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Feeding our hungry early-season beet crops

Fig. 1. Accessible nutrients will boost early canopy growth.

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Nutrients have an important role to play in getting your crops up and running quickly. Young sugar beet plants with rapidly growing leaf canopies are hungry for essential nutrients such as nitrogen and manganese, and the task is to ensure there are sufficient nutrients available to plants when they need them. Unfortunately, more often than not we are playing catch-up and don't realise they are running short of nutrients until we see deficiency symptoms in the canopy. In this article we review some of the key essential aspects of early crop nutrition, as well as taking a look at some new approaches to feeding our crops.

Nitrogen for rapid leaf growth: essential early dietary requirement of crops.

Of the key major nutrients (nitrogen, potassium and phosphorus) the key focus should be on nitrogen: it is absolutely essential for early leaf growth and development. Work has shown that having the correct amount of nitrogen in the developing plant is critical; the early rate of leaf expansion has been shown to be 50% slower at 3% nitrogen content (% of shoot dry matter) compared to 4% nitrogen, so small differences can have large effects (Ref. 1.) If soils become dry, this difference will become even greater, so it is important to ensure sufficient nitrogen is available to the plant from an early stage, especially in a dry spring. Once plants are established, nitrogen uptake accelerates rapidly during the phase of rapid leaf canopy expansion. In June and July, average nitrogen uptakes of 4-5kg N/ha per day are not uncommon. Remember, crops need to acquire ca 30kg N/ha to produce each unit of leaf area index (LAI); equating to 90-100kg N/ha to produce a LAI of 3 which is enough to fully cover the ground and maximise the interception of incident solar radiation.

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So, make sure you get at least 30-50kg/ha of fertiliser N applied at, or soon after drilling and the remainder at full emergence. Don't then delay in making the second application. If wet weather is forecast (which could restrict your ability to travel), remember it is better to go early rather than late. Also when looking to apply liquid nitrogen to the crop do not hesitate if the weather is forecast to be hot and dry which could delay application due to risk of foliage scorch.

Late applied nitrogen

Fig. 2. The benefits of placement (right) and consequence of getting nitrogen on too late (left).

Work by BBRO to improve the availability and efficiency of nitrogen use by plants has focused on placement systems. This is where fertiliser is placed in a band 5-7cm below the surface and to the side of seed. It is an approach adopted widely by sugar beet growers in other countries, notably the USA. The results of BBRO trials have shown consistent improvement in early canopy development where the nitrogen is placed, and this effect is usually greater in dry conditions. This advancement in canopy development can be translated into a yield increase but can sometimes be overshadowed by other factors such as drought stress, foliar fungal diseases and, later in the season, virus. However, remember that getting crops to the 12-leaf stage quicker in the season is believed to create the added benefit of reduced virus transmission, by advancing the onset of mature-plant resistance in crops.

50KgN/ha broadcast at drilling

50KgN/ha placed at drilling

The question of whether nitrogen rates can be reduced when using placement is also being investigated.

Initial monitoring of commercial crops in Norfolk in 2019, where nitrogen rates were reduced by 15% have been encouraging.

There are likely to be soil type and seasonal interactions at play, so we will be monitoring more crops. If you are interested in working with BBRO on this, give us a call.

So, what about phosphorus and sulphur?

Phosphorus is another important element for the early crop, essential for plant cell development, and energy and sugar transfer within plants. The challenge for plants is to extract sufficient phosphorus to support rapid root and shoot growth. Sugar beet plants don't have the benefit of mycorrhizal associations which have been shown to aid uptake in other species, so in a cool and moist spring soil, phosphorus availability can be reduced. It can also be locked in the soils by cations such as calcium, especially when base fertiliser applications have been made a long time in advance of drilling. Clearly, when soil P indexes are low it is important to ensure the right amount is applied, so check your soil levels. The recommendations are for 110 and 80kg/P2O5/ha on P Index 0 and 1 soils respectively. Crops may also run short of phosphorus on P Index 2 soils if conditions reduce nutrient availability by causing small roots systems.

Work is ongoing, looking at placing some phosphorus (as diammonium phosphate), using starter fertiliser products or applying an early foliar application to ensure there is some freshly available phosphorus in the seedbed. This has shown some improvements even on Index 2 soils (in early canopy growth) but to date these have not consistently been carried through to yield improvements at harvest. However, this remains an area of interest and experimental work is continuing.

As for sulphur, any light land not receiving sulphur-containing fertilisers, especially organic manure applications, will be at greatest risk of deficiency. Running short of sulphur early on will result in stunted and pale looking plants and a potentially backward crop. However, we tend not see too many cases of sulphur deficiencies in sugar beet as this is something that is usually addesssed in preceding crops. Many sources of sulphur are soluble, requiring spring application to the soil. Recent BBRO work has shown, applications of 30-40kg S/ha are required (75-100kg SO2/ha) to support high yielding crops. Responses to foliar applied sulphur have been inconsistent, and it is probably best to use soil applied sources.

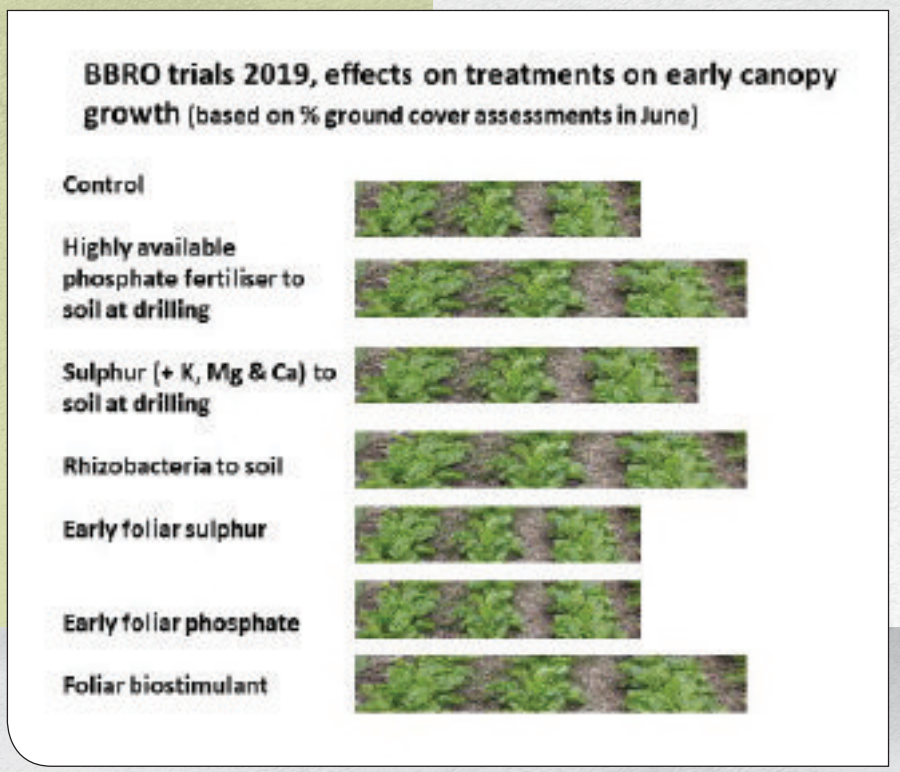

Fig. 3. BBRO trials 2019 showing treatment effects on early canopy growth (based on % ground cover measurements in June).

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Micronutrients and early growth

The key trace elements to focus on are manganese and boron. Make sure you are ready for manganese from an early stage (4-6 leaf stage) as this is key to ensuring sufficient amounts are available to the rapidly growing parts of the plant. Don't wait for deficiency symptoms to appear, and remember that deficient crops can be more susceptible to herbicide damage. Consider applying 0.5 -1.0kg Mn/ha in each application as part of a two- or three-spray programme, depending on the risk of deficiency. As with all foliar applications, try to time your application to a period of active growth and high humidity to aid leaf uptake. Avoid applying to stressed plants and/or in full sun and hot temperatures.

Of all crops, sugar beet has one of the highest requirements of boron, and the BBRO Plant Clinic often sees cases of boron deficiency samples at an early growth stage. Boron can be tightly bound into the soil by other elements and clay minerals as well as organic matter. Boron is not very mobile in plants and in rapidly growing crops it can run short in the new growth. The growing points of the plant can be affected and become blackened, with petioles showing signs of cracking and necrosis in severe cases. Light textured soils, especially in dry conditions, are likely to create the higher risk situations. Options for both soil and foliar applications of boron exist, but there has been little recent work to look at this in the UK. Placement of sodium borate fertiliser to the soil, along with the use of foliar treatments, is practised in the USA on soils considered to be susceptible.

Fig. 4. Manganese deficiency (top) – very common in rapidly growing crops, don't wait to see symptoms before spraying. Boron deficiency (bottom) - not unusual to see symptoms in beet.

Can biostimulants and soil applied bacteria help with early crop nutrition ?

A three-year study programme by BBRO which looks at a number of products across a range of soil types, is now in its final year. We have measured some increases in early canopy devlopment in response to some of these types of treatments (see chart). However, as is often the case, these are inconsistently linked to corresponding increases in yield. There appears to be significant site and season interactions, it is therefore best to wait for a full set of results before drawing firm conclusions.

Initially, trials aimed just to test early foliar applications but the use of soil applied bacteria to enhance the rhizosphere (the volume of the soil immediately surrounding the roots) has been included recently and is attracting a lot of interest. The use of PGR (plant growth promoting rhizobacteria) has been linked in controlled laboratory conditions to the better uptake of key nutrients such as N, P & K as well micronutrients and also improving their availability (such as making elements more soluble in the rhizospehere). Whilst their mode of action in relation to nutrition has been identified, the challenge is of course, getting this to work in the soil. Watch this space!

The message is relatively simple, ensure sufficient nitrogen is available early enough to feed the rapid growth of your canopy.

Don't delay in applying foliar manganese as soon as the canopy begins to expand rapidly, keep a 'watchful eye' on conditions where other nutrients may become in short supply, and be ready to respond accordingly. The chart below may help with this.

Nutrients and early canopy growth	Typical deficiency situation where early applications could be considered.
Manganese	Organic and sandy soils, high pH, after liming, fluffy seedbeds. Cold wet conditions. High organic matter. Rapid growing crops require high levels of manganese.
Phosphate	Low organic matter, acid and very calcareous soils. Low P soils. High iron levels. Cold and wet soils, poorly rooted crops (even where soil levels of P are good). [Phosphate is essential for early rooting and leaf growth.]
Magnesium	Sandy and acid soils. High K levels, high applied P and Zn. Cold and wet conditions. Moisture stress.
Sulphur	Acid soils, light sands, low organic matter. Poorly aerated, waterlogged soils.
Boron	Sandy and calcareous soils. Low organic matter. High nitrogen and calcium soils. Drought, cold and wet conditions.

References

1. Milford et al., 1985.