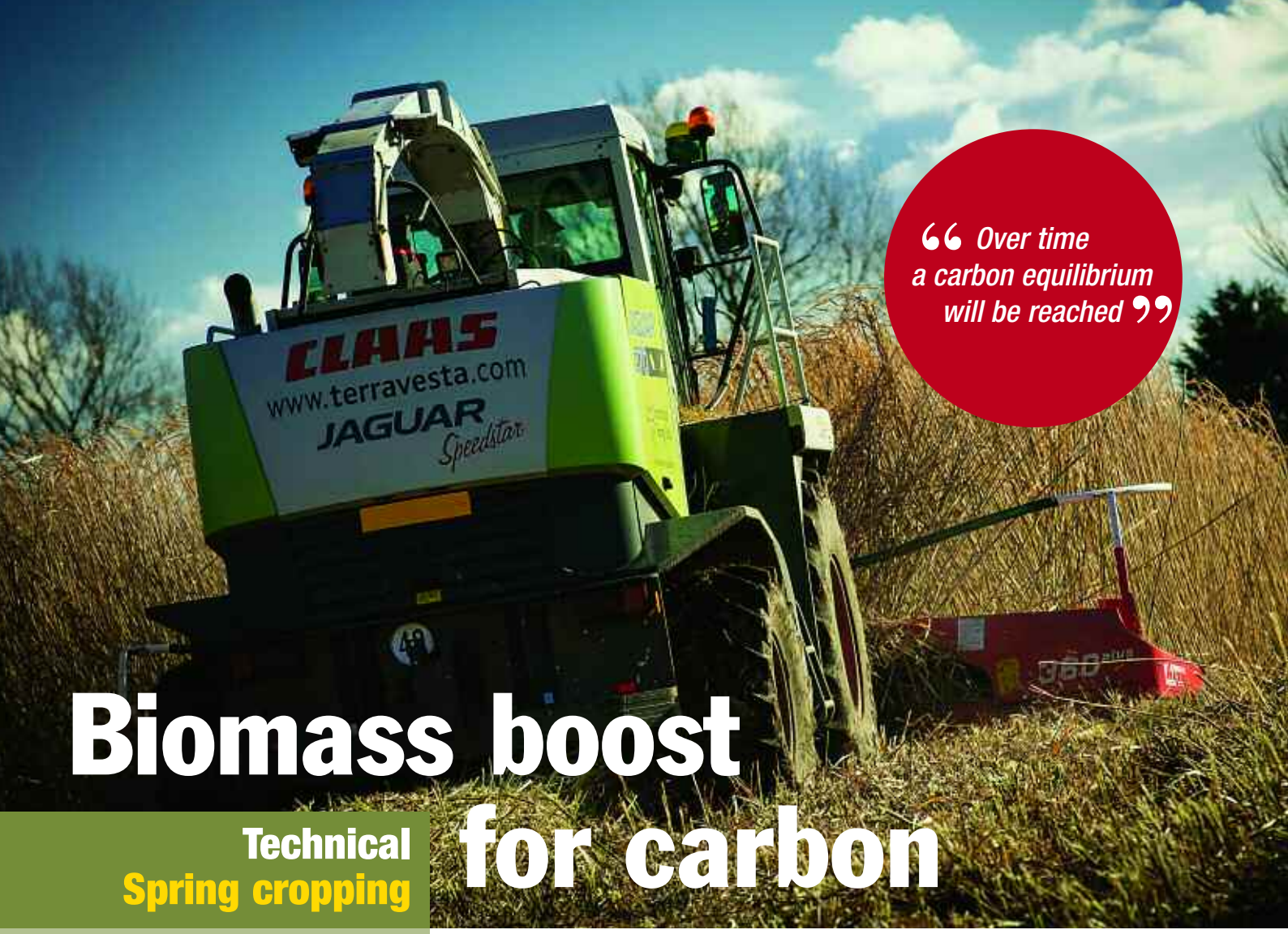

> *Over time a carbon equilibrium will be reached*

Biomass boost for carbon

Technical
Spring cropping

There's less than a 20-year timescale for UK agriculture to meet the NFU's Net Zero target– that's also less than the lifecycle of the biomass crop, miscanthus. *CPM* explores the potential of a crop with a market that's beginning to expand rapidly.

By Lucy de la Pasture

Farming with carbon in mind is something many growers are getting to grips with — partly because increasing carbon in the soil goes hand in hand with soil health, but also by necessity as the industry sets its sights on achieving Net Zero by 2040.

Sarah Wynn, principle sustainable food and farming consultant at ADAS, says many growers are choosing to look at carbon accounting on their farms — a process which was driven primarily by the supply chain until very recently.

Although there's a lot of discussion about the discrepancies between the carbon accounting tools available, Sarah says the absolute numbers they provide don't really matter. "The important thing is to choose a tool and then stick with it so you can see the direction of travel and then the results will help drive the adoption of the right carbon practices.

Carbon capture

"Generally the tools are very good at calculating emissions but less so when it comes to carbon capture. The interaction of soil type, environment and carbon is very complex and the science is only just catching up with demand. The risk is that the tools oversimplify things and, in some cases, over-estimate how quickly soil carbon can be accumulated."

Carbon capture and sequestration is much more nuanced than is widely believed, explains Sarah. "In a normal annual cropping cycle, we don't look at carbon capture in carbon accounting because it is so transient. It's true to say a winter wheat crop will capture carbon dioxide by photosynthesising and build the assimilates into plant-based material, However the grain is then consumed and the straw either incorporated, used for livestock or combusted, releasing the carbon stored in it."

Building soil organic matter is acknowledged to be a very slow process and exactly the same applies to soil carbon, which is why coppice and timber are more effective ways of sequestering carbon — particularly if the above-ground biomass is used in construction, which ▸

Sarah Wynn explains that carbon capture and sequestration is much more nuanced than is widely believed.

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Underground the miscanthus adds carbon to the soil over its lifetime, whereas above ground the harvested biomass only offers a transient capture of carbon.

▸ maintains the carbon 'under lock and key'.

That's not to say shorter term crops don't have a role to play in increasing soil carbon, explains Sarah. "When a grass ley is planted, it starts to accumulate carbon by putting on biomass — with its roots, root exudates and leaf matter all adding carbon to the soil. So over time the grass ley sequesters carbon until it reaches a state of equilibrium and then it becomes carbon neutral, if it's continuously managed in the same way, where the carbon it uses equals the carbon it stores.

"Once this point is reached, only a change in management practice will enable the crop to accumulate more carbon. For, example changing from an intensive grazing regime to a rotational one, where the grass is rested so it has more chance of capturing carbon, will allow the crop to continue to add carbon to the soil."

Management change

Even so, there is a 'but' when it comes to the influence of a management change, she highlights, because different soils or vegetation types behave in different ways and climatic conditions can either promote emissions or carbon sequestration.

Min-till and no-till cultivations minimise the release of carbon from the soil but exactly the same principle applies as it does when a new crop of grass is planted. "When a change is made from ploughing to min-till, or from min-till to no-till, there will be a gradual accumulation of carbon. But over time a carbon equilibrium will be reached so then you have to look to do something else, such as introducing cover crops into the rotation or adding organic amendments, to continue to enhance the carbon in the soil," explains Sarah.

But carbon doesn't travel in just one direction so the problem remains that growing practices also have the potential to release carbon as well as store it, highlights Sarah.

"All the benefit from moving to a system of minimal cultivations can be undone if the ground has to be ploughed for agronomic reasons. The carbon turned up in the soil will become oxidised when it's exposed to the air and released as carbon dioxide."

Because carbon is so easily released from soil and this happens much more quickly than it can be accumulated, Sarah believes it's important to

have a good understanding of the processes involved in the carbon cycle and the practices that influence them.

Crops which occupy a longer term in the rotation, such as miscanthus, can add a pool of carbon to the soil over its lifetime. "Miscanthus is planted as a small rhizome which accumulates biomass each year until it becomes a large root body — allowing the soil to accumulate carbon. The leaf litter falls which also replenishes carbon in the soil.

"The above ground harvested biomass only offers a transient capture of carbon, although there is some carbon offset to put against otherwise burning a fossil fuel. If the miscanthus is used as a biofabric then this will lock the carbon up over a longer period of time."

Miscanthus is currently grown on over 7,000ha of marginal land in the UK and its mainly supplied to whole-bale biomass renewable energy plants, which power over 200,000 homes. The crop could have a key role to play in reaching Net Zero emissions in agriculture and not only is it scalable — it's making waves in the industry as new technologies and markets emerge.

Earlier this year, the UK Committee on Climate Change (CCC) released its "Land use: Policies for a net zero UK" report, stating that expanding biomass crops, including miscanthus, by around 23,000ha/annum would deliver a 2Mt CO_2e emissions saving in the land sector. Additionally, it highlighted that an extra 11Mt CO_2e reduction in emissions is possible by using harvested biomass for construction or bioenergy with carbon capture and storage (BECCS).

Jonathan Scurlock, NFU chief adviser for renewable energy and climate change, believes miscanthus can contribute significantly to UK net zero targets. "The NFU expects growth in land use for perennial energy crops like miscanthus to result in feedstock supply for bioenergy, displacing fossil fuels, supply of bio-based materials and also bioenergy coupled to carbon capture (BECCS), all of which are essential components of our ambition for Net Zero agriculture and will contribute to the overall national goal," he says.

"Probably the largest bulk end-market will remain as a feedstock for power generation, which is likely to include carbon-negative technology in the future, but miscanthus also has potential as a fuel for ▸

Over a period of time a crop or management practice becomes carbon neutral and a change in management is then needed to capture more carbon.

Miscanthus acts as a net carbon absorber which helps mitigate against greenhouse gas emitted by the land-use sector, says Alex Robinson.

▸ district heating, as a supplement to wheat straw for anaerobic digestion, and as a source of fibre products for a growing bioeconomy."

Expanding the sustainable future of the crop is miscanthus specialist Terravesta, a company which works with over 300 growers throughout the UK, facilitating planting, providing agronomic support, securing markets and offering long term contracts.

"Agriculture is seen as a significant carbon net emitter. With miscanthus, what you have is a proportion of land that's a net carbon absorber which helps to mitigate against greenhouse gas emitted by the land-use sector," says Alex Robinson, the company's operations director.

Terravesta is working with scientists to introduce new 'performance hybrids' to the market which can be cultivated from seed rather than having to plant a rhizome.

"Not only is there a case for planting miscanthus for environmental reasons, it helps boost food production on-farm and it makes good business sense because it's grown on unviable farmland, which struggles to yield annual crops, and improves the quality of the land."

The perennial energy crop can grow to heights of up to 3.7m and has the potential to yield 15t/ha, which can give a return of £900/ha after establishment costs have been paid back. The new performance hybrids provide an average net profit of £558/ha/annum over 15 years.

So what about agronomy? Miscanthus its soil carbon capabilities and positive ecological impact, and with the uncertainty around farm subsidies under the Environmental Land Management (ELM) model, it provides a long-term fixed price, reliable income, " he adds.

100% the right decision for Yorkshire farmer

Rob Meadley, agricultural business consultant for Brown and Co and an East Yorkshire arable farmer, grows 12ha of miscanthus on outlying land of varying quality which wasn't delivering a viable return with arable crops.

His crop is coming up to eight years old and had a slightly difficult start. Rob planted miscanthus in March 2012 in good conditions, but this was followed by the wettest April on record, meaning the freshly planted crop was in standing water and then the bad weather hit again in June.

"We therefore couldn't control weeds on a poor-quality field with a heavy weed burden," he says. "We applied a selective herbicide in August that year, then the following year we topped it and controlled the weeds. Apart from a little patch spraying in 2014, no herbicide has been used on the crop, which out-competes the weeds each year.

"The only issue to note was on one of the headlands — where the forager and baler turns, we noticed compaction. We used a low disturbance subsoiler and this affected the height of the crop across a couple of passes, but the following year it was back to normal."

Rob explains that the 2014 harvest was affected by the legacy from flooding and lack of weed control, but arable crops would never have survived the conditions that the miscanthus was exposed to and he didn't lose any money on inputs. "The annual yield quickly recovered, and in 2017 we had a bumper harvest of 13t/ha."

Rob believes it's the right crop for this land and has not only met the budgeted return but has introduced additional ecological benefits to the farm.

"We've had a number of RSPB surveys done on the farm and the feedback was that they were genuinely surprised by the abundance and diversity of birds in and around the miscanthus, including curlews, rarely found in East Yorkshire," explains Rob. "We also saw breeding deer, brown hares and an abundance of invertebrates."

The miscanthus-planted area has allowed Rob to square off an arable crop next to it and has also helped to naturally control blackgrass. The field is two miles away from the farm, meaning the minimal maintenance required is noticeable, he notes.

Ultimately, Rob says that there wouldn't have been another option for a crop on that land which would have been as profitable. "In 2012 when we decided to plant miscanthus, the principle was looking at the whole farm net margin and identifying the risk in this area.

"It wasn't performing as well as other parts of the farm and miscanthus was 100% the right decision for it. The only other option for that land would have been environmental grass, but miscanthus beats this hands-down from a net margin point of view.

"Miscanthus is a vitally important crop due to

Since planting miscanthus, the abundance and diversity of birds in and around the crop has increased in RSPB surveys, says Rob Meadley.

Micanthus yield (t/ha)

	2012	2013	2014	2015	2016	2017	2018	2019	2020 * Est.
Tonnage	-	-	9.78	100.66	143.64	157.54	139.94	153.41	159.36
Yield (t/ha)	-	-	0.81	8.36	11.93	13.08	11.62	12.74	13.24

Source: Rob Meadley, 2020.

The miscanthus crop grows up to about 3.7m tall and produces a stem, which is primarily used as a biofuel but its use is expanding rapidly into new markets.

requires minimal inputs once established, because the root stock or rhizome, recycles nutrients back into the soil, so no fertiliser application is required.

"Planting takes place in the spring and there's a minimal herbicide input once established as the crop suppresses annual weeds, such as blackgrass, because its high canopy out-competes it," says Alex.

Assured income

As miscanthus is harvested annually between March and April, and has a productive life of 20+ years, growers consider it a long-term, low maintenance investment that provides an assured income well into the future.

Terravesta offers long-term, index-linked, fixed price contracts for miscanthus. "The upfront cost is £1,500/ha, which is significant but with yield improvements, a return on investment is quicker and its zero inputs means the crop delivers a reliable annual income," says Alex.

The market for miscanthus is seeing sustainable growth and is currently expanding, with several different end-markets including whole bale power stations — Terrvesta currently supply Brigg in Lincolnshire and Snetterton in Norfolk on long term contracts.

Other markets include horse and poultry bedding, consumer briquettes, miscanthus logs and firelighter ranges, and current development into future markets include construction, biofuels, composite materials, medical/cosmetic applications, land remediation, and as a bioherbicide replacement for glyphosate.

"The national annual crop is around 50,000t and there's an opportunity for this to expand a hundredfold by 2030. This is due to the rapidly growing demand for heat from biomass and potential future markets," adds Alex.

The firm is also progressing a standardised approach to measuring and auditing miscanthus carbon storage, enabling farmers to be rewarded for the carbon sequestration delivered by the crop.

"One of the areas worth considering on the farm are grass strips on the headlands," adds Sarah. "Managed properly these can provide carbon stores, but equally a lack of care in management can promote the release of carbon. Another area of interest is hedges — though their age and management make a big difference to the carbon they can sequester or store."

But one thing's for sure, farmers are in a unique position within the food supply chain to take action to sequester carbon on their farms, she says. ■