

Irrigation

Introduction

In the UK it is estimated that around 5% of the sugar beet crop is irrigated each year. Despite being a small area, it is a topic which raises many questions, especially regarding amount and timing of irrigation. This Fact File gives guidance on irrigation in sugar beet whilst considering the wider farm context.

Irrigating for establishment

This Fact File will focus on irrigation of the established crop. However, irrigation can help the crop to germinate and establish early in the season in a dry spring. Care must be taken when using rain guns which can damage young plants or damage soil structure. While the crop is growing towards full canopy, there is little requirement for irrigation, except in exceptionally dry years, as this will promote the growth of roots deep into the soil profile.

Crop water requirements

Water is a limiting factor most years in UK sugar beet crops. To achieve a good yield sugar beet requires over 400mm of water over the season. The peak of this requirement is from June to August when canopy cover is at its maximum and solar radiation and temperature at its highest. During this period water demand is more than 275mm. In most years, the water supply from rainfall and soil reserves is below this requirement so irrigation will drive an increase in yield. This is also the period of highest demand for other crops on farm which is a key consideration when allocating irrigation.



Is irrigation needed?

Sandy soils hold less available water than loams, silts and clays so are at a greater risk of water deficit. The level of water deficit at which yield loss starts are available in Table 1 below.

If you are measuring soil moisture deficit (SMD) using soil moisture probes or estimating it using predictive models these values can be used to decide on whether it is worth irrigating .

Apply irrigation if the critical SMD is exceeded. If you do not have a measure of SMD apply if the crop is wilting and struggling to recover by the following morning. In both cases hold off if significant rain is forecast to ensure irrigation is worthwhile.

The highest risk period for sugar beet water stress is from full canopy onwards; irrigation timing is covered later in this fact file.

Table 1. Critical soil moisture deficit (SMD) for sugar beet

	Coarse sands (mm)	Loamy sands (mm)	Sandy loams (mm)	Clay loams (mm)
Mid-June	25	30	35	50
Mid-July	35	40	50	100
Mid-August	50	60	75	125
Mid-September	65	75	125	150

Is it worth irrigating?

Estimating yield response to irrigation is challenging because multiple factors must be considered. Irrigation trials across several UK sites showed that when summer rainfall (June-August) exceeded 140mm, the yield response was typically 1 t/ha sugar or less. Responses above 1 t/ha sugar were only observed when summer rainfall fell below 100mm, a situation occurring in around 1 in 20 years. When rainfall was between 100 and 140mm, yield responses were more variable, making cost-benefit assessments of irrigation more difficult.

Table 2 below provides average yield responses based on summer rainfall taken from research undertaken at ADAS Gleadthorpe. Despite this work being 30 years old it is still useful as a rough guide; actual responses will vary considerably depending on crop-specific factors.



Table 2. 20 years of experiments at Gleadthorpe over a 30-year period from 1958 to 1998

June to August Rainfall (mm)	Clean beet yield increase (t/ha)	Sugar yield increase (t/ha)	Adjusted beet yield increase (t/ha)	Irrigation applied (mm)
Over 140 (13 years)	2.31	0.31	1.94	65
100 to 140 (4 years)	9.10	2.19	13.69	99
Under 100 (3 years	30.10	5.37	33.56	175
20-year mean	7.84	1.44	9.00	89

What irrigation rate?

It was shown at ADAS Gleadthorpe that irrigating sugar beet at 50% of the calculated required amount gives a better return per mm of water applied than the full rate. This is likely linked to the calculated full irrigation rate being more than the crop actually required in practice.

These findings suggest that irrigation of the crop can be beneficial at lower rates, even if it does not fully replenish the soil moisture deficit. This also means that applying a lower rate over a larger area of sugar beet is often more effective than full rate on a smaller area.

When to irrigate?

Irrigation during June-August is likely to give the best return. The decision on when to irrigate can be driven by the critical soil moisture deficit or timed to avoid long periods of crop wilting when leaf area is lost. However, it is likely that other crops on farm will be prioritised during this peak water requirement period. This raises the question of whether later irrigation is worthwhile.

ADAS Gleadthorpe data shows that irrigation in August and September can be very beneficial following a dry summer. This will depend on whether September is a dry month and if the crop will be harvested from December onwards. If the autumn is not dry then late irrigation can pose the risk of diluting sugars.

Does variety change anything?

BBRO trials have shown that current RL varieties do not significantly differ in their response to drought. Trials in this area are on-going, and the latest information will be available on the website. It is worth considering that varieties have increased in yield potential since much of the irrigation research was undertaken so the response to irrigation might be greater in current varieties.

The economics

Irrigation economics are challenging as on-farm irrigation costs vary depending on what is accounted for in the cost. To give a rough cost-benefit analysis:

- Irrigation equipment has typically been purchased for higher value crops so the cost of irrigating sugar beet can be accounted for using variable costs only
- Yield responses can be estimated using the information in the yield response section and using the current sugar beet price



Key factors to consider if irrigating:

When do you have capacity to irrigate?

- Early: June-August it is likely to have a yield benefit, but the increase will depend on summer rainfall levels
- Post August: yield benefit is likely if September is dry and the crop is late lifted

How much can you put on?

- Less over a wider area is preferable to more on a smaller area eg 12.5mm over 25mm to cover double the area

Is it worth it?

- Undertake a cost benefit analysis based on estimated yield increases, using the estimated values in this Fact File, variable irrigation costs and the current sugar beet price

Additional actions to help manage soil moisture

Irrigation is one option to managing soil moisture but there are some other actions which can help early in the season, before irrigation is often considered, as follows:

1. Ensure rapid establishment to ensure that the canopy closes quickly and prevents moisture loss from the soil surface
2. Reduce soil movement to preserve water throughout the soil profile
3. Ensure soil is free from compaction so plants can root deep into the soil profile
4. If using a cover crop, ensure timely destruction to prevent the cover crop removing water from the soil before the beet
5. In the longer term the use of organic manures to increase soil organic matter can increase the water holding capacity of the soil
6. Increase drilling depth to place the seed into moisture is an option but seed should not be drilled more than 5cm deep
7. Ensure foliar diseases are detected and controlled early to protect the canopy ensuring good soil coverage to prevent moisture loss

References

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