

# The pursuit of happiness

## Groundswell report

Being the one-stop-shop for all things regenerative farming means Groundswell's fan club continues to grow at a rapid pace. Now in its seventh year, *CPM* attended the festival to hear the latest perspectives on sustainable agriculture.

By Janine Adamson  
and Emily Padfield

**It's a much-quoted phrase — find a job you enjoy doing and you'll never have to work a day in your life. For those attending Groundswell festival this year, that message couldn't have been clearer.**

Whether selecting a new break crop, integrating livestock into the rotation or diversifying the business, the show encouraged attendees to follow their passion and move away from what can sometimes prove a monotonous life.

And with 6500 visitors attending the event this year, that's a lot of reignited passion ready to be invested into UK agriculture.

To illustrate, farming consultant Alice Andrews gave an example of how

enthusiasm can translate into results during the 'Rotation — mind the gap!' panel session, which explored alternative break crops such as hemp and lupins.

"Choosing a crop you have an interest in or can become passionate about will inherently help it to be a success," she said. "It enables you to persevere when things don't always go to plan."

Alice explained a successful break crop isn't simply about making money and wider benefits should be considered. "Ask whether it supports using less inputs, can it fix N, does it facilitate livestock integration? Choosing a break crop which enhances biodiversity has the potential to boost the following cash crop," she said.

It was a pursuit of happiness which encouraged Rebecca Mayhew to rethink the approach to her family's South Norfolk farming enterprise. Formerly a 200ha conventional arable business with indoor pigs, the farm now boasts a range of pasture-fed livestock as well as a farm shop, butchery, restaurant and vineyard.

During the 'Farming regeneratively and profitably' masterclass at Groundswell, she said despite being efficient, the old business model was commodity-based, high risk and didn't make the family happy.

"Our new approach spreads the risk and we control the price because products are sold direct to consumers. However, every part of the business has to earn its keep. For those thinking about a transition to regen, don't change

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everything at once. Although there are still lows, among the many highs is finding happiness," she said.

## Diving deeper

Those looking for a deeper dive into regenerative farming, Groundswell hosted two advanced sessions for the first time — the first looking at integrated pest and disease management with Joel Williams.

During the first part of his talk, Joel spoke about diversity and biology and how mixing different tools gives the greatest chance of control. "A monoculture encourages pests to thrive but improving diversity breaks up uniformity and prevents widespread pest movement through integrating non hosts. This can be novel cash crops and widening the rotation, or doing the opposite of ▶



Getting to Groundswell early this year paid dividends as later arrivals found traffic approaching the event meant a lot of queuing.

▶ what you're already doing — annual versus perennial or summer versus winter," he said.

Joel explained diversity also includes agroforestry, silvopasture, intercropping and companion crops. It can even be as simple as letting grass grow which creates a space for beneficial insects to thrive. And importantly, this doesn't have to be margins alone, it can be strips within a crop to support more productive field areas.

But ultimately, diversity can be broken down into three layers — temporal, spatial and genetic. "Temporal is diversity over time, for example, rotation changes. Spatial adds a physical barrier such as

a buffer strip or field margin whereas genetic can be using varietal blends rather than a straight," he said.

"The effect on disease pressure of increasing plant species diversity is it also increases pathogenic diversity. So by diluting the host, it's harder for pathogens to proliferate and they can't cause as much economic damage.

"Spatial separation can also give other integrated strategies more time to be effective, such as biological controls."

To illustrate his point, Joel shared the benefits of intercropping in reducing weed, pest and disease pressure, including the mechanism of emitting plant volatiles to reduce insect feeding. "It's

back to breaking up the monoculture to make it easier for yourself," he said.

Regarding biology, Joel believes a fundamental piece of the disease triangle (environment/host/pathogen) is missing, and that's the soil and plant microbiome. "These beneficial organisms play a considerable role yet haven't been factored in.

"To prevent disease, the microbiome works in various ways, from competitive exclusion of space, food and nutrients to antagonistic antibiotic and antifungal qualities. To maximise these benefits, we can either feed existing native organisms or introduce new populations," said Joel.

## Feeding biology

Feeding biology can be achieved through keeping soil covered to continuously produce root exudates, using molasses or sugar, applying humic substances and plant extracts, or using organic amendments such as FYM or compost.

Whereas to introduce new biology, techniques include using commercial inoculants, or creating DIY versions from compost and indigenous microbes. "Begin by approaching soil care first and then investigate top-up inoculants afterwards," he added.

Although often above ground plant tissues are under attack, Joel said it's roots which have more power and activity against pathogens. "When we discuss immunity, plants send chemical signals to the roots which recruit microbes that

## Getting comfortable with composting

From the Johnson-Su bioreactor to classic turned livestock manure, there's opportunity for arable farmers to become more comfortable with composting and its many benefits. Led by soils lecturer Dr Julia Cooper, this AHDB-hosted panel session explored the pros and cons of three systems.

Kicking off with the Johnson-Su, Ben Taylor Davies, aka 'Regen Ben', explained the system converts a farm's own indigenous ingredients, both green and brown, into fungal-rich compost which can be used as a microbial inoculant. "The result is a biologically robust and complete product which improves soil health and functionality," he said.

Because it recycles an IBC and requires little intervention once built, Ben believes Johnson-Su is the ideal composting solution for regen farmers, however, he admits it can only serve relatively small operations.

In contrast, Agriton's Andrew Sincock championed the Japanese bokashi fermentation method — ensiling microbe-inoculated farmyard manure. "With bokashi you capture more carbon and energy to put back into the soil compared with other decomposition methods."

Unlike Johnson-Su which takes 400 days to complete, Andrew said bokashi is ready in just six to eight weeks and can process much larger volumes.

Finally, Herefordshire farmer Billy Lewis pitched that rather than having to be a scientist, good old-fashioned turned cattle manure is his preferred approach. "It's simple and requires no horsepower or expensive kit. We convert 700 tonnes of FYM each year, reducing the bulk of our muck by half."

For Billy, this is all part of a regenerative mixed farming approach. He believes composting converts an average soil amendment into a



Johnson-Su, Bokashi or good old fashioned turned manure — the pros and cons of compost-making were discussed on day one.

valuable soil health product. But in comparison with the other two methods, there's the problem of ammonia emissions.

To conclude, the panel instigated an audience vote on which method is the best. One choice was 'it depends on the individual farming system', and it was this that prompted the majority of attendees to raise their hand.

subsequently help the plant defend itself. This can be further enhanced through using specific inducing biostimulants such as seaweed or other botanicals," he said.

"Additionally, the rhizobiome can shield plants from infection by releasing siderophores which uptake iron. They steal this essential resource from the pathogen, which is used for physiological processes such as DNA replication, transcription, metabolism and respiration."

The second part of Joel's talk focused on nutrition which he said starts with photosynthesis — the building block of plant life. "To fuel this function, as well as the obvious sunlight and water, plants require nutrients from the soil. These drive plant production and immunity, acting as catalysts," explained Joel.

"And the product of photosynthesis is sugar, which is used to build complex sugars, carbohydrates, amino acids, lipids, hormones, vitamins, defense chemicals and protective compounds."

He said it's possible for the plant to synthesise such compounds for preferred outcomes but it all relies on having the correct nutrients in the first place. Therefore, key pest and disease fighters can be specifically and intentionally managed.

To drill down further, Joel explained plants have two means of defence — physical, such as skin thickness and cell wall strength — and systemic biochemical, which is internal and reliant on the soil microbiome.

An example provided for improving physical defence was increasing cell strength to make a plant impenetrable to attack, achieved through optimising calcium, silicon and boron. Whereas calcium acts as both a nutrient and signalling messenger, boron provides a structural boost and is a synergist.

Silicon, although not essential, alleviates plant stress and reinforces cell walls. "It depends on where silicon is deposited as to which insects are suppressed," said Joel. "If it's surface deposited, it's ideal for chewers and borers but it also has the potential to be embedded in cell walls to deter sap suckers."

He also highlighted the role of plant breeding in maximising soil nutrient scavenging. "Because some plant varieties are better at seeking nutrients than others, they'll be more suited to lower input systems. Has this been neglected by breeders? Perhaps a discussion point," he said.

N management was also a topic during

the talk. Although the nutrient can have a positive effect on a plant's physical status through improving the thickness of the cuticle (waxy outer layer), it also reduces lignin (main component of plant cell walls) production so increases lodging risk.

Joel then explained converting nitrate- and ammonium-based N requires energy. "Why not feed the plant organic N to be more efficient, acting as a metabolic shortcut? Wasting energy deprives the photosynthetic process when it could be used to support tillering or other growth processes.

"Remember plants access N in other ways – urea, amino acids, peptides and proteins. These are favourable forms for plant health and immunity and therefore far more useful."

Joel warned that N-rich plants can be more attractive to pests and diseases because they also have a demand for amino acids to build protein. However, it's all about balance — a surplus of N compared with the other essential nutrients.

## Stress responses

He also weighed up the pros and cons of pesticides which he said can undermine the protein creating process and make a plant vulnerable to pests and diseases. "Stress response in the plant triggers a protein break-down, converting it back into the initial building blocks in order to re-build as detoxification.

"We also see a spike in pest-appealing free amino acids during this process, all while potentially affecting beneficial insect populations. Mismanagement of both N and pesticides makes plants more attractive to insect damage so it's crucial to stay within the optimum use zone," he said.

Other nutrient examples provided were potassium and zinc. Potassium increases proteins, starches and cellulose in a plant which contributes towards complex protein production. By nature, a deficiency of this nutrient increases the occurrence of simple compounds which again lure insects. In contrast, heavy metal zinc is toxic to pests and pathogens including nematodes.

To conclude, Joel stressed the importance of integrated pest and disease management techniques. "If we want to protect the effectiveness and lifespan of pesticides, it is essential to focus on these other techniques that increase plant health and thus reduce dependency on such inputs."



*Talking about alternative break crops, Alice Andrews suggested choosing a crop you have an interest in or can become passionate about will inherently help it to be a success.*

"Many knowledge gaps remain so instigating further research will be vital in creating a strong evidence base," he said.

## Underground chatter

How do plants communicate and what are they communicating with? Nicole Masters addressed these questions during the second deep dive session at the festival.

She began: "Take a moment to think about the last time you were hungry. What did you do? Did you make your way to the fridge? Did you tuck into your packed lunch? Did you call in at the garage for a quick fix?"

"As humans, we're in complete control of sourcing the materials we need to thrive. But plants aren't. As farmers, we have to facilitate the correct over- and under-ground conditions for them to flourish.

"A plant's endocrine system, its gut system and so much more is located outside of its body in the soil, so it outsources most of the functions humans take for granted."

She described the soil as a living matrix — an underground metropolis full of constant underground chatter. "Billions of microbes build these cities, complete with hallways, tunnels and stairways. Here weave your earthworms, while bacteria form the building blocks, and fungi the mortar that holds it all together."

Building on the metaphor, she continued: "Protozoa are using the bathroom, nematodes are weaving in and through the corridors. There are shops, schools, hospitals and even a pub. But what happens when we degrade these soil structures? Soils start to collapse." ►



Nicole Masters headlined on day two, taking delegates into the world of underground communications, elucidating how plants and microbes interact.

► As many as 80% of New Zealand dairy farms have been surveyed as having significant compaction, indicating soils have collapsed and these all-important services have been lost, she added, and as a result, to get the same yields, more nitrogen has to be used.

Plant exudates act as a conductor for this underground chatter, sending out bundles of amino acids, sugars, hormones and organic acids to trade with microbes. “These carbon-based exudates act as payments to stimulate the microbes in turn for beneficial services, as well as providing communication signals to suppress and defend against pathogens and pests.

“Not only this, but they also play a key role in aggregate stability as well as carbon and nitrogen dynamics.”

Nicole went on to discuss secondary metabolites — natural products predominantly made by bacteria, fungi and plants.

“Close your eyes and imagine you’re a microbe in this underground metropolis. How do you know how to get around? Who wants to eat you and who is a friend or foe? What is a food and what is poison? Who do you mate with?”

## Secondary metabolites

These microbes have no eyes, no ears and thus have adapted themselves to be able to communicate solely through secondary metabolites, she explained. “These secondary metabolites include things like phenolics, alkaloids, terpenoids, essential oils, flavonoids and the compounds that give nutrition and flavour to our food. They also form our antibiotics and drugs both medicinal and recreational.

“But the signals these produce are being disrupted by air pollution, nitrate and hydroxyl radicals, smoke, and a range of other factors. A study recently found some flowers are no longer sending out scent due to the amount of smog. They won’t invest energy into producing a secondary metabolites if nothing can hear the signal,” she said.

“Every single cell is waiting for a signal, but the environment effects how it is read.



Joel Williams led the first ever intensive session at Groundswell which went beyond first principles and explained the science behind them.

For example, a stressed environment fundamentally changes how every single cell signals to microbiology, both in flora and fauna.”

Stress also alters gene expression, she warns. Pesticides, herbicides, soluble fertilisers and neonicotinoids all alter a plant’s natural process of gene expression. “In fact, neonicotinoid application can alter as many as 600 genes. These are the same genes required for disease and pest resistance.”

Nicole is picking up these effects in her practice. “Broadly, I’m seeing low functional calcium even on chalk soils, and the reason for this is the lack of beneficial fungi. This is the same for

## Bring in the livestock

When it comes to integrating livestock into arable systems, the advice from the experts was not all sheep are the same, so choose wisely from day one. But once you’ve chosen the best quality stock, that is suited to your system, the advantages are wide ranging.

Speaking at Groundswell, former agronomist Jo Franklin runs Kaiapoi — a mixed sheep and arable business in North Herefordshire. The farm boasts 320ha of permanent pasture and 650ha of arable cropping, which her flock of New Zealand Romney occupy in the winter.

“Environmental Stewardship and SFI have opened the door to so many more options for farmers; integrating livestock is made for it. Being honest, it won’t solve problems like blackgrass despite some claims, but it massively improves soil life,” she said.

Jo explained her sheep rotate through the arable aspect of the business every other year and she believes doing so makes greater use of

products such as Unium’s Tiros (now marketed by Syngenta as Nuello Ni) due to the soil health benefits. She’s also been able to reduce applications of synthetic N.

New entrant sheep farmer James Edwards runs his flock across arable estates, grazing cover crops, standing cereals and herbal leys. He warned that arable farmers can’t expect flocks to come in and out overnight. It has to be worthwhile.

“The livestock has to come from somewhere, and for that you require year-round grazing. If you’re buying livestock yourself, be aware of what you’re going to do with those sheep throughout the whole year.

“If you’re seeking a grazer partner such as myself, there must be enough options locally to make transporting the sheep cost-effective. Making use of poorer grassy areas by planting cover crops and herbal leys makes it attractive to potential livestock partners,” he said.



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In terms of cover crop management, the panel stressed that sheep are a no-brainer, particularly when it comes to destruction, saving both glyphosate and fuel. “There’s always something left in those covers because sheep preferentially graze the blends. Then what remains is trampled into the soil as valuable organic matter,” said James.

nitrogen, boron, copper, manganese, and zinc. It's all down to a breakdown in how plants express these genes.

"But this also affects human health in the very same way, by altering the ability to be able to turn these genes on and off to build immunity."

Nicole explained that biology is releasing volatile organic compounds (VOCs) all the time to move through soil and water to communicate from plant-to-plant, plant-to-microbe and microbe-to-plant.

## Quorum sensing

"As a result, this plant can now synthesise plant hormones to respond to stress like flavonoids and defend itself. The key to all this is that the plant can't do this by itself, this communication happens outside of its roots. "Producing nutrient-dense food relies on a healthy microbial bridge and a healthy population of secondary metabolites.

"When a plant comes under some sort of pressure, it's going to signal to produce things like quorum sensing molecules, antimicrobials which allows a plant to defend itself, as well as phytohormones and VOCs."

Quorum sensing regulates the gene expression of certain types of organisms. "It's what plants and microbes use to coordinate group behaviours to either collaborate or compete with other species.

"When populations are small, microorganisms are unable to express certain genes, as full gene expression requires a strong community. As numbers increase, autoinducer signals reach a threshold and gene expression now switches on. An example of this in humans can be a sore throat in response to a streptococcus infection."

So what's the impact of this in agriculture? "There are now wheat varieties that no longer communicate with mycorrhizal fungi. Although the plant will grow, it won't have the same access to vitamins and minerals like phosphorus and zinc, and it won't communicate through secondary metabolites as the relationship has been interrupted," explained Nicole.

"So how a plant is grown or where you're sourcing your seeds is critical. Does it come from a system that is full of chemicals with a tiny or non-existent seed microbiome, or can you farm-save seeds that are more robust for your system?" she challenged.

"We're now learning so much more about the seed microbiome, which can set



*There was no shortage of bums on seats as attendees flocked to soak up the knowledge being shared at the festival.*

you up for success or failure, particularly as we start to move towards lower input systems. Some modern varieties are simply not adapted to thrive without inputs."

Nicole stressed the difference between commercially grown varieties and older varieties in terms of root systems and their ability to develop healthy, functioning and communicative rhizosheaths. "This can be the difference between a plant being drought, disease or pest resilient or not. Can this plant communicate with the microbiology beneath the soil?"

"We have focused so much on what is happening on top in terms of production. It's like breeding racehorses simply to run fast but forgetting they need good feet and a good temperament."

The ability to tolerate challenging environments comes through both phenotypic (short-term changes as an individual) and epigenetics. "Epigenetic changes passed down through

generations play a pivotal role in plant memory and priming plant defences to pests, diseases and climatic extremes. This in turn alters root exudates, as well as the expression and composition of primary and secondary metabolites."

As is so often stressed in regenerative circles, diversity is the key — both above and below ground. "The more diversity we see in the soil system, the more plants communicate with microbes, and the more microbes communicate back to the plant.

Nicole highlighted ergothioneine as a prime example. "Ergothioneine is an amino acid produced by fungi such as bollate, oyster and lion's mane mushrooms. All of these are full of this compound, and it's being dubbed as the 'longevity vitamin' or 'powerhouse nutrient'. Deficiencies have been linked to Parkinson's Disease, Alzheimers and overall reduced life expectancy.

"What's interesting is that ergothioneine ►



*With 6500 attendees this year, there was no shortage of things to investigate as Groundswell further expanded what was on offer.*



The festival vibes ramped up in the evenings as the thirst for knowledge turned into a thirst for beer and music.

► is a secondary metabolite produced by soil fungi and is then taken up by the plant. But research suggests if you till your fields, it simply disappears.”

One possible mechanism linking soil disturbance to reductions in ergothioneine uptake is the decline in the population of arbuscular mycorrhizal fungi, she added.

So does that mean tillage is always a bad thing? Not according to Nicole.

“Yes, you can till but you have to ‘earn the right’. How do we achieve this? By feeding fungi every time you’re in the field

and for every operation, think about how to feed the fungal biomass and how to encourage more and more diversity of the biology in the system.”

It’s questioning everything you do that Nicole explained was important. “Am I looking at my landscape and thinking ‘how do I get in sync with nature’, and ‘how do increase more vibrant life in my system’? If you follow these principles with every management decision, there’s a higher chance you’re going to be actively regenerating your soil.”

But that isn’t always the case, warned

Nicole, who believes glyphosate use is counterproductive to soil health. “A new USDA survey says cover crops are more popular than was earlier thought. Growers who responded to the survey say they’re using cover crops on 40 percent of their cropland in 2022.”. But they terminated these cover crops with glyphosate, so the use of the chemical also grew.”

She recommended thinking about how to achieve goals while all the time fostering microbiology.

“Maximising photosynthesis should also be a key consideration,” she added. “Your main role is to plug into the sun. How well is my plant capturing sunlight energy — do I have a diversity of solar panels to capture every piece of sunlight energy I possibly can?”

“What I’ve seen of the UK so far is that your photosynthetic rate of capture is very low, and I suspect that’s down to minerals and trace element availability.”

With that in mind, Nicole advised delegates to get their diagnostic hat on. “Why are my plants not capturing sunlight energy? It’s this sunlight energy pushing sugars out of the root zone is what drives the afore-mentioned benefits.” ■

## Bring your soil back to life



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