

- There is still some fine tuning to be done, but generally it is possible to use a precision sugar beet drill to sow oil seed rape using the same row widths and, if seed sizes are similar, the same cell wheels.

- In the late summer and early autumn, it is possible to get out the mechanical precision drill and sow your oilseed rape crop. Although this approach is very popular in parts of main-land Europe, generally the weather in the UK is more variable and other methods have been found to be more adaptable. As technology has advanced, especially with the advent of GPS, it is now possible to match and use a precision drill as a separate operation in other systems such as with strip-tillage or as part of a controlled traffic system which helps to gain more drilling days. With separate seeds being precisely placed, it may be possible to re-evaluate seed-applied treatments and approaches for the future. There is, however, a lot of interest to increase oilseed rape yields, which could start with a precision approach to drilling as well as further utilising drilling equipment already on the farm.

Acknowledgements

The author would like to thank Mark Rollinson, Chris Eglington, Kverneland UK and Ezy Technology for their help in producing this article.

Reference

BBRO has recently established a Technical Board whose primary role is to ensure that the quality and output of BBRO research is robust and of a high scientific standard. The Technical Board will liaise closely with the Stakeholder Board, whose primary role is to prioritise new areas of research (see BBRO update in the Winter 2015 edition of the British Sugar Beet Review). Membership of the Technical Board comprises Colin MacEwan and Mark Stevens as Head of BBRO and Lead Scientist respectively, alongside five other members who have been appointed to reflect the three pillars of BBRO research. In addition, if expertise in a specific area is required, and it is not adequately covered by Technical Board members, then this will be brought in as needed.

1. Yield progression

Debbie Sparkes (Chair)
Debbie is an Associate Professor in Agronomy at The University of Nottingham. She has a strong research track record in crop physiology and sustainable agriculture. Her research has focussed on cereal and sugar beet physiology and its application to improve crop management. In 2013, Debbie completed a review on future research priorities for the BBRO in the area of yield progression and this was followed by a second review on crop protection in 2014.

Tim Hess
Tim is an Associate Professor in Water Management at Cranfield University. He has over 30 years' experience in research and consultancy in the application of hydrology in managed rural environments, and particularly irrigated agriculture in the UK and overseas. This has been applied to sustainable food supply chains, working with national and international organisations and major UK retailers.

2. Yield stability

Jon Knight
Jon is Head of Research and Knowledge Transfer at AHDB Horticulture. Jon's background is in entomology and he brings a wide range of experience in crop protection of agricultural and horticultural crops to the Board. In addition, Jon provides an important link with the AHDB and their current research programme and future strategy.

Ian Bedford
Ian is Head of Entomology at the John Innes Centre. His research has focussed on insect species that are specific vectors of plant viruses throughout the world, including aphids, leafhoppers, plant hoppers and whitefly. Ian also has many years' experience in undertaking crop protection product assessments to ORETO standards and as a consultant for horticultural pest control.

3. Harvest and storage

Jim Monaghan
Jim is a Principal Lecturer in Fresh Produce at Harper Adams University. He has expertise in the agronomy of fresh produce and, of most relevance to his role on the Technical Board, post-harvest technology, including minimising losses in storage.
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Welcome and Introduction

Colin MacEwan – Head of the BBRO kicked off proceedings covering topics such as the project prioritisation matrix and recent changes in the BBRO structure. The technical board and remit is a recent addition, chaired by Dr. Debbie Sparkes, to support the stakeholder board in ensuring strong scientific efficacy. Colin emphasised the diversity of the board members, which features scientists from Cranfield University, Harper Adams University, AHDB (Agriculture and Horticulture Development Board), John Innes Centre and the BBRO. Alongside scientific research, BBRO will also be assessing novel technologies, implementing field scale fertiliser placement work and including KWS seed varieties (which incorporate ALS technology) as part of the BBRO/BSPB (British Society of Plant Breeders) recommended list trials.

Participants took part in an interactive poll which enabled the BBRO to see the thoughts and opinions of the delegates on questions such as, ‘What areas should BBRO focus on for greatest impact on farm’ and, ‘What is your most limiting factor for beet yield?’. These results will be collated and utilised by the BBRO.

Review of 2016 BBRO Technical Events

2016 saw the replacement of the annual BBRO conference with four Technical Events in early February, each strategically located across the growing region. The events were aimed at growers and industry experts keen to hear more of the science involved in the development of the crop. The absence of an exhibitor area enabled better interaction between industry experts, scientists and the delegates.

Colin MacEwan welcomes the delegates.
EU experiences of strip-tillage and nutrient placement

Dr. Heinz-Josef Koch – Institute of Sugar Beet Research, Germany gave a brief overview of the concept of strip-tillage, differences between its use in spring and autumn and the workflow. He stated that, in sandy soil, spring strip-tillage gives high yields and is well adopted by farmers, as it is easy to combine with sugar beet seeding. Shortcomings include an uneven seedbed, coarse soil aggregates and voids in the seedbed (that can cause fangy roots and aid slug movement). He then gave an overview of strip-tillage in autumn as an approach to improving crop establishment and growth. He concluded that high and regular field emergence is still a challenge and reported a lower white sugar yield under autumn strip-tillage. A benefit is that strip-tillage has good potential to control soil erosion and to increase water availability.

Dr. Otto Nielsen – Nordic Beet Research, Denmark leads a nutrient placement study which has deployed trials in Denmark to improve nitrogen utilisation by crops in the field. Their research is driven by restrictions on the application of nitrogen in Denmark and Sweden. A considerable focus was the use of fertiliser placement to influence the subsequent availability of nutrients. Fertiliser trials have revealed that yield increases of up to 8% could be achieved by placing fertiliser along with seeding. Other research has highlighted that placement after drilling was better than placement at drilling in terms of sugar yield.

Understanding soil-plant interactions to improve sugar beet productivity

Dr. Debbie Sparkes – The University of Nottingham explained the three areas of research that make up the soil-plant interactions programme at Nottingham: evaluating and mitigating limitations to water uptake, optimal rooting structure for nutrient uptake and improving establishment and early growth.

The first area ties in with Tamara Fitters’ PhD project regarding water as the main limitation to sugar beet yield in the UK. Debbie presented preliminary results obtained from growing sugar beet in 1 m tall columns to see how much water can be taken up by beet in non-limiting conditions. 2016 will see water uptake experiments transferred to the field. She explained how innovative technology such as X-ray CT has been used to understand water uptake.

The optimal nutrient uptake project investigates genetic variation in rooting traits and tests the relationship between root traits and nutrient uptake/yield. Future work will aim to see whether the relationship between early rooting traits and nitrogen uptake extends to the field, and whether placement improves nitrogen uptake efficiency or not.

The final project aims to develop a tool/sensor to facilitate grower decision-making in terms of improving establishment and early growth. The system will utilise in-field data and meteorological data/forecasting.

Sweet Succession

PhD updates. The technical events were an excellent opportunity for the BBRO PhD students to exhibit their innovative work. One of BBRO’s greatest strengths is its close ties with top UK universities, enabling sugar beet research to benefit from excellent young scientists. BBRO are collaborating with The University of Nottingham where PhD students Alistair Wright, Jake Richards and Tamara Fitters are based under the supervision of Dr. Debbie Sparkes.
Lastly Rachel, now in her 3rd year, introduced her PhD: understanding internal structures of sugar beet roots. In particular she aims to elucidate characteristics that have an effect on the structural properties of sugar beet cells. So far her work has revealed cells that are important for sucrose storage. Rachel’s research, combined with genetic projects, can lead to key breeding targets for the development of novel elite varieties. Another potential application of the project is to enhance sugar yield by optimising vascular development in the root.

Importantly, all four students effectively related how their research will directly benefit UK sugar beet growers. The students hope to present their subsequent findings at the BBRO summer open days.

Crop recovery and quality

Colin Walters – BBRO emphasised the multitude of factors involved in crop recovery and the potential to minimise losses. The use of satellite and drone technology to monitor crops, and remote sensing, are elements to be exploited to increase the recovery of the crop.

Harvester losses used to be 9% but significant advancements have reduced it to 2-3%; it can be driven even lower by improving machine performance and operator training for example. Beet damage is something that contributes to harvest losses, so the ‘electronic beet’ project was implemented to see if sugar loss can be related to impact damage. The results successfully showed a directly proportional relationship between impact damage and sugar loss. Losses are exacerbated when storage is considered. Clearly, there is considerable room to implement the knowledge obtained and BBRO will work with the wider industry to do this.

Lastly, novel approaches to beet quality factors were considered. Sugar beet plants store sugar as sucrose that can be naturally broken down to glucose and fructose. To conclude, Colin stated that there are ‘quick wins’ available but also longer term opportunities to recover more of what we have grown. BBRO will build on its relationships with universities, technology providers and interested parties to realise improvements in crop recovery and quality.
Crop Stability

Dr. Sacha White – ADAS, a research entomologist, presented the latest situation on the mangold fly, which has become an increasing problem in the UK in recent years. Around 50-70% of canopy cover can be lost, and few mitigation strategies are available, so in April 2015 a project was initiated with the aim of improving chemical control of the pest and providing a more thorough understanding of adult activity via the BBRO yellow water trap network.

A field trial was conducted at a high impact site near Wisbech, to assess the control efficacy of a range of insecticides applied at different stages by analysing larval numbers, % leaf area mined, yield and sugar content. Three sprays were applied for each generation. Dursban effectively controlled larval numbers and % of leaf area mined but, unfortunately, its use has now (2016) been revoked but encouragingly Hallmark and Zeon also performed well.

For the second part of the project, the yellow water trap network was utilised to determine adult emergence patterns at ten sites across the growing region. Other aims were to understand regional differences and relate to local pressures. Future work will repeat the water trap collections, improve spray targeting, improve treatment thresholds and develop risk assessments. Importantly the research has shown that we do have options in the face of chemicals getting banned.

BBRO Science Update

Dr. Mark Stevens – BBRO, the final speaker, described the current portfolio of crop stability work that encompasses aphid control, downy mildew, foliar diseases and Innovate UK projects.

The UK is an aphid hotspot region, particularly if winters are mild, and therefore virus yellows remains prominent. Despite the neonicotinoid debate in the EU, these insecticides are used for protection. BBRO runs 30 yellow water-pan sites to trap aphids; these are located from Yorkshire to Essex, and at each meeting Mark focused on data collected from traps in the relevant factory area, but also compared them to the other regions.

Due to the mild winter, the virus yellows situation is likely to be exacerbated in 2016 but this may be counteracted by high numbers of beneficial insects working as biological control agents.

Downy mildew, a disease that has caused problems in the past, has become a pressing issue because of the current mild winter facilitating its spread. It has been building particularly in Cambridgeshire in recent years, and concurrent results are apparent in Europe. In two 2015 recommended list trials up to 40% losses were recorded with downy mildew but, importantly, there were varietal differences, particularly in those from KWS and Limagrain. Mark highlighted that vigilant farm hygiene will be vital to mitigate losses and varietal and chemical approaches will be investigated further in 2016.

In terms of foliar diseases, 2015 can be described as another rust year. There were more signs of cercospora leaf spot and early observations of powdery mildew but fortunately no stemphylium. Many fungicide trials were implemented in 2015; the results are still being analysed but a comprehensive review will be available at the BBRO open days.

Lastly, Mark gave the latest on the two Innovate UK projects that commenced in 2015. Firstly, SporeID is a project that aims to produce a real-time, in-field tool/sensor to monitor disease and pests. The other project aims to develop a novel pre-breeding strategy to mitigate the effect of virus yellows without the need for neonicotinoids. Mark concluded by stating that 2016 looks set to be a challenging year but there will be a multitude of studies, trials and knowledge attained to enhance our future options.

All of the presentations are now available to download (www.uksugarbeet.co.uk). Thanks to all who attended; we look forward to seeing you at our summer open days.
Focus on PhD students

Interactions between beet cyst nematode (BCN), sugar beet and brassica crops

By Alistair Wright, The University of Nottingham

I am currently in the second year of a four year PhD studentship looking into, ‘Interactions between beet cyst nematode (BCN), sugar beet and brassica crops’. The project aims to develop our understanding of the beet cyst nematode and improve the ways that British growers can manage the threat.

My background

I grew up on the family farm in south Norfolk where we grow approximately 200 ha of beet annually on the sandy Breckland soils. The nature of the soil makes it one of the favoured environments of the beet cyst nematode, Heterodera schachtii (Pic. 1), and I witnessed first-hand how it can limit beet yields. I have seen it spread around our farm and become an increasing problem across the beet-growing area of the UK. I was therefore fortunate to be offered the PhD studentship after I had completed my undergraduate degree in Agriculture and Crop Science (also at Nottingham), enabling me to research methods to manage the threat to growers.

About BCN

BCN can be found in all factory areas and is an increasing threat, reducing yields of severely infested crops by up to 60% in dry years (Ref. 1). It currently infests 6% of the land on which beet is grown in the UK, leading to estimated losses in the millions of pounds every year (calculated from 2014 cropping data and beet prices1). Juveniles hatch out from brown cysts, no bigger than a grain of sand, which can contain around 300 eggs and juveniles. The juveniles travel through the soil and establish themselves in a root of a host plant. Here they extract water and nutrients, and go on to reproduce. Females mature into new egg-filled cysts which become detached from the root and can remain viable in the soil for the next ten years. In Britain, we are lucky that BCN is still relatively well-contained within the areas scheduled for statutory control measures under the old beet eelworm orders enforced during the 1940s and the 1970s (Ref. 2). However, growers in other areas should not be complacent about the risk: without adequate management, control and knowledge of BCN host species, populations could easily build up to threatening levels, similar to those of our European counterparts.

My research

So far, I have been looking into the response of different varieties of sugar beet to the presence and absence of BCN. Over the spring and summer of 2015, I grew eight BCN tolerant or susceptible varieties from the recommended list, and a BCN resistant variety from Europe (which can decrease populations of BCN (Ref. 3), whereas the others increase populations). I looked at canopy development, photosynthesis and yield of these varieties to see how differently they behaved under controlled conditions without BCN.

I have also just completed a smaller scale experiment in a growth room to compare the same varieties with BCN present and grown to allow one generation of BCN to develop, to see if the varieties respond differently to infestation under controlled conditions. I have also completed a hydroponic tank trial of the nine varieties, to look at differences in early rooting habits (Pic. 2). Further work on some of these nine varieties and other resistant varieties is planned for larger soil-filled box and field trials in 2016.

In 2016 and 2017 I am hoping to establish trials to look at BCN resistant mustard and radish cultivars, known as trap crops because they stimulate juvenile hatch from the cysts but do not allow BCN reproduction. Trap crops are already in widespread use in continental Europe. My research will see if their use is appropriate for the UK. As our climate is more changeable and less predictable than the continent, and the time between harvest ending and average

1 Total UK sugar beet area 113,000 Ha of which 6% is 6780 Ha. Mean Yield of 75.3 tonnes per hectare (Ref. 4). Yield loss is assumed to be 30% (Ref. 1). Total losses therefore equal 153,160 tonnes and the value of this is £3,675,844 (at £24 per tonne).
temperatures dropping to below 10°C (when BCN becomes dormant and therefore the trap crops are ineffective) is also less predictable, then the use of trap crops needs to be assessed. Investigations are planned also to ensure that the European mustard and radish cultivars will work effectively against British BCN strains.

I hope that my PhD will produce realistic and useful results which can be incorporated in a BCN management plan for growers whose fields are infested with BCN, so helping to maximise British sugar beet yields.

Acknowledgements

I would like to thank the BBRO and The University of Nottingham for supporting my PhD studentship, and Syngenta Seeds for providing the resistant variety for use in my experiments. I would also like to thank my supervisors, Dr. Debbie Sparkes and Dr. Mark Stevens for their ongoing support and guidance, as well as Dr. Matthew Back from Harper Adams University for his advice.

Summary

BCN is a developing problem in the UK which needs careful management. My PhD project is hoping to develop and investigate strategies for BCN control. BCN resistant trap crops have not been proven to work yet in our UK climate.

References

**Focus on PhD students (continued)**

**Water uptake in sugar beet**

By Tamara Fitters, The University of Nottingham

Currently, I am in the second year of my four-year PhD studentship looking into, ‘Understanding water uptake in sugar beet’. During this project I hope to improve our understanding of root growth and water uptake in sugar beet.

**My background**

I am originally from the Netherlands, where I studied at the Radboud University in Nijmegen. In August 2014, I completed my master’s degree in Biology, which included two internships involving roots. The first internship at the university was to look at the root growth of maize when there were differences in nitrogen placement and top-soil drought. The second internship was to look at clonal reproduction (through root suckers) of black locust, Robinia pseudoacacia, in Japan, where this species is invasive. Since I wanted to continue working with crops and roots, I was lucky to get the opportunity to start a PhD studentship at The University of Nottingham in 2014. Over time, I will look at sugar beet root growth and responses to root-limiting factors such as drought and compaction.

**Sugar beet and drought**

In the UK, drought is a serious and annually recurring problem. In normal years, yield loss from drought is about 10% but this can increase to 25% in dry years (Ref. 1). Sugar beet leaves are particularly slow to close their stomata during warm weather. This results in excess water loss, visible to us in the form of wilting. Wilted plants hardly photosynthesize and they are at risk of being scorched when the leaves touch the ground, resulting in lasting damage.

Sugar beet roots can grow to 1.5 m depth if there are no restrictions in the soil. However, there is hardly any water uptake from those deeper layers. Most of the water uptake (80%) is from the top 0.30 cm of the soil (Ref. 2). Since this is also the part of the soil that dries out first, it is important to look into reasons why sugar beet do not take significant amounts of water from deep layers, or if there are ways to improve water uptake by sugar beet from these layers.

**My research**

So far, I have looked into root responses to drought and to different levels of compaction. During early spring 2015, I grew sugar beet in 1 m-tall columns (Pic. 1) in the glasshouse under three different water regimes: irrigated to field capacity, irrigated to simulate rainfall, and drought. While the plants were growing, I looked at photosynthesis, transpiration and stomatal conductance in relation to changes in water content in the soil at different depths. By washing the soil off the roots (Pic. 2), I was able to determine root growth and the effects that drought and irrigation had on the roots.

After finding that roots seemed able to grow deeply, provided that there are no physical barriers, a compaction experiment was conducted. Again, plants were grown in 1 m columns, but in some columns soil in the bottom 50 cm was compacted. In this experiment, I monitored the photosynthesis, transpiration and stomatal conductance and changes in water content in the compacted and non-compact ed halves of the columns. After washing the soil off the roots and analysing them (Pic. 3), it became clear that roots have trouble growing in compacted soil. This also means that they cannot take up any water from compacted soil layers.

These findings led to a new experimental plan, but this time in the field. In 2016 and 2017, I hope to start field trials to compare root growth of specially selected varieties under varying water regimes in the field. With soil probes, we can measure the changes in soil moisture over time, and so we will be able to determine from which soil layer water is being taken up. By taking soil cores at multiple points in time, and washing out the roots, I can look at the response of roots under natural conditions. By using three different varieties, I hope to see if there are root differences between varieties and if changing the available water will result in different growth patterns.

**Acknowledgements**

I would like to thank the BBRO and The University of Nottingham for supporting my PhD studentship. I would also like to thank my supervisors: Dr. Debbie Sparkes, Prof. Sacha Mooney and Dr. Mark Stevens, for their ongoing support and guidance.

**Summary**

- On average, water stress causes yield losses of 10% every year.
- During my PhD project, I hope to find out why sugar beet have difficulty coping with drought even when there is water available.

**References**

Understanding internal structures of sugar beet roots

By Rachel O’Neill, University of Leeds, Rothamsted Research

Knowledge of the characteristics and structure of key cells within the sugar beet roots can be used as a basis to improve sugar yields and unlock the potential additional uses for sugar beet pulp.

My background
Coming from a scientific background and growing up in the flat lands of Cheshire, where dairy farming is common place and sugar beet is nowhere to be seen, I didn’t have much experience with the crop. However, after completing my university studies in cellular and molecular biology at Newcastle University, I looked to further expand my knowledge of what had become my main interests: plant sciences and molecular biology. My project in collaboration with the BBRO was just that, investigating sugar beet at an anatomical and molecular level to characterise the complex structure of its cell walls.

About my project
The sugar beet pulp remaining after sucrose extraction is an abundant source of cell walls. These surround all the cells, giving protection and determining what can enter and exit the cell, as well as giving the sugar beet its shape and mechanical strength. The cell wall has a complex structure containing many different components with unique compositions. Every plant has different requirements for their cell walls and are constructed a little differently depending on the species’ needs (Ref. 1). The presence of particular cell wall components has an effect on the structural properties of the sugar beet root (Ref. 2) and the potential for additional uses of the sugar beet pulp.

My research
I am currently beginning the third year of my four-year project where I am looking to identify key characteristics of the sugar beet cell wall. Using molecular mal structure and in situ positions of these key cells (Pic. 1). This system of identifying specific features of the cell wall can be used in a range of ways and is the basis for the majority of my project. I have been assessing the abundance of specific features throughout root development. Characterising the nature of sucrose versus non-sucrose dry matter is an important step in discovering developmental shifts in resource allocation and carbohydrate storage, thus generating information about the stored resources that could be utilised in the future.

These biological markers are proving useful to locate specialised cells within the sugar beet root including those involved in sugar assimilation, the phloem. With this knowledge I can investigate the development of these cells over time. This work has led me to understand the cell arrangements within the root and the abundance of key cell types within the rings of the vascular system (Pic. 2).

I envisage the work from my PhD contributing to the understanding of the structure of sugar beet roots and the cells within. This will allow those in the industry to make markers, I have been able to highlight specific features of the sugar beet root cell walls and obtain an exclusive insight into the chemise maximum the use of this important resource.

Acknowledgements
I would like to thank the BBRO, British Sugar and BBSRC (Biotechnology and Biological Sciences Research Council) for supporting my project.

I would also like to thank my supervisors: Dr. Belinda Townsend, based at Rothamsted Research who has worked with sugar beet for many years and has helped me get to grips with sugar beet inside and out, and Prof. Paul Knox based at the University of Leeds for his breadth of knowledge on cell wall biochemistry and analysis.

References
Focus on PhD students (continued)

The effect of cover crops on soil structure and the subsequent sugar beet crop

By Jake Richards,
The University of Nottingham

I am in the early stages of my PhD to investigate the growth of cover crops and their potential to enhance soil structure, with the ultimate aim of increasing sugar beet yield. We have set up field sites in Norfolk to study the in-field effects of a radish cover crop. Future work will include looking into the way cover crop roots grow through different soil types.

My background

I grew up on a family farm, growing sugar beet south of Bury St. Edmunds, and studied Agricultural and Crop Science at The University of Nottingham. I completed my B.Sc. project on the effect of early season temperature on the canopy expansion of the sugar beet crop. This gave me an insight into the reasons why the UK crop is sown in early spring, the importance of the current understanding of nitrogen supply and the need to achieve maximum canopy size as early as possible in the season.

Having enjoyed my work with the crop, and having an interest in the beet industry, I looked into the PhD projects on offer and was pleased to see how well-focused the BBRO / The University of Nottingham projects were on applied crop science and transfer of knowledge to the grower. After being successful in the application process, I started my PhD in September 2015.

The project

The title of my project is, ‘The effect of cover crops on soil structure and the subsequent sugar beet crop’; it is funded jointly by the BBRO and The University of Nottingham.

There are a lot of claims about cover crops in all-arable systems but comprehensive evidence is lacking. As the beet-growing area has such diverse soil types and rotations, it is currently very difficult to apply information across the board. Therefore the overall aim of the project is to look at the effects of the cover crop on the structure of soils and, hopefully, translate the results to predict the effect of the cover crop on the growth of sugar beet.

As the project is at a very early stage, one of my first tasks has been to look at the research that has already been undertaken, and I found most of this had occurred in Australia and Denmark. In the coming months, I’ll be looking at the techniques used in the past and determining the best way to use similar methods that will work well for sugar beet in the UK. A tool that we have at our disposal is the globally unique Hounsfieild Facility at Nottingham. This produces a 3D images of rooting structures and soil, and will allow us to investigate how the soil changes over time as a result of the cover crop.

Current and on-going work

The field sites in Norfolk are with Salle and Holkham farms where, with their kind permission, we’ve been taking small soil cores, compaction measurements and images to compare the effect of a radish cover crop (Pic. 1) with non-cover cropped fields on their following sugar beet crops. In the future, further field studies will examine a range of cover crops, different soil types, growing periods and drilling techniques on the yield of sugar beet.

Figure 1 is an example of the soil resistance measurements we are able to take with the cone penetrometer (Pic. 2); it measures the soil resistance throughout the soil profile. Changes to soil resistance can be due to tillage practices, soil type and moisture content. Through the autumn the soil is likely to become more hydrated; this reduces soil resistance. The research is likely to provide an indication of the roles that tillage and cover crops have on the soil resistance at depth in the soil. It is important, however, to remember that roots will follow the path of least resistance and exploit old rooting or worm channels and, therefore, won’t necessarily experience the same soil resistance that a cone penetrometer would.

Future prospects

The cover crop project has potential to link with the other BBRO projects that aim to look at water and nutrient uptake of the crop. There is also the potential to find a system which provides a better method of establishing beet to increase yield. On a larger scale, cover crops have been linked to bio-tillage that may reduce the need for some tillage on certain soils, so reducing tillage costs and improving profitability.

Acknowledgements

I would like to thank the BBRO and The University of Nottingham for supporting my project and Dr. Debbie Sparkes, Professor Sacha Mooney and Dr. Mark Stevens for supervising my work. I would also like to pass my thanks onto Paul Hoveson and James Beamish at Salle and Holkham farms for allowing me to use their farms for field experiments. I’d also like to thank Paul Brown from King’s crops for supplying seed for my upcoming experiments.

Fig. 1 – Soil penetration resistance from Norfolk field site.
Clamping trials 2012-2014

Until 2011/12, negotiations between growers’ representatives and the processor concerning the price to be paid for late-delivered sugar beet were informed by data that included information from trials in which roots were ‘topped’ or de-crowned before lifting and analysis in the tarehouse. Roots to be stored before delivery were stock-piled on-farm, either in heaps of varying shape and size or in BBRO-recommended ‘conventional’ clamps; these are piles of roots retained by Heston bales to give a heap which is more-or-less rectangular in section. Developments in machinery design during the early 2000s have enabled roots to be defoliated with the crown left intact before lifting, and this has led to the current ‘whole beet’ arrangements for delivery and payment (Ref. 1). Coincident with this has been the development of the A-section clamp, designed to accommodate loading by modern, large, self-propelled cleaner-loaders: so-called Maus-type loaders and clamps. It is possible that the rate of loss in root weight or sugar during storage of whole roots could be different from that for de-crowned roots: whole roots have more green material and axillary buds, giving greater potential for sprouting with associated increases in respiration, temperature and loss of sugar. Also, A-section clamps have a larger surface to volume ratio than conventional clamps, and could be more rapidly affected by ambient temperatures. The BBRO was asked to investigate the relevance that these new techniques might have for the sugar content of beet delivered from A-section clamps, and for the determination of late-delivery payments.

Trials began in 2012 and were carried out in Lincolnshire and Norfolk (Fig. 1) on commercial sugar beet farms chosen primarily for their experimental practicality, soil type, timeliness of harvest, accessibility of machinery and security of the site. On each farm, a conventional clamp containing about 800 tonnes of sugar beet, and an A-section clamp containing approximately 400 tonnes were to be compared. Four sites were planned for each season but, in 2012, inclement weather

Pic. 1 – Nets filled with beet ready to be weighed and incorporated into an A-section clamp.
Methods
The protocol for measuring sugar losses during storage, developed during previous BBRO projects over many years, records the weight, sugar concentration and quality of samples of beet before storage and after storage for a range of time-periods: in these experiments planned storage times were: 0, 30, 60, 90 and 120 days. Each sample consisted of about 15 kg of freshly-lifted roots contained in a nylon net which was labelled with an identifying bar-coded tag, and inserted at a pre-determined position in the clamp (Fig. 2). Clamp building is illustrated in Pics. 1 to 4. All nets were recovered from clamps after the appropriate storage period, and put through the Wislington warehouse for analysis by the standard industrial practice. As temperature has profound effects on the physiological processes of all plants, a thermistor was attached to each net to log hourly records of temperature to facilitate correlation of sugar records with thermal time, if required.

Results
At Redbourne in 2013, the rate of loss in adjusted weight of clean beet was significantly faster in the A-section clamp than in the conventional (Table 1). At Sutton Bridge, the space available was sufficient only to accommodate a conventional clamp; the site, after being selected, became particularly muddy, and the roots went into the clamp caked in wet clay and trash, which possibly delayed the start of the entire BBRO trials harvest, and clamp-building had to be postponed until all field trials had been lifted; consequently, only one storage trial was completed: at Redbourne.
The effect of storage duration on the rate of loss in weight of roots in the A-section clamps was inconclusive (Table 3). At Redbourne in 2012 and Salle Farms in 2013 the data suggest a significant deceleration of the rate of sugar loss with time, but at Sandringham in 2014 the opposite was the case, possibly because average ambient daytime temperatures during the latter part of the storage period rose from between 2.3°C and 5.8°C, to about

<table>
<thead>
<tr>
<th>Trial</th>
<th>Conventional (Mean temp. °C)</th>
<th>A-section (Mean temp. °C)</th>
<th>LSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redbourne (2012)</td>
<td>0.089 (6.48)</td>
<td>0.119 (5.21)</td>
<td>0.031</td>
</tr>
<tr>
<td>Redbourne (2013)</td>
<td>0.081 (6.36)</td>
<td>0.125 (5.54)</td>
<td>0.016**</td>
</tr>
<tr>
<td>Salle Farms (2013)</td>
<td>0.108 (6.67)</td>
<td>0.099 (6.36)</td>
<td>0.033</td>
</tr>
<tr>
<td>Sutton Bridge (2013)</td>
<td>0.205 (7.75)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Grimston (2013)</td>
<td>0.076 (7.06)</td>
<td>0.146 (6.04)</td>
<td>0.103</td>
</tr>
<tr>
<td>Carrington 1 (2014)</td>
<td>-</td>
<td>0.072 (4.26)</td>
<td>-</td>
</tr>
<tr>
<td>Snettisham (2014)</td>
<td>-</td>
<td>0.161 (10.65)</td>
<td>-</td>
</tr>
<tr>
<td>Sandringham (2014)</td>
<td>-</td>
<td>0.159 (4.26)</td>
<td>-</td>
</tr>
<tr>
<td>Carrington 2 (2014)</td>
<td>-</td>
<td>0.039 (3.05)</td>
<td>-</td>
</tr>
<tr>
<td>Mean*</td>
<td>0.089 (6.64)</td>
<td>0.115 (5.67)</td>
<td></td>
</tr>
</tbody>
</table>

*excluding Sutton Bridge data.  **significant p < 0.01

Table 1 – Effect of type of clamp on weight loss (% loss in adjusted weight of clean beet per day); means of data for all storage periods at each site.

explains the relatively high rate of weight loss; the absence of the A-section clamp here was compensated by an extra A-clamp at Grimston. Over all trials in 2012 and 2013 where an on-site comparison between the clamp types was possible, rates of loss (% adjusted weight of clean beet per day) ranged from 0.076 to 0.108 in conventional clamps, with a slightly higher range of 0.099 to 0.146 in A-section clamps even though clamp temperatures in these clamps were consistently lower than in the conventional ones; so the expected positive correlation between clamp temperature and sugar loss was therefore not generally supported by the data for these sites, although the A-section clamp at Snettisham, which recorded the highest mean temperature of any of the clamps, also produced the highest rate of sugar loss for a clamp of this type.

Over all clamps in 2012/13, there was an indication that the rate of loss decreased with time (Table 2), though this observation was statistically significant only at Salle Farms and Sutton Bridge. The rates of loss in all clamps, except for the early storage period at Sutton Bridge, were similar to the 0.12% per day reported from trials in the UK carried out on conventional clamps in the 1990s (Ref. 2). For these reasons, the BBRO decided to focus further trials on the A-section clamps after 2013.

The effect of storage duration on the rate of loss in weight of roots in the A-section clamps was inconclusive (Table 3). At Redbourne in 2012 and Salle Farms in 2013 the data suggest a significant deceleration of the rate of sugar loss with time, but at Sandringham in 2014 the opposite was the case, possibly because average ambient daytime temperatures during the latter part of the storage period rose from between 2.3°C and 5.8°C, to about

![Table 1](image1.png)

DOW SHIELD YOUR SUGAR BEET YIELD.

There is only one cost-effective answer to volunteer potatoes, difficult thistles and mayweeds in beet. Dow Shield 400. Tried and trusted for 40 years, on its own or as a ‘booster’. It’s the only choice against yield robbing weeds, year in, year out.

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payments. Further trials could produce sufficient data precisely to define the difference between the clamp types, but it is likely that the difference will be too small, and too variable between farms, to be of commercial consequence, and the resources required to generate it would not, therefore, be justified by the outcome; hence the BBRO’s decision to curtail the trials after 2014. However, the trials re-inforce the BBRO’s recommendation that growers should store beet for as short a time as possible in order to minimise the loss of sugar: at a beet price between £20 and £30 per adjusted tonne, the value of sugar lost would be between £2.40 and £3.60 per day for every 100 adjusted tonnes in store.

Information on beet storage and all best practices in relation to the production of the crop is available in the BBRO Reference Book 2016, and at www.uksugarbeet.co.uk where reports of previous trials also are available.

Acknowledgements
We are grateful to Mr. K. Jacklin of Ralph Day & Co., Redbourne, Mr. J. Beamish of Salle Farms, Reepham, Mr. R. Coe of F K Coe & Son, Grimston, Mr. T. Matkin of Robinson Farms, Sandringham Estate and Mr. J. Bush of B E Bush & Son Farms, Revesby for providing their valuable time, space and facilities to enable the BBRO to complete this work on their farms.

References

Table 2 – Effect of length of storage period on weight loss (% loss in adjusted weight of clean beet per day): site means for all clamps 2012/13.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Date built</th>
<th>30</th>
<th>60</th>
<th>90</th>
<th>120</th>
<th>LSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redbourne (2012)</td>
<td>14 Nov</td>
<td>0.120</td>
<td>0.089</td>
<td>0.091</td>
<td>0.113</td>
<td>0.041</td>
</tr>
<tr>
<td>Redbourne (2013)</td>
<td>12 Nov</td>
<td>0.117</td>
<td>0.091</td>
<td>0.113</td>
<td>0.105</td>
<td>0.022</td>
</tr>
<tr>
<td>Salle Farms (2013)</td>
<td>2 Dec</td>
<td>0.149</td>
<td>0.087</td>
<td>0.073</td>
<td>-</td>
<td>0.037**</td>
</tr>
<tr>
<td>Sutton Bridge (2013)</td>
<td>8 Nov</td>
<td>0.315</td>
<td>0.135</td>
<td>0.165</td>
<td>-</td>
<td>0.075**</td>
</tr>
<tr>
<td>Grimston (2013)</td>
<td>13 Jan</td>
<td>0.078</td>
<td>0.153</td>
<td>-</td>
<td>-</td>
<td>0.096</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>0.116</td>
<td>0.105</td>
<td>0.092</td>
<td>0.109</td>
<td></td>
</tr>
</tbody>
</table>

1 excluding Sutton Bridge data. ** significant p < 0.01

Table 3 – Effect of length of storage period on weight loss in A-section clamps (% loss in adjusted weight of clean beet per day).

<table>
<thead>
<tr>
<th>Trial</th>
<th>Date built</th>
<th>30</th>
<th>60</th>
<th>90</th>
<th>120</th>
<th>LSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redbourne (2012)</td>
<td>14 Nov</td>
<td>0.157</td>
<td>0.117</td>
<td>0.089</td>
<td>0.114</td>
<td>0.022***</td>
</tr>
<tr>
<td>Redbourne (2013)</td>
<td>12 Nov</td>
<td>0.136</td>
<td>0.108</td>
<td>0.139</td>
<td>0.114</td>
<td>0.031</td>
</tr>
<tr>
<td>Salle Farms (2013)</td>
<td>2 Dec</td>
<td>0.151</td>
<td>0.081</td>
<td>0.062</td>
<td>-</td>
<td>0.053**</td>
</tr>
<tr>
<td>Grimston (2013)</td>
<td>13 Jan</td>
<td>0.154</td>
<td>0.132</td>
<td>-</td>
<td>-</td>
<td>0.161</td>
</tr>
<tr>
<td>Carrington 1 (2014)</td>
<td>11 Dec</td>
<td>0.104</td>
<td>0.065</td>
<td>0.048</td>
<td>-</td>
<td>0.195</td>
</tr>
<tr>
<td>Snettisham (2014)</td>
<td>1 Oct</td>
<td>0.165</td>
<td>0.182</td>
<td>0.136</td>
<td>-</td>
<td>0.086</td>
</tr>
<tr>
<td>Sandringham (2014)</td>
<td>10 Dec</td>
<td>0.100</td>
<td>0.108</td>
<td>0.270</td>
<td>-</td>
<td>0.068***</td>
</tr>
<tr>
<td>Carrington 2 (2014)</td>
<td>8 Jan</td>
<td>0.043</td>
<td>0.035</td>
<td>-</td>
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<td>0.041</td>
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<tr>
<td>Mean</td>
<td></td>
<td>0.126</td>
<td>0.104</td>
<td>0.124</td>
<td>0.114</td>
<td></td>
</tr>
</tbody>
</table>

1 excluding Sutton Bridge data. ** significant p < 0.01. ***significant p < 0.001

16.5°C, there was no significant trend at the other five sites though a tendency towards decreased rates of loss with time was usual.

Conclusions
Generally, the rates of sugar loss recorded in 12 of these 13 clamps, discounting the anomalously muddy Sutton Bridge clamp, are in the range 0.10-0.12% per day already determined in other storage trials carried out in the UK and elsewhere in Europe for losses of both sugar (Refs. 2 and 3) and root weight (Ref. 3). There is, therefore, insufficient evidence from these trials to suggest that beet delivered from A-section clamps should be considered differently from conventionally-stored beet in determining late-delivery payments.

Pic. 3 – Nets containing beet are incorporated into an A-section clamp.

Pic. 4 – Wiring data loggers to thermistors buried near each net in the clamp.
Soap from Sugar Beet

At first glance not many would associate a muddy clamp of beet with the pristine pharmaceutical industry. However, many household soaps in fact contain Betaine; a compound that can only be derived from sugar beet.

What is Betaine?
Betaine is a compound naturally produced by sugar beet. Following sugar crystallisation beet impurities concentrate in a syrup known as Low Green. Previously, Low Green has been recirculated through the refinery in an attempt to recover more sugar. The attempts at recovery through recirculation were both expensive and relatively inefficient due to the energy requirements and lower purity of the sugar produced. The remaining by-product was beet molasses which was added to the animal feed produced from beet pulp. Now, technologies at the Phoenix plant enable Low Green to be separated into various useful compounds including Betaine.

Betaine is made up of nitrogen, carbon, hydrogen and oxygen. Its chemical structure gives it a net positive charge at one end and net negative charge at the other. This means that Betaine can bond ionically with the negatively charged end of water molecules forming the stable foams common in shower gel, shampoo and washing up liquid.

![Chemical structure of Betaine](image)

The Phoenix plant
The Phoenix plant was built in 2001 at Wislington and began operation in 2002. It now runs 24/7, 365 days a year converting Low Green into valuable products: sugar extract, Raffinate salts and Betaine. Three people are needed continuously to run the plant while process and engineering technicians as well as the management team support optimisation and maintenance.

The plant is now achieving a throughput of up to 200,000 tonnes of Low Green syrup each year. This means that it is able to process not only the Low Green produced at Wissington, but also that from the Cantley and Bury St. Edmunds sugar factories.

Separation process
Betaine is separated from the Low Green syrup through chromatography. This involves passing the syrup through a series of specialised resin beds that enable different molecules to pass through at different speeds. At the end of the process valves at known positions in the series can withdraw samples containing a very high proportion of an individual component. These samples are called fractions.

There are three main steps:
1. Filtration
2. Separation
3. Evaporation

1. Filtration
The Low Green syrup contains particles that would interfere with the separation resin causing blockages and preventing separation. The syrup is therefore passed through fine membranes to remove particles as small as 7 micron (0.007 mm).

2. Separation
Tiny resin beads, 350 micron (0.35 mm) in diameter, formed from a hard plastic are tightly packed together in metal columns. The columns of resin, known as resin beds, form an extremely fine molecular filter. Different compounds in the syrup have different sizes and properties meaning that they move at different speeds through the resin bed.
Initially, the syrup passes through a series of six columns, each four meters high so travels a total of 24 meters through the resin bed (Fig. 3). This separates a sugar solution known as sugar extract from Betaine molasses, a 50% purity Betaine product. The salt fraction, Raffinate, is removed incrementally from each column as the syrup passes through. It is run in a batch cycle, each lasting 50 minutes and taking two cycles to complete the full separation.

Large molecules that are oppositely charged to the resin, such as Raffinate salts, are repelled by the beads so pass very quickly through the resin bed. Raffinate can therefore be withdrawn through the valves first. Smaller molecules, such as sugar are able to enter and leave the individual beads by diffusion and so take longer to reach the end of the bed. Similarly, Betaine, being a very small and neutrally charged molecule interacts with the beads on a molecular scale. This prevents it from moving through the resin bed quickly so is the last compound to be collected.

The syrup is spread evenly across the surface of the resin bed using a cobweb of pipes. This means that the individual fractions will move through the bed evenly. Water is used to effectively push the section of syrup through the matrix of beads. In total, separation takes two hours.

The conditions, including temperature, pressure and time, are determined by specific recipes that enable the Betaine to travel at a known speed. The temperature is usually maintained at 95°C as heat makes the syrup less viscous and easier to push through the resin bed.
The second stage of separation isolates liquid Betaine from the Betaine molasses (Fig. 5). The syrup passes through 4 columns each 4 meters high so travels a total distance of 16 meters though the resin bed. This time however the batch cycle time is around 70 minutes.

3. Evaporation
The final stage of the process is evaporation. This involves heating the fractions to remove excess water. This is important as transporting concentrated products is more cost effective. Liquid Betaine is taken to Finland for further processing.

Uses of Betaine
Annually the plant produces approximately 12,000 tonnes of liquid Betaine, all of which is sent to Finland for further processing and crystallisation. A disused sugar factory in Naantali, Finland is used by Finnfeds, a member of the DuPont group, to crystallise Betaine through evaporation, in much the same way as sugar crystals are produced. They then sell this for use in pharmaceuticals, animal feed, and sports nutrition.

Betaine is a useful molecule in that it has a net positive charge at one end and net negative charge at the other, this is known as polarity. Electrons are pulled more strongly towards the end of the molecule where two oxygen atoms are, bonded meaning that the two ends of the molecule have opposite net charges. As a result, Betaine interacts unusually with water molecules; binding them through electromagnetic forces.

Betaine’s ability to hold water molecules allows pharmaceutical companies to produce products formulated to foam when mixed with water. It is incorporated into many of the shampoos, bubble baths and washing up liquids that we use every day.

In a similar way, Betaine can assist in the retention of water molecules when ingested. Betaine is added to animal feeds as it holds water molecules in the gut helping in the absorption of essential nutrients from food. Betaine is also used as a sports supplement for athletes as it helps the body avoid dehydration.

The future of Phoenix
The plant has now been operational for 14 years and we have been consistently improving productivity. Recently a complete resin replacement has taken place enabling the team to improve liquid Betaine yield. Projects such as this will ensure that even greater quality and throughput are achieved in the future.

So, look out for Betaine on your bathroom bottles and when you next take a shower think of all the sugar beet you are sharing it with!

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Agrifac UK, 4 Thorby Avenue, March, Cambridgeshire, PE15 0AZ
Contractor focus –
R. J. C. Todd Limited

I have been working as an area manager with British Sugar for approximately three years in one of the Northern areas of the Newark sugar factory around Doncaster, Selby, Goole and Scunthorpe. When looking at the small group of excellent contractors in this area, it is clear to me that modern and effective machinery, skilled operators, and attention to detail are vital in driving the yields and efficiencies required to continue growing beet long into the future.

Robert Todd, from R. J. C. Todd Limited near Doncaster, has been lifting sugar beet since the 1970s when his father and uncle grew 25 acres (10 ha) of beet. This was lifted by a single-row Standen Rapide tanker; it was really slow going! Robert saw an opportunity in the early 1990s and bought a three-row trailed machine; he approached neighbouring beet growers who were also running single-row harvesters and, due to the greater speed and efficiency of the three-row machine, his service to help them quickly expanded. He ran the three-row harvester for five years and was soon lifting almost 400 acres (160 ha). Demand from farmers for quicker sugar beet lifting machinery pushed Robert to change to a six-row harvester. This again gave significant increases in speed of harvesting and cost-effectiveness. In its first campaign, R. J. C. Todd Limited lifted 1000 acres (400 ha) with the new six-row harvester; acreage continued to grow in the following seasons, and the company is now harvesting across Yorkshire, Humberside and into Lincolnshire.

Now Robert runs an Agrifac Exxact Sixx Traxx six-row beet harvester, the fourth ‘Big Six’ owned by the business. Thinking of the many times that I have seen the machine working, I am always impressed how it leaves a level field with minimal rutting. Robert explained to me why this is the case: “This is due to the weight of the machine being spread evenly over the three axles. We also found, during the 2012 campaign and other particularly wet conditions since, how well it can travel in extremely poor conditions because of the bigger engine but also to the large 1050 rear tyres which, on this new model, have replaced the old model’s 800s.”

Contractor focus

Robert Todd, from R. J. C. Todd Limited near Doncaster, has been lifting sugar beet since the 1970s when his father and uncle grew 25 acres (10 ha) of beet. This was lifted by a single-row Standen Rapide tanker; it was really slow going! Robert saw an opportunity in the early 1990s and bought a three-row trailed machine; he approached neighbouring beet growers who were also running single-row harvesters and, due to the greater speed and efficiency of the three-row machine, his service to help them quickly expanded. He ran the three-row harvester for five years and was soon lifting almost 400 acres (160 ha). Demand from farmers for quicker sugar beet lifting machinery pushed Robert to change to a six-row harvester. This again gave significant increases in speed of harvesting and cost-effectiveness. In its first...
Although the basic concept of the latest Exxact Sixx Traxx is unchanged, in this new model a number of significant technical upgrades have been introduced to benefit both the customers and the operator. “Contour following is improved as the topper floats independently on front and back wheels and in a uniform crop the knives take off the optimum amount of top,” says Robert. “Row share steering makes the machine simpler to drive and allows the operator to maximise output and sample quality by fine-tuning the levelling and topping components. Harvester tests, which I have completed on this machine during autumn 2015, recorded minimal losses; this takes into account losses both from topping and root breakage. A cleaner sample and impressive tap roots also come from running larger turbines at a slower speed, and the ability to widen the track width makes lifting easier as it provides greater manoeuvrability.”

Growers favour the machine’s ability, because of its increased tank size, to get a full round in larger fields; this reduces field compaction from the harvester itself and from having less traffic on the field as fewer trailers are required, plus the ability to unload on headlands in wet conditions. This also saves the additional cost and liability involved with getting mud on the roads.

Over the years R. J. C. Todd Limited’s sugar beet operation has naturally progressed, with drilling added to the portfolio. Looking to further increase yields, Robert is considering a new drill that has GPS shut-off on each individual row, a mulch kit to drill effectively into seedbeds with stubble or clods, automatic tramlining to any width, with pre-emergence markers for ease of spraying, and the capability to increase the seed rate adjacent to tramlines and to suit soil conditions. As a significant proportion of the final yield of a crop is determined at drilling, this step-change in precision drilling technology which clearly gives growers a reduction in seed costs, will also produce an increase in yield which should not be overlooked!

R. J. C. Todd Limited also has an 8,000 litre Agrifac Endurance self-propelled sprayer, used for both chemical and liquid suspension fertilisers. Its impressive 36-metre boom is fitted with twin lines; the spray line with auto-section cut-off and the fertiliser line with individual auto-nozzle shut-off. It also has full GPS auto-steer technology and twin pumps. Robert has been applying suspension fertilisers for over 20 years, and work has increased year on year; David Mattocks (Pic. 1), is now employed to complete the bulk of the spraying. Looking at the beet which Robert grows on his own contract, plus the beet of other growers where suspension fertiliser is used, it is clear to me that this bespoke system of suspension fertilisers is highly efficient; it can deliver nitrogen for spring application, or just phosphate, potash, sodium and magnesium plus micronutrients as required, ensuring that the crop has all the nutrients required without unnecessary cost or risk of run-off. In these current times, when yields must be maximised to increase the returns from growing beet, such accuracy of applications is essential to get the best returns out of all inputs!

As we all know, the control of weed beet and bolters in a beet crop is essential to allow sustainable beet growing in the future; R. J. C. Todd Limited also offer both inter-row cultivation with band-sprayer capabilities, and weed wiping. When considering inter-row cultivation with band-sprayer capabilities, these are both long-standing technologies which work well; combining the two operations has enabled beet growers in this area to reduce both chemical and overall growing costs. Another option for the control of weed beet or bolters is weed wiping; this can be used later in the growing season in established crops to prevent weed beet becoming a much bigger issue in future crops.

Robert says, “We don’t tend to advertise for work, most of our work comes via word of mouth and existing loyal customers, although you cannot become complacent as you are only ever as good as your last job. We always try to go the extra mile to ensure our clients are looked after. Our aim is to provide a service that is second to none and completed to the best of our ability. The 2015 sugar beet campaign has seen some impressive yields with sugar levels remaining good. We are confident of a bright future in contracting working hand-in-hand with customers and British Sugar.”
Driver CPC for beet drivers

The Driver Certificate of Professional Competence (Driver CPC) is a qualification for professional bus, coach and lorry drivers. It was introduced across Europe with the professed aim of improving road safety and helping to maintain high standards of driving. This legislation came into effect in the United Kingdom on 10th September 2009.

All drivers, to keep driving for a living, need to complete 35 hours of periodic training every five years on an ongoing basis. Drivers can check their Driver CPC periodic training record online to see how many hours they have done. Periodic training is delivered through courses that drivers attend over the five-year period for which their current Driver CPC is valid. There is no pass or fail element to these courses.

The minimum length of a training course is seven hours per session, although they may be longer. Each new five-year period will begin from the expiry date of the driver’s current Driver CPC qualification, and not from the date on which they reached the 35 hours minimum training requirement.

During one of the pre-campaign safety meetings with the Industry Harvest and Haulage Scheme contractors, relevant training for lorry drivers delivering sugar beet was raised as a topic for possible improvement in our industry. Working in partnership, British Sugar and Knowles Transport Ltd created the beet specific driver CPC module. The module was approved by JAUPT (Joint Approvals Unit for Periodic Training) prior to campaign. The course covers the required seven hours and includes all aspects of delivering sugar beet, right through from vehicle checking, safe loading and delivery to the factory. The course can be easily tailored to suit any of the four factories as it details the minor differences between sites.

Knowles successfully trialled the course with a group of their drivers prior to British Sugar hosting training courses at the Bury St. Edmunds and Cantley factories. Both of these courses were well attended and the participants were extremely complimentary about the course content and the manner in which it was delivered. David Cooper, from Knowles Transport, is the qualified instructor to deliver these courses. They can be delivered at Knowles depot in Wimblington or arrangements can be made for delivery at a third party’s premises.

British Sugar strongly recommends that all drivers delivering beet to the factories sit this module as part of their ongoing Driver CPC training. It is extremely valuable and will aid them in their job of beet loading and delivery.

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- Instructors with many years of industry experience and up to date knowledge
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Mob: 07958 062171
Email: david.cooper@knowles-transport.co.uk

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Driver Course.
In partnership with British Sugar

By
Tom Brown,
British Sugar plc
An introduction to Dr. Simon Bowen – new BBRO lead on Knowledge Exchange, Soil Science & Nutrition

It’s great to have this opportunity to introduce myself as I join the team at BBRO, I look forward to meeting and working with you in due course.

Firstly, a little bit about me; I have a background in agricultural research having initially studied for a PhD at the Rothamsted Experimental Station on cyst nematodes. This included the beet and brassica cyst nematode and my work was looking at understanding nematode population dynamics and identifying opportunities for their control in rotations including common host crops such as oilseed rape, sugar beet and brassicas. Inevitably, I retain a strong interest in nematode pests.

After completing my PhD, I moved to Scotland and was based in Edinburgh at SAC (now SRUC), initially working on cereals and then with potatoes as a specialist adviser alongside the local SAC advisers and growers. The role allowed me to combine research and the delivery of agronomy advice on farm, a combination which always ensured I kept focused on the real challenges facing growers! My work covered crop nutrition, variety development, fungal diseases and harvesting. After eight years in Scotland I moved to Norfolk where I managed the Agronomy Team at Anglian Produce potato grower co-operative (now part of GVAP), again looking to drive potato crop improvement via a programme of focused research and knowledge exchange and advice.

I then joined Produce World and the ‘roller coaster’ that is the fresh produce sector for ten years! I worked mainly on potatoes; with key customers such as Waitrose but also on a wider range of root, allium and brassica crops. Working across crops I developed a key interest in improving soil health and management, both from a specific crop but also a rotational perspective, recognising that this was the key to solving many of our challenges to yield improvement. I was proud to be part of the team that developed the Soil-for-Life land management system.

Based in Lincolnshire, my last three years have been spent at AB Sugar where one of my key responsibilities has been to bring some new technologies and growing techniques to the production of both sugar beet and sugar cane crops. This role has allowed me to look at agriculture in many different regions of the world, not just the technology but also the best ways of getting new ideas translated into practice on farm. I am keen to explore ways of looking at new technologies, especially with the greater use of on-farm grower’s trials.

I hope therefore I can bring to BBRO a perspective on production that goes wider than just sugar beet. My experience on other crops has drawn a conclusion that, whatever and where ever the crop, many of the challenges we face are broadly similar and of course the big common denominator and challenge is about improving our soil. Whether it is soil structure, fertility, moisture or soil pests and diseases I believe we need to understand how we can manage our soils differently, getting soils to work more efficiently both at lower input levels but also in a more resilient way in order to deal with the predicted volatility of weather going forward. Key to achieving this is to be able to use data and information on our soils and crop performance more effectively. Having been recently involved with a satellite mapping project, this has shown how we can use soil, crop growth, yield forecasting and weather information to prioritise and target improvements, driving more precise and detailed actions around soil cultivation, drainage, nitrogen management and irrigation.

In my experience, the difference between the good and the very best production is usually due to the attention to detail, and the detail is usually about making more informed decisions. This requires good data and information about the land and crop performance so, whilst the newer technologies around data capture and analysis are clearly not a substitute for experience, I believe they are of great assistance in driving improvements and efficiencies.

I greatly look forward to working with you and in particular seeing how we can deliver some data-driven improvements.
Opinion: Biotech & Beet

My name is Laura Rutherford and I'm a wife, mother and marathon runner in the Red River Valley region of North Dakota. My husband and I, along with our three young children, grow sugar beets, potatoes, dry beans and wheat. I am passionate about food quality, safety and nutrition: both what my family eats and what we produce for others to eat. I am also a ninth generation farmer and have been engaged in farming and production most of my life.

I am a shareholder in the American Crystal Sugar Company and a member of the Red River Valley Sugar beet Growers Association (RRVSGA), the World Association of Beet and Cane Growers (WABC), and the American Society of Sugar beet Technologists. I also serve on the Board of Directors of the Sugar Industry Biotechnology Council.

In the United States, 1.2 million acres (~470,000 ha) of sugar beets are grown annually in 11 states by 10,000 family farmers like us. Sugar beet farmers co-operatively own all of the nation's 22 sugar beet processing factories, and together we grow 56% of all the sugar produced in the United States. Growing this crop is more than an occupation, it's a way of life we want to be able to pass on to our children, but the stakes are high and the challenges are only increasing.

Every year, American sugar beet farmers face a combination of problems when producing our crop. The challenges are faced by all farmers, whether they are conventional, organic or users of genetically engineered (GE) technology. These include pests, a variety of diseases, excesses or shortages of water, and hail and frosts in the spring and fall. However, weed control has been the single largest production challenge to the American sugar beet industry. Traditionally, sugar beet growers had to use some combination of 13 different, costly herbicides that required exact application, timing and conditions. We had to use specialised equipment, multiple cultivations, and an expensive and depleting source of hand labour. All this effort used significant management time and large financial investments for only marginal results, which were not acceptable as more and more cropland was being managed by fewer farmers.

We could not be a sustainable industry until we found a solution that would successfully address the weed problem, while providing the same high quality products for our consumers and achieving multiple environmental benefits for our farming communities. Adopting agricultural biotechnology in sugar beets was a solution for consumers, the environment and farmers.

The sugar beet is a well suited plant for the use of biotechnology for these reasons. These benefits are why GE, glyphosate tolerant sugar beets have had the fastest adoption rate of any biotech trait of any commodity in the history of biotechnology. Once American sugar beet farmers had experienced the success of agricultural biotechnology in their soybean and corn varieties, we aggressively led the process to adopt the technology in sugar beets. The technology was deregulated in 2005 and commercialised to sugar beet farmers in 2008 when seed became available.

Agricultural biotechnology has made a dramatic difference on every American sugar beet farm by providing effective weed control, higher yields and benefits to human health. The annual trend line yield increase of sugar beet has doubled in the U.S. since transition to GE seed, and that yield increase has replaced acreage increase as the variable required to meet the steady increase in consumption in the U.S. market.

The transition to biotech sugar beets has also positively impacted the environment in several distinct ways including promotion of no or low tillage farming, improves soil health, increases water retention in soil, uses less fuel and chemicals, reduces greenhouse gases by keeping carbon sequestered in the soil, and reduces wind erosion.

Agricultural biotechnology is also a humanitarian issue, because world population is expanding. There will be 9 billion people by 2050. In 36 years, we are going to need at least 50% more food, 45% more energy and 30% more water, but only 24% of the world's land can grow crops. We need crops that will be able to withstand changing climates. There will be increased competition for water, limited land and fewer farmers, and everyone will be affected. We must be
able to adapt very quickly and get new varieties, because our population is exploding. Fortunately, agricultural biotechnology will enable us meet these challenges.

The biggest concern for a portion of the American consumer public is whether agricultural biotechnology is safe. Every GE trait coming into the U.S. market or food system has been reviewed and cleared by the U.S. Food and Drug Administration (FDA), United States Department of Agriculture (USDA) and Environmental Protection Agency (EPA).

In 20 years of eating GM foods here in the U.S. and around the world, no credible evidence exists linking a food safety or health risk to the consumption of GE foods.

Consumers must know that the credible international scientific community, including the United Nations Food and Agriculture Organization, the World Health Organization and the International Academies of Science, supports agricultural biotechnology. Further, in 2011, the European Commission issued a summary report covering a decade of publicly funded research, 130 research projects, and 500 research groups similarly concluded that there is no scientific evidence of higher risks of GE crops to the environment for food or feed safety.

Before the American sugar industry took sugar from the biotech plant to the store, samples were taken of all beet and cane sugar produced in the United States. Forty-four commercial sugar samples were independently tested in the United States, Europe, South America, Australia, Africa and Mauritius, Mexico, Canada and the Caribbean. The samples included white cane sugar, white beet sugar, raw sugar and organic cane sugar, and all 23 of the North American factories were tested multiple times; there was no DNA or biotech protein present in any sugar or molasses. There is no RoundUp residue found in sugar made from RoundUp Ready sugar beets, and the conclusion shared with consumers was that sugar is the same regardless of the source.

However, despite the amazing advancements that have been made, and the wonderful things that ag biotech can do, agriculture all over the world is now facing greater challenges than ever before. The majority of consumers do not reside in rural areas and are far removed from the farm. Unfortunately anti-biotech activists have misinformed and misled consumers. Women who work in agriculture are the messengers with the ability to appeal to them and reach them where they’re at. It’s time to remove the wedge that activists are trying to drive between us and consumers.

We must all be willing to commit to conversations with consumers and use social media to invite dialogue. Research has shown that consumers do trust farmers and want to know how food is produced. They want to see pictures and videos of farms and farmers at work. Sugar beet farmers take what they do very seriously. We want to show consumers that we are open to their input, know that their concerns are real and will answer their questions with authentic transparency. We farmers share their same values and concerns. We want them to understand what we do so that they can have a greater appreciation for what we do. Our goal is to make them fascinated by farming and sugar beets and feel that they are on the side of agriculture.

The next generation of GE traits, which offer even better and lower cost weed control, higher yields, drought and disease resistance and improved storability, are within our grasp. Our future depends on these traits and on our ability to show the consumer public that we are producing a safe, nutritious, high quality product that we stand behind and that they can eat with confidence.

We are all here today because our ancestors worked hard for a better future. Many men and women have laboured on the farms and in the factories to get our sugar industries where they are today. It is now up to us to pass on farms and factories to the next generation. Whether there will be a sugar industry for our children is entirely dependent on what we do today.
Pest and disease challenges: Lessons learnt from 2015 and thoughts for 2016

Every sugar beet season has its challenges from pests and diseases and 2015 was no exception, especially after another relatively mild winter and warm start to spring. This, coupled with predictions of high risks from diseases such as virus yellows and powdery mildew, and potential threats from leaf miner and downy mildew, all served as a timely reminder for vigilance and to monitor the crop closely throughout the season to protect its yield potential. The following article is a summary of the key issues that developed throughout 2015 and thoughts for some of the pressures the new crop may face during 2016.

Aphids and Virus Yellows

The Virus Yellows forecast (Table 1) showed that less than one percent of the National crop was at risk from virus infection at the end of August due to appropriate use of seed treatments across all factory areas. This is despite temperatures being relatively mild and ranging from 4 to 5°C during January and February 2015. Without pest management, the risk of infection would have been between 9 and 48%, depending on sowing date and factory area. Again, this served as a timely reminder to encourage good farm hygiene across the farm in order to limit the risk of virus infection by removing or destroying all groundkeepers and spoilage heaps containing sprouting root remnants. All these can host virus-carrying aphids as well as other important diseases such as downy mildew and rust.

The network of yellow water traps was deployed from early May until the end of July and a total of 8,189 *Myzus persicae* were caught at the 30 sites. The main migration occurred at the end of June/early July, although trap catches varied significantly between sites and the largest numbers were seen in Cambridgeshire and Norfolk. It was presumed that this was due to winged aphids migrating from nearby crops of maturing oilseed rape. Insecticide resistance tests on these aphids, conducted by Rothamsted Research, showed very high levels of resistance to pyrethroids and pirimicarb. The BBRO aphicide trial conducted at Grimston, Norfolk produced encouraging results for the control of *Myzus persicae* (Fig. 1) with several alternative products, particularly flonicamid (Teppeki), giving good control.

Black aphids

At the end of June, the BBRO received many telephone calls concerning the need to control black aphids in beet. Previous work has shown that only backward/stressed crops, severely infected with black aphids (100+ per plant) across the field and not just on headland areas, potentially warrant treatment. Spraying to control black aphids will impact on the developing populations of beneficial insects leaving the crop more vulnerable to later infestations of other pests such as spider mites.

Table 1 – Virus Yellows incidence forecast for 2015/2016 sugar beet crops using mean air temperatures from 1st January to 28th February 2015.
In the untreated plots of the 2015 BBRO aphicide trial in North Norfolk, black aphid numbers averaged 44 per plant at the beginning of July; fewer than 10 per plant could be found three weeks later. Predator and parasite numbers were extremely high in this trial and controlled this issue successfully, re-enforcing the need to protect beneficial insects throughout the season. Also, overall, less than one percent of plants within the trial became infected with virus yellows at the end of September, and there was no significant difference in yield between any of the treatments, demonstrating that any direct feeding by aphids had no consequence on final yield (Fig. 2).

Silver Y moths

Silver Y moths were caught in pheromone traps during June and July, particularly in Norfolk and Suffolk, and several reports of eggs and caterpillars in commercial crops were received. However, generally, numbers remained low; little, if any, significant damage was recorded in 2015.

Beet leaf miner

Leaf miners (Pegomya hyoscyami) continued to cause concern for an increasing number of growers in 2015, particularly around the Wash/south Lincolnshire. In extreme situations up to 400 eggs per plant (6-8 true leaves) were found near Holbeach Marsh, Lincolnshire. Historically, it has been regarded as a sporadic pest, but its impact and importance has grown over the last four years, with up to three generations of the pest affecting the crop, usually when seed treatments have expired.

Adult males can live up for up to 38 days and females up to 60 days. Their life span is influenced by temperature, food supply, predators and fungal attack. Eggs usually hatch in 4 to 5 days and larvae mine for up to 15 days before dropping into the soil and burrowing to a depth of approximately 5 mm. Adults emerge 14 to 20 days later to start the next generation.

In most cases during 2015, the first generation was controlled by the seed treatments but the later generations can lead to further leaf damage, potentially impacting yield. Loss of these leaves will affect autumn growth, potential early frost protection benefits, harvesting scheduling and ultimately yield.

In response to issues being faced by a number of growers, and to provide an alternative method for control in addition to Hallmark Zeon, BBRO was granted an emergency authorisation for the use of ‘Biscaya’ for the control of beet leaf miner on sugar beet. This was a 120 day emergency authorisation for the use of ‘Biscaya’ for the control of beet leaf miner on sugar beet. This was a 120 day emergency authorisation. Growers and agronomists were able to apply...
this product when the number of eggs and larvae of the beet leaf miner exceeded the square of the number of true leaves (example 10 true leaves = 100 eggs and/or larvae). Applications could be made via a ground boom sprayer in a minimum water volume of 200 l/ha. No more than two sprays of Biscaya (maximum individual dose: 0.4 l/ha of thiacloprid) were permissible, and no later than the end of 31st October 2015, or 35 days before harvest.

2015 leaf miner summary

- The neonicotinoid seed treatments were very effective, but it is clear that these only gave up to 10 weeks of protection.
- The pest did not affect the entire National crop, although the problem could be found over an increasing area, working northwards as the season progressed.
- BBRO were granted emergency off-label application for use of thiacloprid (Biscaya) for the control of leaf miner in 2015. This expired on the 31st October 2015.
- BBRO started a new project with ADAS monitoring adult activity via the yellow water pans and assessing 11 insecticides for their efficacy (existing and novel). These results showed that Dursban gave the best control, but this product has been withdrawn by the authorities and cannot be used post 31st March 2016. Hallmark Zeon did give some control but it highlights the need for alternative methods to tackle this pest.

Free-living nematodes and Vydate

Due to the limited availability of Vydate in 2015, growers were forced to ration its usage carefully across the rotation. This situation has been compounded further for 2016: no fresh supplies are available, although it would appear that production will resume for 2017.

Interestingly, Vydate is not widely used on sugar beet, where it is primarily incorporated for the control of free living nematodes, although it does give some early aphid protection. A more detailed review of the situation and challenges faced in the absence of this nematicide were documented in the winter edition of the 2015 British Sugar Beet Review (Ref. 1).

Beet cyst nematode (BCN)

The first white cysts were observed in crops in Norfolk by mid-June, and further samples were received into the BBRO laboratories throughout the summer and autumn. Also, where crops were starting to wilt following dry conditions, and if this was occurring in patches, it can be a good indicator of the presence of BCN. It is worth sampling such suspicious areas, together with any land due for sugar beet next year in higher risk areas, to determine the presence and extent of any BCN infestation so that the most appropriate variety selections are made, particularly as the yield gap between susceptible and BCN tolerant varieties, in the absence of the pest, is narrowing rapidly each year.

Foliar diseases

Downy mildew

The first reports of downy mildew were received from Norfolk and Suffolk in mid-May and, as the disease developed, it affected a number of crops, particularly those in Cambridgeshire (especially on the chalky soil types), west Norfolk and parts of south Lincolnshire. However, sporadic levels of infection could be found across most of the factory areas. Downy mildew is not a new disease and it would appear that the areas worst affected in 2015 were no different to those regions where crops were affected since the 1930s and 1940s (Ref. 2). Then, proximity to overwintering seed crops, which provided a green bridge for the disease to survive through the winter, was the main reason for disease inoculum pressure.

Powdery mildew

In 2015, 38 ground frosts were recorded in February and March at the reference weather station at Rothamsted Research-Broom’s Barn. This was actually 20 more frosts than observed in 2014. Consequently, in the absence of any control strategy, 22.2% of the National crop could have become
infected with powdery mildew by the end of August. In reality the warm, dry conditions of late June and July did favour early signs of the disease but cooler, damper conditions were not conducive to its further development in August. As a consequence, powdery mildew was not a major concern. However, it is clear from recent years that rust is the most abundant disease for growers to control in the UK.

**Foliar disease control**

Most crops received at least one fungicide application by early August, and those crops that received a second spray to target rust were treated from late August until the end of September.

The good news was that no further reports of stemphylium were recorded during 2015, although low levels of cercospora leaf spot were seen in several crops, especially in Suffolk. Such low levels of this disease would have little impact on yield due to the effectiveness of fungicide applications and the lateness of such infection (i.e. September and October). However, cercospora was particularly severe in parts of mainland Europe in 2015 (e.g. Austria) where up to seven fungicide sprays were used in an attempt to control the disease; on the Continent fungicide resistant isolates are a developing problem.

![Cercospora leaf spot symptoms, Suffolk, October 2015.](image)

**Mouse damage**

Each year, and 2015 was no exception, mice cause problems on some of the more cloddy seedbeds, and where seed is not fully covered. Although sporadic, mice burrow down, crack the seed case open and eat the contents before moving onto the next seed point and repeating the process. Often, damage is seen around headlands but the centres of fields are also at risk. It is important to ensure that no spilled seed is left uncovered.

**Thoughts for 2016**

At the end of February, the Met Office announced that the winter of 2015/16 was the warmest ever recorded for England and Wales. Therefore, not surprisingly, the Virus Yellows forecast (Table 2) shows the risk of high levels of virus throughout the National crop at the end of August in the absence of any control strategies. Fortunately, the majority of the UK crop will be protected by seed treatments, but the recent withdrawal of Chlorpyrifos (Dursban) and the temporary loss of oxamyl for 2016 (Vydate) all serve as a timely reminder of the increasing reliance (or for some problems a lack of control options) on a shrinking agrochemical portfolio for controlling key pests and diseases within the UK crop.

These winter conditions will have ensured that other pests and diseases also will potentially threaten the 2016 crop (downy mildew, leaf miner, powdery mildew and rust), although it must be remembered that these conditions will have ensured many of the beneficial insects such as ladybirds, lacewings and parasitic wasps should also be in larger numbers too. Timely information on the incidence and distribution of these issues will be highlighted in the regular BBRO bulletins throughout the new season. If you currently do not receive the bulletins please sign up via the British Sugar Beet Portal (www.uksugarbeet.co.uk).

Therefore, on-farm hygiene will be critical for the coming season, and it will be extremely important to remove all spoilage heaps, cleaner loader sites or remaining beet fragments as soon as possible to prevent a green-bridge for pests and diseases between the two crops.

**References**


**Table 2 – Virus Yellows incidence forecast for 2016/2017 sugar beet crops using mean air temperatures from 1st January to 29th February 2016.**

<table>
<thead>
<tr>
<th>Factory area</th>
<th>Option</th>
<th>Virus Yellows (%) on sowing dates of 15th March</th>
<th>30th March</th>
<th>15th April</th>
<th>Usage of pesticide-treated seeds</th>
<th>Mean temperature</th>
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<tbody>
<tr>
<td>Bury</td>
<td>Without pest management</td>
<td>23.9</td>
<td>32.1</td>
<td>45.6</td>
<td>–</td>
<td>4.99°C</td>
</tr>
<tr>
<td></td>
<td>With pesticide-treated seeds</td>
<td>0.93</td>
<td>1.06</td>
<td>1.25</td>
<td>99.60%</td>
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<tr>
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<td>5.33°C</td>
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<td></td>
<td>With pesticide-treated seeds</td>
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<td>32.1</td>
<td>45.6</td>
<td>–</td>
<td>4.99°C</td>
</tr>
<tr>
<td></td>
<td>With pesticide-treated seeds</td>
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<td>1.31</td>
<td>98.47%</td>
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<tr>
<td>Newark</td>
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<td>48.9</td>
<td>66.6</td>
<td>–</td>
<td>5.03°C</td>
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<tr>
<td></td>
<td>With pesticide-treated seeds</td>
<td>0.91</td>
<td>1.04</td>
<td>1.23</td>
<td>98.65%</td>
<td></td>
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</table>

Mouse damage.
Advanced Sugar Beet Technology Course 2015

The Advanced Sugar Beet Technology Course, now in its third year, is recognised by BASIS as an advanced module (worth 30 CPD points) and can be applied towards the BASIS Diploma in Agronomy.

The course comprises six days of training, divided into three two-day units. There is also a fourth, optional unit, on water management and irrigation, delivered by Cranfield University. The first unit of the 2015 course, ‘Foundation in Sugar Beet’, was held at The University of Nottingham’s Sutton Bonnington Campus on 21st-22nd October. It set the scene for the rest of the course by covering topics such as the global sugar market, the UK sugar beet industry, crop physiology, agronomy and soil management in relation to profitability and sustainability. Delegates also heard about current BBRO-funded research in water uptake by the crop, and had the opportunity to visit the University’s Hounsfield Facility where plant roots can be visualised in undisturbed soil samples using X-ray CT (Pic. 1).

The second unit, ‘Crop Protection’ was held at the BBRO offices and laboratories in Norwich on 18th-19th November; it covered the wide range of pests and diseases that can affect the crop, together with the principles of weed control. Alongside the talks, delegates had opportunities for lots of hands-on experience, such as analysing plant clinic samples and identifying different aphid species (Pics. 2-4). Delegates also heard about the new ALS herbicide-resistance technology being developed for sugar beet and, via a live video link with North Dakota State University, learned about experiences growing RoundUp Ready sugar beet in the USA.
The Advanced Sugar Beet Technology Course was established with funding from the Biotechnology and Biological Sciences Research Council (BBSRC) as a Modular Training Partnership, with support from the BBRO and British Sugar. Now in its third year, it has been incorporated in the BBSRC’s Agrifood Advanced Training Partnership programme, providing links with other advanced training courses in agronomy and crop physiology, ranging through to food science and animal production (www.agrifoodatp.ac.uk).

The final unit of the course was divided between Plant Breeding, Seed Production and Seed Technology (8th December), and Harvest, Storage and Processing (9th December). Delegates learned about the history of plant breeding and seed production, and how breeders select for disease resistance. This was followed by a visit to Germains where the focus was on the technology of priming and seed treatment, including a tour of the factory. The final morning of the course was largely in the field, with practical demonstrations of harvest and storage management to minimise losses (Pic. 5). We then moved inside for a tour of the Wissington sugar factory and the trials tarehouse (Pic. 6).

I would like to thank the many contributors, too numerous to name individually, who together provide a unique training course in sugar beet production.

If you are interested in attending the course in 2016, please contact Debbie Sparkes (Debbie.Sparkes@nottingham.ac.uk).

Hutchinsons have put three agronomists through the Advanced Sugar Beet BASIS course, run by the BBRO and The University of Nottingham – Rob Hamlen, Ed Stevens and Darryl Shailes. Each has a range of crop and agronomic experiences and all are involved in sugar beet. Rob is relatively new to the crop with 5 years involvement and Ed having nearly 10, through to Darryl who’s been field walking beet for over 20 years. Darryl commented, "We all got a lot out of the course and feel it will help ourselves to be better agronomists, and help our customers grow more profitable sugar beet in the future. We particularly liked the Beet Grow model and think this could be a very useful tool to help improve our growers yields."

Darryl Shailes, Ed Stevens and Rob Hamlen, Hutchinsons.

The Advanced Sugar Beet Technology Course was established with funding from the Biotechnology and Biological Sciences Research Council (BBSRC) as a Modular Training Partnership, with support from the BBRO and British Sugar. Now in its third year, it has been incorporated in the BBSRC’s Agrifood Advanced Training Partnership programme, providing links with other advanced training courses in agronomy and crop physiology, ranging through to food science and animal production (www.agrifoodatp.ac.uk).
The mood was upbeat at the 26th annual consultation of the World Association of Beet and Cane Growers (WABCG) and the International Sugar Organization (ISO) in London. A record number of delegates attended the event, held on 16th November 2015, at the International Coffee Exchange, which preceded the ISO seminar on 17th-18th November. Participation in this event has been steadily increasing. Over 130 delegates representing 31 countries were in attendance, and this year the WABCG welcomed new member countries: Nicaragua, Honduras and Belize.

While sugar growers all over the world continue to face challenges, the overall outlook is optimistic for the sugar industry. Economists at the ISO forecasted that world production will fall short of consumption this year, for the first time in six years, and again next year.

“There is a strong optimism that the recent recovery of the world price, from 11-12 cents in October to 14-15 cents in November, is not a fluke,” said Jack Roney, director of economics and policy analysis at the American Sugar Alliance (ASA). “There is an expected deficit this year of 3.5 million tons (~3.2 million tonnes), and possibly 7 million tons next year. World stocks have been high, but as these are drawn down this year and next year, a return to 20-cent prices could occur.”

After opening statements from WABCG president Roy Sharma of South Africa, and ISO executive director Jose Orive, delegates discussed trends in the beet and cane industry and gave updates on their respective countries.

“There are many weather concerns,” said David Thompson, the United States delegate to the WABCG. “Thailand and Tanzania are experiencing drought conditions, and Japan is also very dry. Growers worldwide are worried about warmer temperatures resulting from El Nino. In the US, we are concerned about the effect these warmer temperatures could have on our beet piles.”

Delegates also heard about efforts to improve the relationship between growers and millers in India, and received an overview of the potential impact of the Trans-Pacific Strategic Economic Partnership on Japan’s sugar industry. There was also discussion about sugarcane diseases in South Africa and Australia, and the conversion of rice farms to sugar plantations in Thailand.

In Brazil, sugar mills continue to experience significant financial difficulty. More are closing and there are currently no new ones being built. However, the falling value of the Brazilian Real relative to the strong U.S. dollar has shielded Brazil from the decline in the world price of sugar. It was noted that although the world price declined 10% from January to October in terms of the U.S. dollar, in Brazilian Reals the price rose 32%. Therefore, as long as the dollar remains strong, world commodity prices, which have virtually all declined this year, will have difficulty recovering.

Plinio Nastari, president and CEO of Datagro Consulting, Ltd., told delegates that the sugarcane outlook in Brazil continues
to be driven by ethanol. The recent increase in the amount of ethanol allowed to be blended with gasoline rose this year from 25% to 27%, and ethanol use of cane rose to 58%.

Nastari said that the rising flex-fuel make-up of Brazilian cars suggests that the ethanol share of cane could rise to 65% within the next ten years. No predictions were made on whether there will be sufficient cane expansion to accommodate Brazil’s huge level of sugar exports.

Sustainability and agricultural biotechnology were also heavily discussed in London, during a four-speaker session. “There are different ideas around the world about what ‘sustainability’ means,” said Thompson. “Sustainability was discussed from the perspective of agricultural producers, as well as from a consumer and manufacturer perspective.” He also said that Americans think of sustainability in terms of the environment, whereas Europeans think of sustainability in terms of human dignity. “In Columbia and Guatemala, ‘sustainability’ is viewed as good worker health and safety and long term employment,” Thompson said. “Delegates from those countries described the efforts they are making to ensure worker health and safety.”

During a session called ‘Efficiencies in Beet’, American sugarbeet grower Duane Grant explained the many environmental benefits of agricultural biotechnology in sugar beets in the United States and the resulting yield increases. Grant serves as chairman of the board of directors of the Amalgamated Sugar Company in Idaho and was at the event on behalf of the American Sugarbeet Growers Association.

Consumer perception of agricultural biotechnology is an important topic to sugar growers worldwide. Australia has developed GMO sugarcane but has not adopted it due to consumer resistance. Brazil will be adopting GMO sugarcane in the next three years, because of its traits for resistance to drought, diseases and insects. There was heavy discussion among delegates about how it will be received by consumers.

Over the past year, the WABCG has conducted a study amongst its 33 member organisations, ‘How the value of the final product such as sugar, ethanol, or electricity from bagasse is shared between growers and factories throughout the world to determine the price either of beet or cane’.

Timothé Masson, WABCG secretary, presented the results of the study at this London meeting.

The study concluded that almost everywhere in the world, the price for beet or cane is calculated according to the application of a predefined formula based on the value of the final product, such as sugar, ethanol or electricity from bagasse. It was recommended that this should not be changed in areas where it is currently successful.

Masson said the study found that if the rules are more precise, and better related to a clear segmentation of the share of the final products sold by the factory, then the subsequent discussions are more limited.

“Nowadays, the segmentation, when it exists, is very largely focused on the share of sugar, occasionally on ethanol and very rarely on bagasse used for electricity, despite the strong development of co-generation over recent years,” according to a statement from the WABCG. “In the cane sector, and because of the new uses of bagasse, the balance of the value sharing between grower and miller has shifted to the detriment of the grower, and the priority is now to adapt the rules of sharing to take account of this new situation.”

The WABCG encourages growers and processors to engage in negotiations in order to set up a mechanism to recognise the value of the whole crop that growers deliver.

“Cane and beet growers welcome the new world sugar market situation,” Masson said. “Entering a new cycle of world deficit, prices should return to a normal level that allows growers to receive a more remunerative price for their production.”

The WABCG/ISO consultation is a valuable experience for grower organisations to learn about what is happening on an international level, according to David Thompson.

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World Association of Beet and Cane Growers (WABCG)

The World Association of Beet and Cane Growers (WABCG) is the international organisation which groups together the national and regional associations of sugar beet and sugar cane growers at international level.

WABCG has over 30 member associations and unites over 5 million sugar beet and sugar cane growers from the five continents. WABCG is present in 30 countries, producing 60% of world sugar production.

WABCG is a non-political organisation in close contact with other international organisations in the sugar sector and, in particular, the International Sugar Organization (ISO). It is fully financed and controlled by its member organisations.

The two main objectives of WABCG are to contribute towards the economic, technical and social well-being of beet and cane growers, by organising an exchange of information and ideas on all problems encountered in the sector, and to contribute towards strengthening the professional representation of beet and cane growers in national and international forums.

International Sugar Organisation (ISO)

Based in London, the International Sugar Organisation (ISO) has 87 member states which represent 86% of world sugar production. The ISO exists to administer the internationally negotiated 1992 International Sugar Agreement (ISA). The ISA’s objectives include providing a forum for intergovernmental consultations on sugar and on ways to improve the world sugar economy, and to facilitate trade by collecting and providing information on the world sugar market and other sweeteners. The ISO is the only worldwide forum for the exchange of views by major producing, consuming and trading countries at an intergovernmental level. Council sessions, held twice a year in May and November, afford the opportunity for policy issues to be debated at a multi-lateral level.
As reported in the previous edition of the British Sugar Beet Review, John passed away suddenly on 12th November 2015.

John was born in West Norfolk, the son of a farmer. He was educated in Canterbury before spending two years at Shuttleworth Agricultural College.

On leaving college, he joined British Sugar in November 1969, as a fieldsman in the south of the Cantley area before moving to Corpusty in the North of Cantley, where he remained until retirement in 2008. During his time at British Sugar, John saw many changes in both the agricultural and administrative sides of the business; the yield for Cantley rose from 36.93 t/ha at 16.87% sugar in 1969, to 69.23 t/ha at 17.73% sugar by the time of his retirement.

He joined the company when it was partly government owned, and then saw it purchased by Beresford before finally becoming part of Associated British Foods.

Prior to joining the EEC, contracts were issued on an acreage basis, the crop being government subsidised; because beet contracts were in demand, fieldsmen had to measure crop areas to ensure that growers were sowing no more than the contracted area.

Seed was mainly multigerm and polyploid, with monogerm just coming on the scene; most of the crop was sown at 3 inches (7.5 cm) and hand-thinned; chemical weed control was still in its infancy.

Important parts of a fieldsman’s job in the late 1960’s and ‘70’s, were helping growers to progress towards eliminating hand labour in the crop, and assisting with trials work. Following entry into the EC (as it then was in 1973), and British Sugar becoming a private company, the UK sugar beet industry faced strong competition from other member countries, and all efforts of the agricultural staff were targeted on helping growers to increase yields to combat this threat.

John always took an optimistic view of life both at work and away; in the early days he enjoyed playing hockey and cricket until forced to retire from them for health reasons. He then took up walking as a pass-time, and walked both in this country and in Europe. Travel was a pleasure of his, and in retirement together with his wife Sally, he visited South Africa and India, not to mention making innumerable trips to France and Italy.

One could not wish for a better colleague than John, and it was a pleasure to be in his company both at work and away. He will be sadly missed by all who knew him.

David Piggott and Max Pinchin

A colleague remembered

John Sanderson
Harvest came to an end for the BBRO trials team on the 8th of February 2016 following completion of the last trial at Bracebridge Heath. This ended five months of moving all over the beet-growing area gathering yield data from a long list of trials. The BBRO team worked very hard throughout; including in extremely windy and wet conditions one Sunday afternoon at Hibaldstow, North Lincolnshire. The team showed their passion for their work and commitment to getting trials harvested, before losing out to the weather.

The BBRO winter technical meetings have passed, and were largely received positively. The change from a single large event to four smaller events was always a worry but has delivered success. The content and speakers offered an insight into the future talent involved in the industry.

Stuart Harder, the BBRO Trials Analyst has been sifting through the field and processing data; checking and resolving any anomalies so that project reports can be completed and progress towards the delivery of BBRO information and advice can continue. This important role often goes unnoticed, but it is the vital bridge between the interpretation of trials results and knowledge transfer.

Drilling plans have continued to ensure that we site trials in the required locations while, at the same time, ensuring that workloads are as efficient as possible. The number of trials continues to grow, so locating them correctly becomes increasingly important.

The Wintersteiger plot drill has been serviced and is ready to work along with our bespoke nine-row drill for drilling cross headlands (spray wheelings) before the plots. The latest edition to the BBRO machinery fleet is a six-row Unicorn Synchro drive beet drill with fertiliser placement capabilities. This will improve the drilling of various types of trials and open day demonstrations. All drilling is completed using John Deere hire-tractors guided by Green Star RTK to ensure that joins are kept within specification and all rows are straight; this eases all subsequent operations including harvest.

Following the drilling of the main BBRO sites, the team will be working on up to 12 different sites: spreading fertiliser, conducting emergence/establishment plant counts, insect monitoring, hoeing, spraying and preparing for open days. The 2016 BBRO open days are:

- 21st June – Wissington, Skylark Garden Centre, Wimblington, Cambs
- 23rd June – Bury St. Edmunds, Garboldisham, Suffolk
- 28th June – Morley, Wymondham, Norfolk
- 30th June – Hibaldstow, Brigg, Lincolnshire

There are many days work ahead after the drilling of the open day sites, to ensure they look great. Azo plot spraying and grass cutting are just a couple of operations that go on at the sites. These open days follow on from the Winter Technical briefings that had a total attendance of about 400 people; they act as a platform for BBRO knowledge transfer, delivering information about trials’ objectives and performance using levy payers’ money. These sites will be used for demo days during the rest of the growing season. Please contact your British Sugar area manager to visit them to discuss anything from varieties to your own yield plans. At the open days, please take the time to give us feedback on the events, as this is always welcome and helps drive change.

Planning for the open day/demo sites can start as early as the preceding December. The cycle of planning and operations is always overlapping to ensure that events are given a great chance of success. If you have a site that you believe would be a good one for a future open day, please let me know as I am always looking to move open days around the factory areas.

As in previous years, if you have any problems or queries regarding the growing of your sugar beet crop, please do not hesitate to contact the BBRO plant clinic at Norwich.

Open day/demo site plans in progress at Bracebridge Heath.
factory news

BURY ST. EDMUNDS FACTORY

Campaign
The 2015/16 campaign at Bury Factory started on Wednesday 24th September and was completed on Thursday 14th January 2016, the earliest finish for many years. The factory daily slice peaked at 15,817 tonnes in October 2015. After a wet December it was a challenge to get all beet lifted before the January closing date, and several loads were delivered to neighbouring factories later in the month.

Sugar content this campaign has stayed fairly static, after an initial peak in October (17.59%). The slight drop after mid-October was due to the increased levels of rainfall and subsequent crop growth. Crop yields varied dramatically across the factory areas this season. To the east of the factory, yields were exceptionally good, and in some cases better than last year’s record, but to the west of the factory, on the lighter chalky soils, yields were disappointing in many cases. The very mild autumn meant that the crop saw some good late season growth. Lifting and storage conditions were generally favourable, as a result the 2015/16 crop will be Bury’s third highest yield on record.

Factory
Now the campaign is over, the factory has started it’s off-season maintenance programme and is still currently refining sugar on its juice run. Work is also progressing well on an Anaerobic Digestion (AD) plant on the Bury factory site, the feedstock for this will be around 97,000 tonnes of pressed pulp. The plant is expected to generate up to five megawatts of electricity per year, which will be exported directly into the National Grid system, and we expect the plant to be fully operational by summer 2016.

2016 Season
Please make sure you have made arrangements for soil testing for your 2017 crops. Bury offers a full pH, nutrient, BCN and free-living nematode testing service. Please contact your area manager to book your fields in, and also to order LimeX. In previous years we have sold out of product in the summer so please take action now to secure your requirements. With commodity prices as low as they are at present, Limex contains some valuable nutrient content, please seek advice from your area manager about the nutrient availability within our LimeX product.

Preparations for the Bury BBRO Open Day at Garboldisham on 23rd June are well under way. The event will be hosted by Frederick Barraclough Ltd. The BBRO and Bury Agricultural Team hope you will be able to attend this event and we look forward to meeting many of you on the day. Please make a note in your diary.

I would like to wish everyone a safe and successful 2016/17 season.

Mark Culloden
Head of Agriculture

CANTLEY FACTORY

Factory performance
I reported in the winter edition of the British Sugar Beet Review, that the factory had a good start-up, but this was followed by a series of mechanical issues which impacted on the factory throughput. The heavy rain post-Christmas made harvesting almost impossible, and this meant that roadside stocks depleted rapidly and, ultimately, the factory had to run on reduced slice for a period of two weeks to ensure that it did not run out. We would like to thank all our growers, hauliers and harvesting contractors for their efforts during this difficult period of the campaign. When the weather improved and the stocks built, the factory was able to maintain a slice of over 9,400 t/day.

Root dig information gave us good reason for optimism on yield and the final delivered crop did not disappoint. The final average adjusted yield for the factory was 80.19 t/ha, with sugars at 17.24%. This excellent performance is the second highest yield that Cantley has ever achieved. Only last year’s 90 t/ha result surpasses this. The results from each factory area varied from 75.8 t/ha in mid-Norfolk to 82.4 t/ha in north-east Norfolk, with some of the highest yielding growers achieving over 100 t/ha.

Off-season maintenance is now underway and, in addition to the routine factory maintenance, there are two capital projects being undertaken. The first is a replacement of the conveying system in the sugar silos and the second is the third phase of the factory control system replacement. This is the computer system that controls 70% of the factory (beet end and sugar end). The animal feed system and boilers were replaced last summer. This is a significant piece of work that is not without its challenges, as it has to be installed and tested prior to the start of the 2016 campaign.

Agricultural Operations Manager

It is with mixed emotions that I inform you of the departure of Patrick Barracough from Cantley factory. Patrick held the position of Agricultural Operations Manager at Cantley for a number of years but has taken the decision to move to Bury factory to further develop his knowledge of the Agricultural Operations role. Patrick has been dedicated to Cantley factory and has been a much liked and respected member of the team. We wish Patrick all the best in his new role. We will inform you when the new Agricultural Operations Manager has been appointed.

Co-products
Please take advantage of our soil testing service which is available throughout the spring and summer months. Use this service to check soil indices and pH in preparation for the drilling next year. Now that beet pads are clear and transport is more readily available, there should be an opportunity to obtain attractive rates from your haulier.

BBRO Open Day at Morley

Preparation for the Cantley BBRO Open Day at Morley, near Wymondham on 28th June is well under way. The Cantley Agricultural Team hopes you will be able to attend this event, and look forward to meeting many of you on the day. Please make a note in your diary.

Andrew Dear
Agricultural Business Manager
**NEWARK FACTORY**

We closed the gates for beet deliveries at Newark on Saturday 13th February, and sliced out on the following day after 144 days of processing. Overall, the quality of the crop delivered was very good: from the 48,000 loads received at Newark, the average dirt tare was 5.6%, and average sugar content 17.51%, which was 0.3% higher than in East Anglia.

The average adjusted yield achieved was 71.5 t/ha, achieving 105% of contract. The yield was very pleasing given some of the challenges seen over the growing season, particularly the cold weather last spring when the crop was established, and the very wet and dull weather in August 2015. In fact, the 2015/16 crop produced our third highest yield at Newark, beaten by the record crop of 2014/15 at 75.6 t/ha, and very close to the 72 t/ha in 2011/12.

Factory operations were very successful throughout campaign, having sliced 3.5 million tonnes of sugar beet: an average throughput of 5,426 t/day, 270 t/day more than our factory technical standard; see Fig. 1 for year on year slice performance comparisons.

**WISSINGTON FACTORY**

2015/16 Campaign summary

The campaign finished with the last beet sliced at 8.30 am on Thursday 28th January, earlier than normal for recent campaigns owing to the reduction in crop area for the year. The factory achieved above-budget throughput: The campaign started with some difficulties on filtration on the carbonation area of the sugar process but, after these were overcome, Wissington operated at a consistently good level.

The crop forecast on yield from early November varied by only 1.7% from that achieved and, as a result, allowed the campaign end to be managed for all hauliers relatively smoothly. A few thousand tonnes of beet were delivered to Cantley and Newark after the Wissington factory closed.

Adjusted yield for this last campaign was the 4th best achieved for the factory, at 74 t/ha. The average sugar content was 17.25%. Considering a cool spring and a slow start to the growing season, this is a surprisingly good crop yield, which demonstrates the ability of the crop to maintain its good yield development over recent years. Seed breeding, fungicide use and whole beet delivery have all contributed to this constant yield growth, a fact that cannot be claimed by any other broad-acre crop.

2016 Maintenance period

As soon as the campaign finished, dismantling of the factory began for the out-of-campaign maintenance. The three large diffusers were opened up and made ready for a repair programme that will continue through most of the summer. The capital programme to ensure constant improvement of factory mechanical reliability continues, despite a shorter campaign last season and another one to follow, our parent company ABF supports the continued high level of investment to ensure the factory asset is maintained.

After a short period of complete shutdown, the sugar end of the factory starts up again to take juice from tanks to final crystallise. With Wissington being the ‘hub’ for all sugar product formats for the company, the juice run is essential to ensure all sugar customers can be serviced through the summer months.

Co-products

Topsoil continues to grow in sales volume from Wissington. This year around 100,000 tonnes will be excavated, conditioned back into a sandy loam and sold to a wide portfolio of customers. Soil is a costly operation to the factory to improve safety, a diffusion cossette pump to reduce emissions, and replacement of boiler burner upgrade to reduce capital cost: £5.5 m.


Fig. 1 – Year on year factory slice comparisons.

Good progress continues on our new 60,000 t thick juice tank (Fig. 2); with the civil work now complete and the construction phase well underway, it will be ready to fill during the 2016/17 campaign.

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Other projects planned for this off-season are: replacing flooring in addition, techniques used on farms are now replicated on the site: a provision of all the heavy equipment for the production of topsoil but, in as efficiently as possible. Buckingham Plant Hire, our resident contractor, provides all the heavy equipment for the production of topsoil but, after these were overcome, Wissington operated at a consistently good level.

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Fig. 2 – Thick juice tank 5 construction – March 2016.

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Capital cost: £5.5 m

Other projects planned for this off-season are: replacing flooring in the factory to improve safety, a boiler burner upgrade to reduce emissions, and replacement of the diffusion cossette pump to maintain reliability.

As the campaign came to an end, we finally saw the arrival of some cooler temperatures, albeit relatively short-lived. The freezing temperatures will help break down some of the heavier soils. It will also reduce aphid numbers and disease carry-over from one crop to the next, which will be very welcome as current forecasts for pest and disease incidence are high. As always, our team is on hand to advise on seed spacing, drill set-up and seed bed preparation when conditions become dry enough to commence establishment.

A date for the diary is the BBRO Summer Open Day which will take place on the 30th June 2016 at Hibaldstow.

Best wishes for a favourable spring.

Nick Morris
Agricultural Business Manager

Dan Downs
Head of Agriculture
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