Part of the H3 project

Field lab: Investigation of the Benefits of Whole Cropped Sorghum for Forage

Final report

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(Established Crop in Herefordshire)

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Summary

Take home messages

Establishment timing and soil temperature are critical; late or cool establishment significantly reduces performance.

In cool, wet springs, slower early sorghum growth increased susceptibility to competition, with companion crops smothering sorghum in some mixed plantings.

Sorghum should be viewed as part of a diversified rotation, contributing to rooting depth, biomass and soil structure rather than as a high-yield replacement for cereals.

Context

Given the limited UK based evidence on sorghum as a forage crop, and the strong influence of local soil and climatic conditions on its performance, this work was designed as a farmer-led, on-farm field lab rather than a tightly controlled plot trial. This approach allows sorghum to be tested under real farming conditions, capturing both agronomic performance and practical considerations around establishment, harvesting and livestock acceptance.

By working across multiple farms and regions, the trial aims to explore how sorghum performs in different contexts, identify common constraints and opportunities, and generate learning that is directly relevant to UK livestock systems. The trial design therefore prioritises replication across farms, practical measurements, and farmer observation, alongside quantitative data collection.

Trial design

This trial was delivered as a farmer-led, on-farm field lab with five participating farms across the UK.

Rationale for crop choice

In the UK, sorghum is mostly grown as a cover crop. However, in mainland Europe and the US it is more widely used as whole crop silage. Silage sorghum is reported to be more drought tolerant, less susceptible to pests and diseases, and to require less fertiliser than maize, making it of interest as a potentially more resilient forage option in variable seasons and on sensitive soils.

Measurements and data collection

Each participating farm established a defined sorghum area. Data to be collected was planned to be:

- **Crop growth and forage quality**: forage sampling and nutrient content analysis at key growth stages.
- **Harvest yield**: measured using a weighbridge where possible (or the best available farm method, clearly recorded).
- **Weed burden**: visual weed assessments undertaken at agreed timings to record competitive pressure and weed composition.
- **Milk yield outcomes** (where relevant): comparison against the previous year's performance to explore whether sorghum forage contributes to changes in milk from forage.
- **Palatability**: farmer observations on intake and cattle acceptance (anecdotal evidence recorded in a consistent format).

Findings

The results highlight the strong dependence of sorghum on warm soil temperatures and timely establishment. Wet and cold spring conditions significantly restricted early growth, increasing vulnerability to competition from faster establishing species.

Although sorghum demonstrated an ability to recover and produce biomass where competition was reduced and the crop was left longer, delayed development meant that crops reached maturity beyond the optimal harvest window, limiting practical application in this season.

Recommendations & next steps

Practical agronomy recommendations

1. **Prioritise establishment conditions**
    - Drill only once soil temperatures are consistently warm and fields are trafficable. Sorghum is highly sensitive to cold soils and slow early growth increases the risk of failure.
    - Where springs are cold/wet, consider delaying drilling rather than drilling into marginal conditions.
2. **Reduce early competition pressure**
    - Avoid companion cropping combinations that establish rapidly and can smother sorghum in cold/wet springs.
    - If under sowing is planned (e.g. grass/clover), consider delayed under sowing once sorghum is clearly established and competitive.
3. **Clarify the intended end use before drilling**
    - Decide early whether the objective is whole crop silage, biomass/forage, or soil-conditioning/cover.
    - In cooler seasons, sorghum may be more reliable as a forage/biomass crop rather than a crop expected to reach full maturity for harvest.
4. **Variety and system selection**
    - Trial earlier maturing varieties (shorter season types) better suited to UK harvest windows.
    - Select fields with warm, free-draining soils and lower weed pressure for initial trials.
5. **Weed and establishment monitoring**
    - Build in early season monitoring to assess emergence and competition risk, with an agreed decision point for intervention (e.g. thinning, topping, or switching management if sorghum is being outcompeted)

Useful resources [Up to 3 links to relevant resources, articles or papers]

- Silage sorghum, an alternative to silage maize - Agricology
- Protokoll

Farmer Key lessons from the sorghum trial

Ian Pye, Old Holly Farm

Why we tried sorghum

- To explore sorghum as a high-yielding forage alternative to maize, with the potential to increase milk from forage while avoiding soil damage associated with late maize harvests in wet years.

What happened

- A cold, wet spring delayed drilling and slowed establishment.
- Sorghum struggled to compete with under sown grass and clover, which established more quickly in cool conditions.
- Despite good soil condition and drainage, low soil temperatures limited early crop vigour.
- By mid-summer, sorghum growth lagged significantly behind maize and grass–clover, leading to the decision to remove the crop and return the field to grazing.

Key lessons learned

- **Timing is critical:** Sorghum requires warm soils to establish well; cold springs significantly increased risk.
- **Competition matters:** Companion or under sown crops can outcompete sorghum before it is established, particularly in wet or cool conditions.
- **Good soils are not enough:** Even well-drained, well-manured fields cannot overcome unfavourable seasonal weather.
- **Have a fallback plan:** Flexibility to revert to grazing or alternative forage is essential when trialling novel crops.
- **Reliability still counts:** Grass and clover may not be "sexy", but they remain dependable under challenging seasons.

Would we try sorghum again?

- Yes, in the right year and under the right conditions. In a warmer spring, sorghum could still offer real potential as a forage crop. However, it should be trialled cautiously, with realistic expectations and careful management of early competition.

Main report

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1 Field lab aims

The aims of this field lab were to explore the suitability of sorghum as a forage crop within UK organic livestock systems, and to generate practical, farmer-led evidence on its performance under commercial farming conditions.

2 Background

UK livestock systems are operating in an increasingly challenging climate context, with greater weather variability, more frequent drought periods, and increased risk of soil damage during wet harvests**.** These pressures have driven growing interest in alternative forage crops that can support productivity while protecting soil structure and reducing reliance on high input systems.

Maize is widely used as a high energy forage crop, particularly in dairy systems aiming to increase milk from forage. However, maize can present significant challenges in UK

conditions, especially in wet years. Late harvesting is associated with soil compaction, erosion and nutrient losses**,** which can undermine longer term soil health and environmental outcomes. These risks are of particular concern in organic systems, where soil protection and biological function are central priorities.

Sorghum has attracted interest as a potential alternative forage crop. In mainland Europe and the United States, sorghum is commonly grown for whole crop silage and is valued for its drought tolerance, efficient water use and lower fertiliser requirements compared with maize. Its waxy leaf coating and deep, fibrous root system enable it to withstand heat and moisture stress, while also contributing biomass and rooting depth that may benefit soil structure.

In the UK, however, sorghum is more commonly used as a cover crop, and there is limited independent, farmer led evidence on its performance as a forage crop under commercial conditions. Questions remain around establishment reliability, competitiveness in mixed swards, yield potential, forage quality, palatability for livestock, and suitability across different soil types and regions.

This field lab was established to address this evidence gap by testing sorghum within real farming systems**,** across multiple regions and seasons, and under organic management. By working collaboratively with farmers, the project aimed to generate practical learning on both the opportunities and limitations of sorghum as a forage crop in UK conditions.

3 Methodology and data collection

Planned quantitative data collection

The following quantitative measurements were planned as part of the field lab to assess sorghum performance under UK farming conditions. Where crop establishment was insufficient, some of these data could not be collected.

- Crop growth and forage quality
- Harvest yield
- Weed burden
- Milk yield outcomes
- Palatability

Due to poor or late establishment at several sites, the planned quantitative measurements were not achievable. These reasons have been recorded and used as part of the trial learning.

Although full quantitative data collection was limited due to poor establishment at several sites, several consistent qualitative observations were recorded across the field lab.

Across all participating farms, soil temperature and spring weather conditions were the dominant factors influencing sorghum establishment. Prolonged cold and wet conditions in early spring delayed drilling and slowed early growth where crops were sown. Sorghum emergence was often slow and uneven, reflecting the crop's sensitivity to low soil temperatures.

Where sorghum was drilled into cooler soils, early vigour was limited. This reduced the crop's ability to compete with faster establishing species, particularly where companion or under sown grass clover mixes were present. In these situations, companion crops established more rapidly and, in some cases, outcompeted or smothered sorghum before it could establish effectively**.**

Even on well drained, well manured soils, establishment challenges persisted under unfavourable weather conditions, indicating that good soil condition alone was insufficient to overcome seasonal constraints. In contrast, sites that experienced warmer conditions later in the season showed improved growth once sorghum became established, demonstrating the crop's capacity to recover when temperatures increased.

Emergence timing varied considerably between sites, but later emergence generally correlated with delayed maturity**,** increasing the risk that crops would reach harvestable stage too late in the season for practical forage use.

Overall, establishment observations suggest that sorghum performance in UK systems is highly dependent on warm soil conditions at drilling, limited early competition, and favourable early season weather**.** These factors appear more critical than soil fertility or field history in determining early success.

4 Results and discussions

Seasonal context

The 2024 growing season proved challenging across much of the UK. Prolonged wet conditions in spring delayed drilling, with many growers waiting for soils to both warm and dry sufficiently before sowing. These conditions strongly influenced establishment success and subsequent crop performance.

Despite these challenges, the trials generated valuable insights into how sorghum performs across contrasting regions and seasonal conditions.

Lancashire and Scotland

In the more northern trial sites, cold and wet conditions during establishment significantly restricted sorghum growth. Early development was slow, and sorghum struggled to

compete with undersown clover and grass. In several cases, this resulted in the decision to abandon sorghum as a forage crop and bring fields back into grazing.

As one farmer observed, “Had the spring of 2023 been repeated, I am in no doubt the plant would have thrived.” This highlights the strong influence of seasonal temperature on sorghum establishment and competitiveness.

Oxfordshire

In Oxfordshire, sorghum establishment was delayed primarily due to competing farm workloads rather than crop failure. This limited early momentum and reduced overall performance.

Cornwall

In contrast, the Cornwall site showed more encouraging results. Despite initial challenges with clover germination, sorghum established well once conditions improved, demonstrating better early vigour and growth than at other sites. This suggests that warmer regional conditions and improved soil temperatures later in the spring supported crop development.

Herefordshire

The Herefordshire trial experienced a delayed start due to wet soils, but conditions improved significantly later in the season. As temperatures increased, sorghum growth accelerated, and the crop established strongly. Demonstrating sorghum’s capacity to recover and perform well when warmer conditions align with sufficient soil moisture. The crop did not reach maturity in time for harvest and the grower commented “*if he attempted to grow sorghum again, he would not drill as deep”.*

Summary of site-level learning

Across sites, sorghum performance was closely linked to soil temperature at establishment, early-season weather patterns, and competition pressure. Northern and cooler regions experienced greater establishment challenges, while sites benefiting from warmer conditions later in the season showed more positive outcomes. These findings reinforce the importance of matching sorghum to suitable climatic windows and managing early competition carefully within UK systems.

Conclusions for all trials:

The sorghum field lab provided valuable learning on the suitability of sorghum as a forage crop within UK organic and regenerative livestock systems. While the 2024 season severely

limited crop establishment at several sites, the outcomes highlight important constraints and considerations that are critical for future adoption.

Across the trial sites, successful establishment was the primary limiting factor**,** rather than inherent yield potential. Prolonged cold and wet spring conditions delayed drilling slowed emergence and reduced early vigour. Where sorghum failed to establish quickly, it was unable to compete with faster growing species, particularly where companion or under sown grass clover mixes were present. In several cases, this led to the crop being overtaken or removed before reaching a harvestable stage.

Even on well drained, fertile soils, establishment challenges persisted, indicating that soil condition alone cannot compensate for unfavourable early season temperatures**.** However, sites that experienced warmer conditions later in the season demonstrated that once established, sorghum can recover and produce meaningful biomass, with one site progressing towards (but not making) a late silage harvest.

The trials suggest that sorghum has potential as a resilient forage crop under warmer and drier conditions**,** supporting its reputation as a drought tolerant alternative to maize. However, in UK conditions, this potential is highly year and site dependent**,** with significant risk in cold or wet springs.

Overall, sorghum should currently be viewed as a high risk, high reward option rather than a reliable replacement for maize or grass-based forages. Grass and clover systems consistently delivered forage under challenging conditions, reinforcing their role as dependable components of UK livestock systems.

The findings underline the importance of careful site selection, appropriate drilling windows, and cautious use of companion cropping when trialling sorghum. Further multi-year, multi-site trials are required to better understand establishment thresholds, optimal management strategies, and the conditions under which sorghum can reliably contribute to forage production in the UK.

Discussion:

The results of this field lab reinforce both the potential and the limitations of sorghum as a forage crop within UK organic livestock systems. While sorghum is widely recognised internationally for its drought tolerance and biomass production, the findings from this trial demonstrate that establishment under UK spring conditions is the critical constraint determining success or failure.

Establishment as the limiting factor

Across most sites, poor establishment rather than poor growth potential was the defining issue. Sorghum's requirement for warm soil temperatures makes it particularly vulnerable in cold and wet springs, which are still common in many parts of the UK. Delayed drilling

reduced the effective growing window, and where emergence was slow, plants lacked the early vigour needed to compete with weeds or companion species.

These observations align with wider European and UK experience, where sorghum establishment is consistently identified as the highest risk stage of production. Even in well managed fields with good drainage and fertility, early season weather conditions proved decisive, reinforcing that sorghum is less forgiving than grass-based forages during establishment.

Competition and companion cropping

One of the clearest learnings from the field lab was the impact of competitive companion or under sown crops. While under sowing with grass clover is often desirable for soil cover, weed suppression and post-harvest ground cover, in this trial it frequently outcompeted sorghum under cool, wet conditions. Faster establishing species were able to dominate before sorghum had developed sufficient leaf area or root mass.

This suggests that companion cropping strategies for sorghum in the UK may need to be reconsidered or delayed, particularly in marginal years. In some systems, sorghum may be better established as a sole crop initially, with under sowing postponed until the crop has reached a competitive growth stage.

Climate resilience

The rationale for trialling sorghum was grounded in its reputation as a climate resilient crop, particularly under drought and heat stress. The trial results do not contradict this reputation, rather, they highlight a mismatch between sorghum's strengths and the prevailing conditions of the 2024 season. Where warmer conditions occurred later in the season, sorghum demonstrated an ability to recover and accumulate biomass, suggesting that in hotter, drier years its advantages may become more apparent.

However, climate change in the UK is characterised by greater variability, not just warmer summers. Cold, wet springs may continue to occur alongside hotter, drier summers, increasing establishment risk for heat loving crops such as sorghum. This variability must be factored into decision making, particularly in organic systems with limited corrective options.

System fit and risk management

The trials underline the importance of viewing sorghum as part of a whole system decision, rather than a direct replacement for maize or grass. Forage systems based on grass and clover proved resilient and reliable across all sites, even under challenging conditions. Sorghum, by contrast, offered potential upside but with significant establishment risk.

For farmers considering sorghum, this suggests a need for:

- Small scale trials rather than whole farm adoption
- Clear contingency plans if establishment fails
- Careful consideration of soil temperature, drilling windows and competition
- Realistic expectations around year to year variability

Value of farmer led trials

Although many planned measurements could not be completed, the field lab delivered meaningful learning precisely because it was conducted under real farming conditions. The variability observed across sites highlights why multi-year; farmer led trials are essential for evaluating novel crops. Recording failures, as well as successes, provides robust evidence that can inform both farmer decision making and future research priorities.

Implications for future research

Further work is needed to refine sorghum management in UK systems, particularly around:

- Minimum soil temperature thresholds for reliable establishment
- Optimal drilling dates and seed rates
- The timing and design of companion or undersown crops
- Regional suitability and risk profiling

Multiyear trials, including warmer and drier seasons, will be essential to fully assess sorghum's role in future forage systems. Until then, sorghum should be regarded as an experimental crop with situational potential, rather than a dependable solution across all UK livestock systems.

6 Tips and recommendations

Based on the findings from this field lab, the following recommendations are offered for farmers considering trialling sorghum as a forage crop in UK systems.

Before drilling

- **Start small:** Trial sorghum on a limited area before committing at scale, particularly in cooler or wetter regions.
- **Prioritise soil temperature:** Only drill when soils are consistently warm enough; cold soils significantly increase establishment risk.
- **Choose the right field:** Select free-draining fields with low weed pressure and good access for flexible management.

- **Have a contingency plan:** Be prepared to revert to grazing or an alternative forage if establishment fails.

Drilling and establishment

- **Avoid early competition:** Consider establishing sorghum as a sole crop initially, especially in marginal years.
- **Be cautious with companion or under sown crops:** Grass and clover can outcompete sorghum in cool, wet conditions. If under sowing, consider delaying until sorghum is well established.
- **Use appropriate seed rates and drilling depth:** Follow best practice guidance and ensure accurate depth placement to support emergence.
- **Monitor emergence closely:** Early intervention decisions may be needed if establishment is uneven or poor.

In-season management

- **Manage expectations:** Sorghum is slow to establish but can grow rapidly once conditions are favourable.
- **Watch weather trends:** Extended cool periods following drilling increase risk; warmer conditions later may allow recovery.
- **Record observations:** Keep notes on establishment, competition, and growth to inform future decisions.

Harvest and utilisation

- **Be realistic about harvest timing:** Late maturity may limit harvest options in cooler seasons.
- **Assess palatability gradually:** Introduce forage carefully and monitor livestock intake.

7 Further reading