

Targeted diversity key to cover crop success

ALEX MILNER-SMYTH

SANTFA Executive Officer Alex Milner-Smyth used a \$5,000 Rural Youth Bursary to explore the management and impacts of diverse cover cropping in farming systems in the USA.

Her trip took her to North and South Dakota, Montana and North Carolina, with time spent on properties where cover cropping is well established and others where the farmers are developing a cover-cropping system.

This article highlights some of Alex's US experiences and observations. More detail is available in her trip blog, which can be accessed at www.ruralyouthbursary2013.blog.com.

Australian research indicates that anything growing over summer in the Australian wheat belt depletes moisture and nutrients needed for winter grain crops, but that is not the experience of US farmers growing diverse, multi-species cover crops.

They report better grain crops after these diverse cover crops, which can contain more than 20 species with diverse root systems and rooting depths, minimal weed problems and soil improvement and 'building' due to the bulk of organic matter produced. There are also consistent reports of good growth of diverse cover crops in hot, dry summer conditions in which mono-cultures die.

I would say you need at least seven or eight species as a bare minimum in a cover crop.

Almost all the people I spoke to identified weed suppression leading to a reduction in the use of herbicides as one of the top benefits of cover cropping. They attribute the reduction in weeds to the competition from the cover crops.

It is also possible to target specific weeds using allelopathy by including plants in the cover crop mixture that prevent the growth of specific weed species.

In North Carolina, where I spent time with Jay Fuhrer, a District Conservationist, they plant rye in cover crops to manage pig weed, which is a problem weed for them.

Jay took me to visit Manoken Farm, a government-owned trial site used predominantly for investigating cover crops. In one of the trials there a cover crop comprising field pea, cow pea, radish, soy bean and phacelia had been



ALEX MILNER-SMYTH FRAMED BY SUNFLOWERS ON MANOKEN FARM, NORTH CAROLINA. THE SUNFLOWERS ARE ON 760 MM ROW SPACING WITH A FIVE-SPECIES COVER CROP SOWN DOWN THE CENTRE OF THE INTER-ROW SPACE.

sown between sunflowers with the aim of harvesting the sunflower and leaving the cover crop to grow on to the end of the season. The paddock had been sown with alternating rows of sunflower and cover crop using a seeder set up for 380 mm row spacing, so the sunflower rows were 760 mm apart with a row of ground cover established down the centre of each inter-row space.

Jay explained that each species in the cover crop has a task, with some providing food sources for beneficial predators and parasitoids and the legumes fixing nitrogen for the sunflowers. The sunflowers provided shade for the cover crop.

Root size and type are also taken into account when developing a cover crop mix, or crop-cover crop combination,

with diversity again the key. Sunflowers and other plants with large tap roots help break up compacted soils, as do root vegetables. Other plants such as the phacelia, which has a fine network of horizontal roots, search for moisture and nutrients in the upper layers of the soil and support mycorrhizal fungi, which are critical in the exchange of sugar, water and minerals and essential in disease and drought resilience.

The presence of summer weeds proves that growing ground cover in summer is possible. It's just a matter of working out what suits summer growing conditions.

The main goal of cover crops is increasing soil health, and Jay was quick to point out that the more complex, diverse and extensive the root network of a cover crop, the greater the impact on the soil.

A combination of vertical tap roots and horizontal roots produces a 'three-dimensional' root network of a type and size a monoculture would never be able to achieve.



IF AT FIRST YOU DON'T SUCCEED ... NORTH CAROLINA FARMER JERRY DOHN HAD TO CHANGE HIS SEEDING TIME AND ALLOW HIS COVER CROPS TO GROW TO MATURITY TO ACHIEVE HIS OBJECTIVES OF MAINTAINING SOIL COVER, INCREASING SOIL HEALTH AND BRINGING LEACHED NITRATES FROM DEEP IN THE SOIL BACK UP TO THE TOPSOIL.

Jay believes that the broader the diversity of a cover crop mix, the more resilient it is, especially in a dry year.

"To me it's safer to go with a high number of species rather than pick out two or three species and try to achieve something. It's more forgiving when you have high diversity," he said.

He believes this is a key message for growers interested in having a go at cover cropping.

"For our first-time people we try to keep the area low but the diversity high".

Jay, who has also worked extensively with farmers implementing no-till systems, took me to meet a young couple, Todd

and Penny, who have recently bought a 315 ha property and are developing a cover-crop system.

When I was there they had 65 ha under diverse cover crop, which was planted at the height of summer and despite minimal rainfall was thick and two metres high in places. Their cover crop mix included sorghum, sedan grass, millet, soybeans, oats, field peas and sunflowers; all warm-season species except for the oats, which survive in the shade provided by the taller plants.

This cover crop, which was due to be bailed for feed soon after my visit, cost about \$90/ha to establish and was sown without fertiliser.



THIS CROP OF CORN, SOWN DIRECT INTO COVER CROP RESIDUE THAT HAS BROKEN DOWN AS THE CORN CROP HAS DEVELOPED, IS EXPECTED TO YIELD EXCEPTIONALLY WELL.

Jay suggests that in the early stages it may be necessary for growers wanting to establish a cover crop in wheat stubble, especially on degraded soils with a history of low diversity, to provide some fertiliser to counter nitrogen tie up due to the large amount of carbon in the straw, but this is just an initial measure to get the ball rolling.

“Once the nutrients are cycling, there’s no need to add fertiliser.”

A combination of vertical tap roots and horizontal roots produces a ‘three-dimensional’ root network.

All the farmers I met with Jay talked about being more satisfied and happier since changing to a cover-cropping system. They also expressed a sense of relief that they now see their enterprises as being more profitable and resilient.

Mike, another of Jay’s clients, said farming was now ‘fun and enjoyable, and we’re not throwing out as much money’.

However, he was quick to point out that his system works for him because the changes he made were custom-designed for his property and enterprises. “I’ve been to a lot of soil health workshops and the way I see it, this will work for me but the same approach won’t work for my neighbour”.

Jay agrees. “The principles to improve soil health are universal, but the road is different for each grower depending on their system”.

Mind set is important too. “Whether you think it will work or you think it won’t work, you’re right either way”.

The first step in the process Jay uses when designing a cover crop program for a grower is to identify the issues. “We identify the resource concerns, then you start to cook”.

In the case of Jerry Dohn, another client, that process included taking account of what the grower wanted to achieve from cover cropping as well as the features and limitations of the enterprise.

Jerry wanted to build soil cover, increase the soil health of his high-leaching sandy soils by improving soil organic matter and bring leached nitrates back up from deep



GABE BROWN, KEYNOTE SPEAKER AT LAST YEAR’S SANTFA CONFERENCE, CHECKING CONDITIONS ON HIS HOME PATCH, WHERE HE DESIGNS DIVERSE COVER CROPS TO FEED HIS CATTLE AND THE SOIL BIOLOGY. GABE AIMS FOR COVER CROP SPECIES WITH A DIVERSE MIX OF ROOT STRUCTURES AND OFTEN INCLUDES SPECIES NOT PALATABLE TO THE STOCK TO ENSURE PLENTY OF RESIDUAL VEGETATION TO BUILD SOIL ORGANIC MATTER AND FEED THE SOIL ORGANISMS.

in the soil to shallower layers where they would be more readily available to post crop and pasture plants. He also wanted to provide feed for his cattle and needed a cover crop that wouldn’t grow too high so hunters could shoot over his land.

The more complex, diverse and extensive the root network of a cover crop, the greater the impact on the soil.

His initial efforts were not very successful, but ‘tweaking’ the system by seeding later and allowing the cover crops to grow to maturity improved the outcomes and he now grows 160 ha of cover crop a year.

This year his cover crop ‘cocktail’, designed specifically to improve soil health and provide high-nutrition cattle feed, contains 12 species including millet, grazing corn, sorghum, sedan grass, cow pea, soy bean, clover and sunflower. Seed for this mix,

which was sown without fertiliser in mid summer, cost around \$70/ha.

Having year-round soil cover has significantly reduced the rate of erosion which plagued Jerry’s his sandy soils in what is a notoriously windy area, and he believes cover cropping helps store rainfall. “It sure helps on the moisture. Whatever you get, at least it’s not evaporating out as bad”.

None of the growers I spoke with reported a reduction in the amount of soil moisture available after a cover crop, and many of the formal studies, including some by Jay Fuhrer, show that, in dry years, cover-cropped paddocks produce far better grain crops in the following winter than summer-followed paddocks.

That is at odds with the Australian understanding that summer growth reduces moisture and nutrient resources for following crops, although from another perspective, the presence of summer weeds proves that growing ground cover in summer is possible. It’s just a matter of working out what suits summer growing conditions.

Jerry's success with cover cropping can be attributed to the careful consideration of the resource issues, enterprise features and limitations that enabled design of a cover-cropping approach that was able to address and correct the issues identified and fit into the rotation without creating a need for great expense or increased labour.

His persistence and flexible attitude to cover cropping were also important factors. Instead of giving up when it didn't work initially, he tweaked the system by changing to later seeding and leaving the cover crop in the paddocks to grow on for longer. And facing a \$25/ha increase in seed cost this year, he reconsidered his plant choices and amended the cocktail to keep the price reasonable.

The principles to improve soil health are universal, but the road is different for each grower depending on their system.

On Gabe Brown's North Dakota property I saw a cool-season cover crop mix sown for grazing by cattle. Most of the species in the cover-crop combination, which included grazing sorghum, grazing corn and kale, had been selected for their palatability and nutritional values but the mixture also included safflower, a prickly plant cattle won't eat, to ensure plenty of residual vegetation to build soil organic matter.

"We need to feed the stock, but we have to reserve adequate cover to feed the soil too," Gabe said. "I have to leave that much to feed soil biology, otherwise we will never have enough to keep this system going".

He considers 'enough' to be one third for stock and two thirds for the soil.

"Most producers will graze their pastures to the ground, then wonder why they don't have any litter on the soil. This paddock will not be grazed again, and by next year the residue will have decomposed. There won't be anything left, and we'll seed straight into it".

For Gabe, the secret to concocting cover crop mixes is diversity of species.

"I would say you need at least seven or eight species as a bare minimum in a cover crop. And it's important to ensure a diverse mix of root structures and to include grasses, broad leaves and brassicas in each mix."

Restoration of soils is a big focus for Gabe.

"The thing I try to impress on people is that we all have a degraded soil resource so we need to regenerate the soils and this, in my opinion, is the fastest way to do that – with multi-species cover crops, livestock integration and a lot of diversity".

Soil tests indicate he has been successful at increasing soil health. In 1993, soil organic matter levels on his property were

between 1.7 and 1.9%. Today they are around 5.3 and 6.1% on crop land and 7% on native pasture.

Improving the soil health of his farm has significantly increased the viability of Gabe's farming enterprise.

"I don't write cheques any more. We don't use fertiliser, we don't use any pesticides or fungicides. We only use a herbicide pass every two to three years when needed".

Because his input costs are so low, producing revenue from each paddock every year is not necessary.

"Even though we're not growing a cash crop every year, the net dollars are way better than if I was buying all the inputs needed to produce a grain crop each year".



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