WANTFA
Western Australian No-Tillage Farmers Association (Inc)
GRDC
PP 634505/0010
ISSN 1329-7600
Farming Systems
SUSTAINABLE AND HIGH PRODUCTION AGRICULTURE — NOW!
JANUARY 2002 · VOL 10 NO. 1 · PP 477–496

Wide row lupins work!

Much to the surprise of some, wide rows in lupins and other pulses can produce good crop yields.

Above: Lupins gave full canopy closure when sown on 1 m rows at the high seeding rate.

Below: Lupins sown on wide rows performed best with residue managers.

THE lupins on 1m rows at Meckering (pictured top in mid-October) actually closed the canopy by the end of their growing time. However, this was only at the high seeding rate of 70 kg/ha. The 35 and 17 kg/ha seeding rate treatments were poor in comparison. This is a warning to those who think that wide rows might mean low seeding rates.

continued over…

There are more lupin pods growing on the north side of the lupin row that on the south side (north is to the left).

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The lupins produced 6.5 t/ha of dry material on this wide row trial and their grain yield was 1.9 t/ha. See 'Wide rows for lupins' inside for more information. Note that trial work by Ron Jarvis and Glen Reithmuller (Department of Agriculture) in the early 1990s showed that 36 cm lupins yielded as well as normal spaced lupins.

There have been a lot of researchers and farmers experimenting with wide row pulse crops in the last couple of years with very encouraging results. These results will be a hot topic of discussion among farmers and researchers at the coming WANTFA Conference.

The 10th Annual Conference

The CSBP WANTFA Annual Conference will feature three speakers on various aspects of these wide rows. Dr Warwick Felton has been researching pulse crops on wide rows for many years in northern NSW. Farm Focus Consultant at Northam, Mr Geoff Fosbery, has been encouraging his farmers to dabble with this approach with success. NSW farmer Hugh Ball has been using BEELINE technology for several years achieving straight and wide rows with ease.

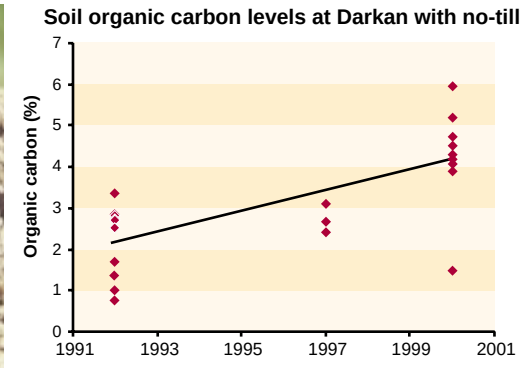
Dr Warwick Felton (far left) and Dirceu Gassen will be among the interesting line-up of speakers for the 2002 CSBP WANTFA Annual Conference.

The Conference is at Rendezvous Observation City on 14–15th February 2002 in Perth and a summarised version will be held on 12th February at Katanning. See the pamphlet inside for more details. Please note that we will also have the dynamic Brazilian entomologist Dirceu Gassen, the pioneer of no-till in the Central Great Plains (Nebraska) Gail Wicks, the clear-thinking Dr Nigel Wilhelm from South Australia and some 'think different' philosophy from Dr John Williams of CSIRO in Canberra.

Organic matter increases with full stubble retention

Long-term no-tillers Ray Harrington from Darkan and Geoffrey Marshall from Hyden have observed good improvements in soil organic matter through long-term no-till. Interestingly, this improvement comes despite them using some stubble burning. See Ray's story inside and come and hear him talk about it at the Conference.

The soil becomes alive with a history of no-tillage.



Geoffrey has been sampling his soil with a dGPS and has been able to show good soil organic matter improvements over the last 5 years. He began no-tilling in 1992. Ray has been no-tilling for 18 years but, about 10 years ago, his organic carbon levels were about 2.0%; the levels are now about twice this. The data taken from the graph above is from three paddocks only.

This story has important implications for greenhouse gases and is talked about at length at no-till conferences all over the world. Can you contribute data to this issue? You can contribute by sending your soil test results in—dGPS would be best, but other forms of information will still be useful.

Summer floods—what can we learn?

Summer rains happen too often and these are probably the biggest uncontrollable contributor to salinity and recharge. Some farmers on the South Coast and in the Great Southern had over 200 mm of rain in early harvest 2001 (just gone), not to mention Esperance which has now had three wet summers out of the last four.

We need agronomic knowledge and the ability to respond quickly to turn pain into profit. Could sunn hemp do this for us? Subclover is too shallow-rooted and averse to heat to be of much value after these rains. Could Cadiz do the job? Perhaps after this summer we will have the answer to that question.

Many farmers throughout the state have been able to try sunn hemp *(Crotalaria Juncea)*, thanks to the innovation of Albany agronomist Wayne Smith who has bought two batches in recently. It is a warm season legume that is drought tolerant and has so far (as at mid-December 2001) performed well in a Meckering acid sand and a red soil at Northam during the current summer. See our website for more information.

Sunn hemp handles drought (top right) and heat and can fix nitrogen for minimal cost. The plants can grow 1.8 m high given enough water. Here at Meckering they have had little moisture as you can see (right).
Below: Sunn hemp (on the right side) and forage sorghum (left rear of the photo) sown at 10 kg/ha at Meckering and sunflowers (on the left side) sown at 50 kg/ha.

Wide rows lupins and N distribution

Several people have asked "with wide rows, won't all the N be located in the rows?" The answer is no! Most N from the lupins is in the leaves which tend to fall evenly over the soil surface—see photo right.

Very little N is in the plants' roots—even though that is where the nodules are. As an analogy, most seeders are on farms—not in the factory where they are made. The N gets transferred into the tops, including the grain, and much is thrown out the back of the header—also reasonably evenly—hopefully!

Right: The lupin leaf material containing much of the plant's remaining N falls evenly over the whole soil surface.

Wheat droughts on the crop's edge—now to yield only 300 kg/ha of crop.

Rip the edges of crops—good money

As one Esperance farmer once said, "the easiest fishing money in the world comes from ripping next to tree lines".

Note the severe drought stress from the shallow tree roots on the edge of the crop. Ripping at 30–50 cm deep for a day or two around your boundary could return $5,000—as they say…"too easy!"

Blanket applicator can be selective

Blanket applicators have the ability to take out tall radish and wild oats while allowing desirable sub-clovers to keep growing and fixing more N and setting seed without damage. Extra legume growth in late spring is invaluable.

So often the window for pasture topping is too small to allow good legume growth before a knockdown needs to be applied. With this selective tool the late rains will allow the legumes to grow more—rather than give the weeds a chance to revive—or give the melons a healthy start to summer.

Wild oats and radish are good tall targets in spring.

Pasture topping also upsets legume seed set and can soften the seeds too much. This blanket applicator allows the use of cheaper broad-spectrum herbicides, like Glean, to be added to the mix to give quick weed death and flower abortion. See South Australian farmer Michael Richards' article on his foam wiper approach later in this issue .

More on South America

South American farmers believe that disc no-tilling is the only way to go. For 26 years they have been using discs and they feel that knife-points disturb too much soil. Many south coast farmers would agree, I know.

This plaque has been placed on Brazilian Franke Dijkstra's farm (diretoria@coopbatavo.com.br) in 1986 to celebrate 10 years of no-till. See Australian no-tillers in the axial hole.

Manoel Pereira

Manoel Pereira, President of CAAPAS (Confederation of Associations of Americans [Latin speaking] for Agricultural Sustainability) shared with the 35 in the Australian Study Tour group the joys and sorrows of no-till. Manoel said when no-till first started many people were critical. When there came a problem all the critics were quick to say "we told you so—it won't work".

Manoel is passionate about the exciting chapter of agriculture no-till has given farmers in Brazil—this shed is a no-till museum on his farm.

The determined no-tillers and scientists pushed through and found a solution and another honeymoon period followed. This cycle has continued 5–6 times up to the present day. Manoel now says there are less critics these days—most people know the system has saved billions of tonnes of Brazilian soil and produced much needed agricultural sustainability.

Jim Kirkwood is the fearless WA explorer of central Brazil. He will speak of land clearing at the coming WANTFA Conference. (Here he is pictured being assisted onto one of our many plane flights by airport staff after hurting his ankle.)

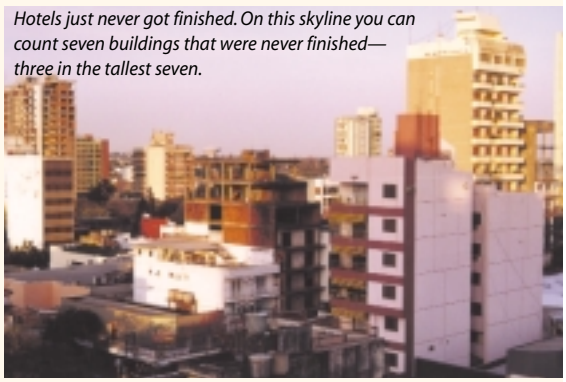
Cheap grain storage —Argentinian style

An Argentinian company called IPESASILO sells plastic sleeves to farmers to help with quick and cheap short-term on-farm storage. The plastic seals properly and does not allow air to get through. The grain respires a little until the carbon dioxide level builds up and this kills insects and inhibits bacterial or fungal activity. Send them an email for more info [ventas@ipesa.com.au].

Plastic sausages wrap the grain and preserve it at high moisture levels—cheaply.

Argentina struggles economically

Argentina is a strange mix of prosperity and poverty. It was as wealthy as Australia in the 1950s. Their agricultural land is very fertile—the rich Pampas plains and lots of rainfall. In about 1990 inflation reached a massive 30% per day and people would trade more in $US than in their own Peso currency.



Hotels just never got finished. On this skyline you can count seven buildings that were never finished—three in the tallest seven.

Warm season crop progress

Mo deficiency in sunflowers

Sunflowers are sensitive to molybdenum deficiencies and we have now observed this at Kojonup this year. Neil Young's sunflowers began to go yellow in patches of the soil. Neil applied Mo and then soon after received lots of rain. The deficiency symptoms then faded.

Stunted yellow sunflowers at Kojonup show Mo deficiency.

Sorghum relay cropping

There is a delicate balance required, in dry WA, to make relay cropping work. The idea is to grow one crop and then part-way through its growth you plant another. The first crop might be killed part-way through its growth—as a cover crop for soil reasons—or may grow on as a cash crop. Two cash crops can be done without compromising yields in wet agricultural areas.

Relay cropping on display at Meckering.

These sorghum rows (shown in the photo) were planted on the Meckering fault-line after the lupins were sprayed out in late September. Where the lupins were allowed to continue their growth, there was almost no sorghum established.

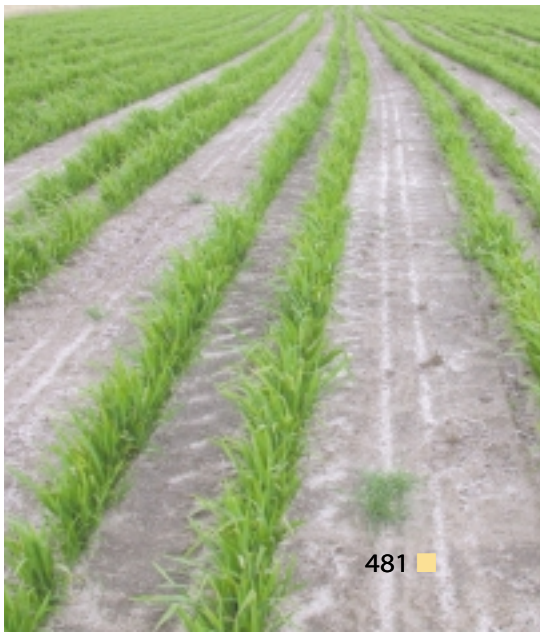
Gmeiner's millet

Nuffield Scholarship winner Murray Gmeiner from Wagin will be travelling the world to learn more about these warm season crops. Many such crops are enjoying the early December rain. For progress on some of these crops check out our website.

If you have a digital camera, or you can scan photos, feel free to email pictures to matt.beckett@wantfa.com.au.

Please make the images no bigger than 150 kBytes.

This millet, located about 4 km east of Arthur River has soaked up the December rains (photo taken 7th December). Note the ryegrass growing quite happily into summer.



From the President

Neil Young, Kojonup (08) 9821 0026, fax 01

WANTFA has always pushed the farming system beyond the accepted practice, and in doing so has established new standards for agriculture in WA.

Your committee has decided to take the next big step toward sustainable farming for the benefit of all members and ultimately the whole community. Many issues have been solved since the formation of WANTFA, but there is still one that has been there from the beginning—successful stubble retention.

The stubble challenge

We have therefore decided to focus our efforts on tackling stubble retention. To date, some members have been successfully keeping all their stubble, while many find it necessary to remove some if not all stubble before seeding some of their crops. The removal is done by grazing, baling, raking and burning windrows or just burning the whole paddock. This is done to many members' great frustration, for the acknowledged benefits of retained stubble are outweighed by the difficulties that come with it—either mechanical or nutritional.

Experience elsewhere in the world has shown that truly sustainable farming is based on maximum residue retention. WA will be no different! The retained residue maintains and even increases soil organic matter levels under continuous crop. Organic matter is a key driver of soil life and soil health, providing a buffer against nutritional deficiencies, and enhancing moisture-holding ability.

In WA it has been frequently and uncritically accepted that cropping inevitably causes a decline in this organic matter, yet we have members who have gone against conventional wisdom and reversed this trend. We wish to build on the experience already gained in order to remove the obstacles to full stubble retention.

New GRDC proposal

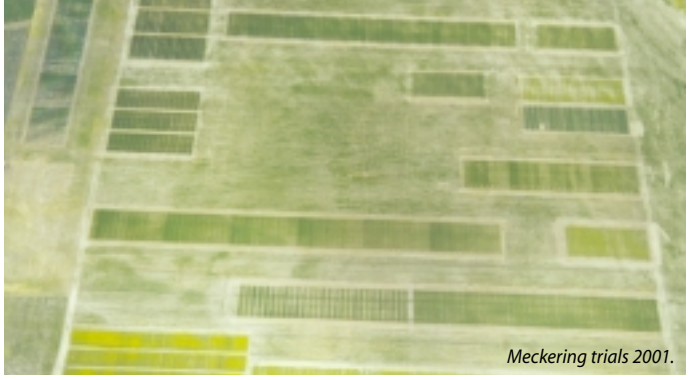
With this in mind we have put a proposal to GRDC that we should be granted sufficient funds to allow us to employ an agronomist who will focus on this issue. We are proposing it be a collaborative venture, working closely with farmers, CSIRO, Ag Department and commercial industry. This Association is an excellent network for sharing knowledge, which will be used to tackle the problems and also pass on that information as quickly as possible.

No-till has provided an enormous benefit to the grain growers individually and the grains industry collectively, and we believe similar significant benefits will arise from overcoming the residue retention problems.

The likely scope of investigation will include both mechanical and agronomic issues—from investigating residue managers to exploring new crop species that are not adversely affected by the retained stubble of the previous crop.

WANTFA works

We see this work being in addition to our present activities. There is a demand for information and short term problem solving by farmers that is not going to go away. This will require the continuation of field days, field walks, conference and our *Farming Systems* newsletter.



Meckering trials 2001.

The Meckering trials and demonstrations site is now the venue for the State's best agronomic practice days.

Your Association now has a membership of over 1,300, making it the most significant grower agronomy group in WA, in addition to its influence across Australia through interstate memberships and affiliations. If we are successful with the GRDC application, we will harness this strength for our collective benefit.

The GRDC has been instrumental in enabling WANTFA to achieve what it has to date, and we hope they will again see the wisdom of enabling this work to proceed.

WANTFA wishes to acknowledge the generous assistance of:

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No-till 'brain transplant'—Beck style

Ben Hobley, 'Mindarabin', Nyabing (08) 9828 5054, fax 89

I was fortunate to spend 15 weeks working with Dwayne Beck at Dakota Lakes Research Farm earlier this year as part of my study at Muresk. Having seen Dwayne speak at the 2000 WANTFA Conference I was keen to learn more about his innovative approach.

I emailed Dwayne and asked if he could use an extra employee for a few months, and he took me on board. I left WA during a hot, dry summer to arrive in a white and very cold South Dakota winter!

There was not much to see apart from snow for the first few weeks, so we spent our time working on, and talking about, the 'concept seeder'. Anybody who attended the 2000 WANTFA Conference would have seen a video of this. Any article of this length cannot do justice to Dwayne's concepts.

When I first joined WANTFA in 1995, I saw no-till as simply bolting a set of knife-points on and using more herbicide for weed control. Experienced no-tillers will know that such an approach is inadequate, and many other changes accompany the adoption of a no-till system. It is this systems discipline that I regard as being at the heart of Dwayne's approach, and the basis for my 'brain transplant'.

Ben Hobley—making the most of his time with Dwayne.

No-till is a system!

Dwayne insists that no-till is a system, and the system must be adopted in whole for maximum results. The occasional bit of recreational tillage or autumn tickle is seen to be inconsistent with a no-till system that aims to beat weeds by not allowing them to germinate in the first place. The adoption of a no-till system at Dakota Lakes has resulted in less weed pressure and, in some cases, crops have been grown without the use of any herbicides at all, contrary to my initial views.

Give the crop the advantage

Dwayne manipulates the environment of the plants as much as possible to give the advantage to the crop. Seed and fertiliser placement and residue management are critical parts of this approach, and the development of the concept seeder has occurred to try and achieve this. The main purpose of the machine is to demonstrate to farmers new ideas so that this can pressure manufacturers to incorporate them into their machines *(Ed: The concept seeder was featured in* Farming Systems*—then the* WANTFA Newsletter*—in September 2000, page 344).*

Some of the features of the concept seeder at the time I was there were:

- **Paired rows**—to maximise competition against weeds between close rows, while wider areas allow moisture conservation and airflow for disease control.
- **Residue management**—Dwayne has done a lot of work on residue managers so that residue can be moved off the narrow area and into the wider area where it has toxic effects on weeds, without disturbing the soil in the process.
- **Fertiliser placement**—fertiliser can be placed with the seed, banded to the side of the seed, or placed above the seed as the furrow is filled. At any time 2–3 bins can be devoted to the fertilisers, allowing N and P (or any other nutrient) to be placed in any of these position separately.
- **Seed placement and singulation**—gauge wheels alongside the disc allow for precise depth control. Press wheels will press the seed into the bottom of the trench (Buffalo one) rather than the dirt on top of it. A closing wheel then fills the trench with loose dirt (Buffalo two) that facilitates easier emergence of the shoot. Case Cyclodrums are used that allow seeds to be planted individually with a consistent spacing between each seed along the row.

Dwayne Beck—the secret of his success—he watches closely and changes accordingly.

Are knife-points really no-till?

I was surprised to see that few farmers in South Dakota use knife-points because they cause too much disturbance and germinate weeds. Knife-points do not build soil structure as quickly as discs because they expose too much organic carbon to oxygen, which releases it. Most farmers regard knife-points as minimum or direct drill, rather than no-till. Dwayne aims to replace tillage with competition, sanitation and rotation.

Diversity and intensity

Rotation in particular is given a lot of attention, with long-term rotation trials having been run for the last 10 years. Diversity is seen as essential. Diversity makes it difficult for weeds, insects and disease to survive until the next time the susceptible crop is grown. In South Dakota they have the advantage of warm season crops to extend their rotation, and this is why we need to develop these crops here.

Intensity of the rotation is also important so that as much water as possible is used, while being careful not to use too much. Again, warm season crops are essential here as they create the opportunity to use 'out of season' rainfall when necessary. The only salinity I saw in South Dakota was near an area under long-term irrigation, which Dwayne suggested was due to insufficient rotation intensity. Anybody that attended the WANTFA 2000 Annual Conference will remember Dwayne suggesting that native vegetation was a good guide to intensity. Our native vegetation includes trees that use water all year round, so that is what we need to attempt to mimic.

Dwayne Beck checks for the right seed depth.

It is interesting to note that Dwayne first began using no-till to reduce run-off under low pressure irrigation systems which produced large, damaging droplets when compared to high pressure systems. We use no-till to conserve as much moisture as possible where water is the most limiting factor to crop production. The ability of no-till to produce results where there is both too much and not enough water proves the versatility and robustness of this system.

Other ideas

There were many other concepts and ideas being trialled by Dwayne and his staff, including:

- **Cover crops**—for water use and disease management, and to stimulate soil biology.
- **Switchgrass** —trials were being done to evaluate the potential of this grass to produce biomass for conversion to a fuel source.
- **Seed coatings**—to allow delayed germination. Some seed coatings claimed to be temperature sensitive, so that germination may only occur when soil temperatures were correct for that plant. These were most useful for relay cropping, where one crop is planted before the other is harvested.
- **GPS**—John Deere guidance and field documentation systems were trialled in an effort to simplify record-keeping by automation. This technology could be very useful for Quality Assurance programs.

Getting the best from no-till

Dwayne's commitment to the no-till system was very refreshing, and he challenged many of the ideas that I had taken for granted. My experience at Dakota Lakes has made me even more enthusiastic for the potential of no-till farming to increase production and facilitate sustainable agriculture.

The no-till system is a dynamic one that is evolving with farmer and researcher innovation, and I believe many exciting things lie ahead for WA, thanks to groups such as WANTFA who continually promote and research new ideas. To quote a South Dakota no-tiller (who I think was quoting Mark Twain): "You can be on the right track, but you will still get run over if you stand still".

Diamond back moth control

Wayne Smith, Albany consultant (08) 9842 1267, www.agronomy.com.au

Ed: This story was extracted and edited with permission from Wayne Smith's monthly Agronomic Newsletter.

The Diamond Back Moth (DBM) has been in canola ever since it was grown here, so why the severe problem now? I believe we need to ask:'What have we done that allowed the opportunity for DBM to be here?' They are only here because we gave them the opportunity.

DBM must survive on live hosts, like aphids do. Therefore, two of the best insecticides available are Roundup and SpraySeed—the removal of its hosts between now and April is vital. They cannot build up if there are no host plants to feed on. We should not make it easy for them.

DBM have been well researched around the world and in Australia. Much is known about their life cycle and effective insecticides. SP insecticides (like Cypermethrin) should be one of the last options used in control programs. We have made a rod for our own backs by using repeated applications of Cypermethrin. There are much better chemicals available. The first control, however, needs to be removing its host plants over summer—radish, turnip, mustard, and self-sown canola.

Effective insecticides

The following chemicals are not registered on canola, but registration should not be complicated since they are registered on similar crops in Australia. Spinosad (eg. Success® at 400ml/ha), BT sprays (eg. Delfin® at 500g/ha), Fipronil (eg. Regent® at 125–250ml/ha but in other countries as low as 62.5ml/ha is registered), chlorfenapyr (eg. Secure® at 400ml/ha), and emamectin benzoate (eg. Proclaim® at 250g/ha).

You may already know Spinosad as a fly control chemical in the product called Extinosad®.There are several other insecticides with activity on DBM, one being Nitofol® (1.1L/ha) and another called Tokuthion® (1.5L/ha), but I am not sure if these will ever have canola on their label.

There are of course the chemicals you do know about, like 1.5L/ha of Lorsban (Chlorpyrifos), 400–500mL/ha of various Cypermethrin and Deltamethrin types, 2.1L/ha of Endosulfan, and Marlin (methomyl at 1L/ha).

Mixtures and rotations

Mixtures of Chlorpyrifos and Cypermethrin are likely to provide better control than either one alone. I have heard of success with 300mL/ha of each product. That is no surprise knowing how well those two insecticides work together on other pests—they are very synergistic together.

However, Avcare and other researchers in 1997,do not favour these chemicals. Instead, they suggest periods when other chemicals should be used. In southern Australia (NSW, VIC, TAS and SA), for horticultural purposes, Secure® (chlorfenapyr) and Success® (spinosad) is encouraged from 1st September to 31st January, whereas Regent® (fipronil) and Proclaim® (emamectin benzoate) are encouraged from 1st February to 31st August. The principle of rotation is relevant for BDM where the first product might be Success® (Spinosad), and a later spray, if needed, with another insecticide. This helps stop insecticide resistance from building up in the population.

Spinosad (found in Success®) is expensive but it sounds like a great product in that at 400mL/ha it controls DBM larvae very well and is a new chemistry group. Even better, it does not harm most of the predators, thus extending its effective control. Using some expensive insecticides may still be economical compared to losing your expensive crop.

Summary

Do not be hasty in dropping back canola areas due to DBM. There is plenty of knowledge and better chemicals available on how to control this difficult pest.

Some of the chemicals mentioned above will be given either a permit to be used on canola next year or will have canola added to the label. Hopefully, some prices will also decrease to match broadacre rather than horticultural pricings.

Warm season crop field days in February

Bill Crabtree, WANTFA Scientific Officer
(08) 9622 3395 p/f

During WANTFA's Conference we will hold several field days on warm season crops. These events will involve the interstate and international guest speakers as well as some local WA talent (including the farmers we will visit).

All WANTFA members are welcome—please encourage non-members to join up and come along.

The touring bus group will include Dirceu Gassen, Warwick Felton, Nigel Wilhelm, Gail Wicks, Hugh Ball, members of the WANTFA Committee and some local agronomists.

The bus will leave Perth on Sunday 10th February in the afternoon and will return to Perth on Wednesday 13th in late afternoon—after our Katanning Conference. Some spaces may be available on the bus. Please fax me if you are interested in joining us. (There will be a nominal charge and you will need to cover your own accommodation costs.)

Monday 11th February

We will start at Owen Brownley's farm at 8:30 am, 20 km SE of Lake King. Then we will travel to 6 km west of Newdegate (on Lake Grace Rd) for an 11:30 am start and meet at David Butcher's on the north side of road—look for Mallee Fowl road sign. At 2:30 pm, we meet at Barry Gray's farm at Kukerin and then onto Phil Bairstow's farm at 4:30 pm at Dumbleyung. Call me if you, or we, get lost on 0427 223395! We will finish the day in Katanning—ready for the Conference the next day.

Wednesday 13th February

Today we begin at Neil Young's, halfway between Katanning and Kojonup at 9:00 am. The bus will then head towards Perth looking for green patches on the way. Feel free to follow us.

After the Perth Conference there is a possibility of further field days north of Perth—this will be decided at the end of the Conference.

Weed wipers in South Australia

Michael Richards, 0427 547 052 or RichardsM@bigpond.com

Following a trip to USA and Paris with the Kondinin Group in February 2001, I have been importing, selling and hiring out weed-wipers in South Australia.

The unit we are using is a Smucker sponge wiper from the USA, chosen as it seemed to be the most effective. The sponge wipers apply higher rates of chemical with less dripping than other wipers.

The wiping concept has proven extremely successful. Conditions are ideal when there is a 6 inch height difference between the target weed and the crop. The sponge wipers are best operated at 11 km/h. Wipers allow low rates of herbicides to be applied directly to target weeds with spray drift and herbicide residual problems being minimised.

The first units we made for hire were 15', 60' and 80'. These units have done thousands of acres in SA this year and the results have been fantastic.

We have also sold sponge kits to others who have made up their own booms.

A small 5 foot wiper has been used around trees for weed control and a variable width unit has been supplied to be used for weed control in vines.

It is important the nets protecting the sponges are maintained to maximise the life of the sponges.

We have since installed a larger tank, altered the tap layout on the booms, and are now feeding the sponges with a 12 volt pump.

We plan to install hydraulic height adjustability on the boom outrigger wheels to improve ground-following ability. The wipers have been mainly used in lentils and pastures but we also plan to use them for summer weed control.

Herbicide mixes

Experience suggests herbicides that translocate are most effective for use with wipers.

Glyphosphate has been mixed at the rate 1 L of herbicide to 3 L of water plus wetter. Ally and Eclipse have also been added for different broadleaf control. Basically we are using the normal broadacre hectare rate of chemical to 3L of water.

When grasses are the only weeds needing controlling 200–300 mL/ha of glyphosate is used. When broadleaf weeds need controlling usually 500–800 mL/ha of mixed solution has been used with up to 1.5 L/ha with heavy weed infestations.

Please note that Goal is incompatible with the plastics used. Nufarm have provided Tillmaster herbicide for trial evaluation with wipers, which may provide improved broadleaf control.

SA Consultants recommend them

For further information contact Bill Long, Trevor Dillon, Allan Mayfield, Mick Faulkner or Peter Cousins. They have strongly promoted the use of weed wipers and their clients have been rapt in the results.

The wipers have provided an additional option for weed control—the use of low cost, nonselective herbicides has many advantages in the farming operation.

Cost

The kits are about $90/ft and the sponges are in 5 foot sections. The complete 80 foot boom costs around $20,000 with a double sided blob dobber. A 12 volt powered hydraulic lift and a 12 volt pump to wet the sponges are included.

This is the 19m Smucker sponge wiper.

Soil quality indicators for WA farmers—Part 1

Nui Milton, Matt Braimbridge and Daniel Murphy, 9380 1884 (or 2494),
Centre for Land Rehabilitation, The University of Western Australia

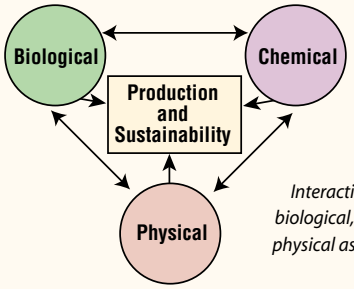
Soil quality indicators are invaluable to help assess the biological, chemical and physical aspects of soil health. Here we will attempt to demonstrate why they are important.

What are soil quality indicators?

Perhaps we could say they are the equivalent to human blood pressure and cholesterol readings and they give us vital information about how the soil is faring. We are identifying indicators that relate to crop yield and/or soil sustainability. It is important to address all components that might indicate what a healthy soil is, including biological, chemical and physical aspects.

Many of these indicators include organic matter aspects since these have a strong influence on soils' biological, chemical and physical fertility. Also, the organic matter fraction is sensitive to changes in management practices.

Such tests could be used by commercial soil testing labs. If adopted, these indicators would give a more holistic soil analysis and the data would help farmers to make informed soil management decisions. It is clear that there is a strong and dynamic link between all aspects of soil fertility and sustainable production (see diagram below).



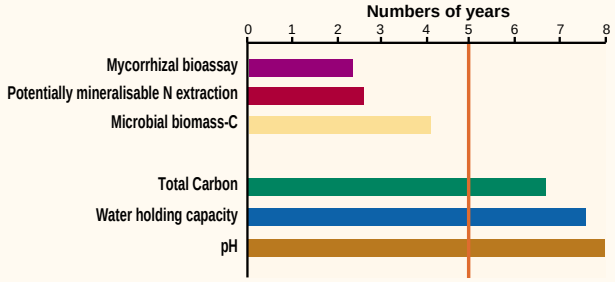
Interaction between biological, chemical and physical aspects of a soil.

Indicators to assess best management

Numerous management practices including no-tillage, improved rotations (including warm season crops), brown manuring, and various soil amendments are being promoted in an attempt to increase soil fertility and maintain crop production. But how do farmers know if these management practices are improving the soil?

The formation of farmer groups enables affordable generation of regional field trial results and provides a 'safety net' for farmers. If the management practice does not work, then farmers have not lost money by hasty adoption. Until now these trials could only rely on basic soil testing and yield monitoring to assess for differences.

We have been applying our soil quality indicators to a range of farm-based trials throughout WA to determine which results can be assessed. Because these trials may have a life of about 5 years we have been screening for measurements that can detect differences within that time. The tests are time sensitive to treatments (see bar chart below for sodic grey clays). Biological measurements are more sensitive to changes in land management than chemical and physical ones. This suggests that the biological indicators will be very useful in monitoring management programs.



Number of years required for 6 measurements (3 biological, 3 chemical/physical) to detect significant differences between management options assessed on a grey clay soil (Sodosol).

In 2001 we worked with the Morbining, Bally Bally, South Mortlock and Mackie Catchment groups. Now we hope to initiate such programs in association with WANTFA's clay trails, the Kondinin Group and the Liebe Group, plus other active catchment groups who wish to understand more about soil quality. Our goal is to develop regional specific values for each soil quality indicator.

An example: The microbial quotient

The microbial quotient is the ratio of microbial-Carbon to total Carbon (expressed as a percentage) which reflects the microbially 'alive' proportion of the Carbon. Generally, the higher this ratio, or percentage, the better the soil's biological fertility—which means more activity to cycle plant nutrients and to fight plant diseases.

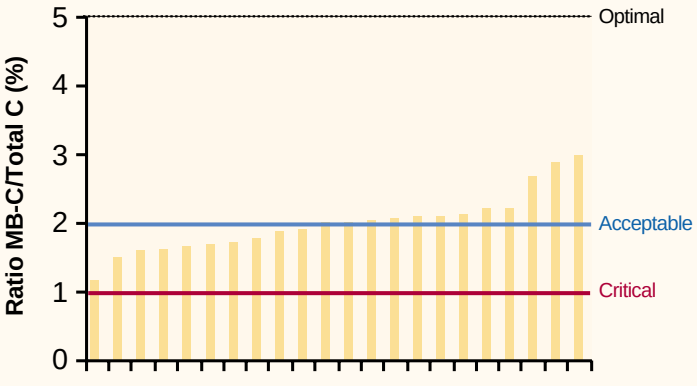
Many soils worldwide range from 1–6% microbial quotient, with the higher numbers being from the more fertile soils. WA soil tests often have low values (see graph below—taken from sodic grey clays at Katanning) in microbial activity. Previously, the microbial quotient has not been promoted in WA as important in management practices. However, this work and the expansion of soil biology research through the newly formed GRDC Soil Biology Initiative should help provide us with data to provide a healthy focus on soil biology.

Where values are above 4–5% we would expect optimal biological soil functions. Here microorganisms can easily provide a buffer against management mistakes—unless major! Healthy microbial biomass values also suggest that the chemical and physical fertility of the soil is good, since healthy soil physics and chemistry (adequate water, air, correct pH, etc) is essential for microbial health.

The grey clays, shown here, have poor chemical and physical fertility due to their high sodium content and associated hard setting. Therefore it is not surprising that this soil does not have optimal biological fertility. Brown manuring and gypsum application would likely improve these soils structural fertility. Then we might see an improved microbial quotient. We are currently researching this.

Very low values for the microbial quotient (less than 1%) suggests that other biological, chemical or physical soil attributes are poor. We have defined an acceptable value of 2%, which we use as an early warning signal. *(Ed: It would be interesting to determine if the soils Ca:Mg ratio of 6:1 helps to avoid values falling below 2%.)* If values fall below this then we need to change the soil quality problems through more sustainable management practices.

Monitoring labile, or alive, fractions of soil organic matter is a useful early indicator of soils' changing fertility. We will report on this in Part 2 in the next issue using specific examples from current trial data. This work has helped us to quantify some biological fertility of WA soils, and to put it into some worldwide perspective.



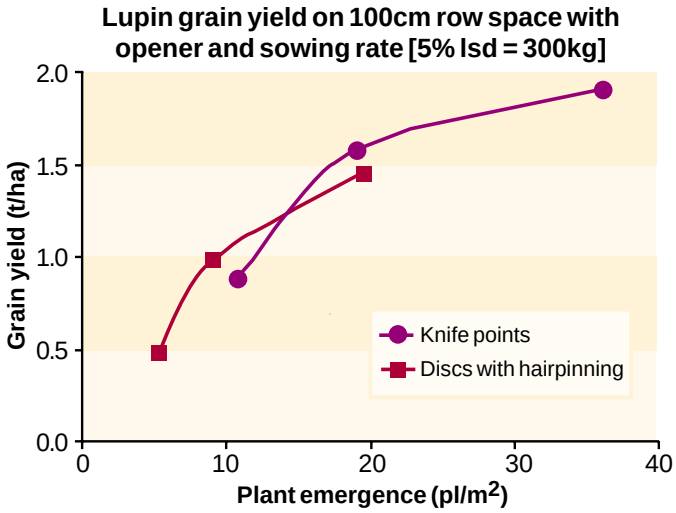
The ratio between the amount of living microorganisms (MB-C) and Total C in grey clay soils.

Preliminary Meckering R&D Site Results

Bill Crabtree, WANTFA Scientific Officer, 9622 3395 p/f

Lupin row spacing issues

Wide rows allow for non-selective herbicides to be applied in the inter-row. Wide rows also stimulate less weeds to germinate as there is less soil 'throw'. However, the weeds that do germinate later in the season will have less competition and will need to be controlled—probably with shielded sprayers.



Red Bull shields from Ellis Equipment (ph 07 4162 1244, ask for Dave) cost $816 for a 28 inch shield. They would be best mounted on 3-point linkage behind the tractor. The other option is to use selective herbicides over the whole area, although this does little to manage the resistance issue. As there is less soil disturbance, there also would be less weeds placed in a seedbed—given that grazing is avoided.

The trial results shown above at Meckering were on heavily grazed wheat that yielded about 3 t/ha. The grazing flattened a lot of the wheat stubble and the WANTFA precision seeder then hairpinned badly. The seeding rates for both the disc and knife point seeders were 17.5, 35 and 70 kg/ha. Note that the establishment rate was half with the disc as compared to the knife.

Similarly on the faultline, where the residue managers were used for half of the area and removed for the second half, the grain yield was greatly reduced. The photo below should be compared to the photo on the front page where the residue managers were used.

This trial also shows the importance of keeping the seeding rate up. The next big question is the time of sowing with such wide rows. Is April sowing a sensible option? Scott McCalman told us at our last conference that from his local NSW experience wide rows benefit from 2–3 weeks earlier sowing than normal. This issue will be explored at Meckering this year. Come and hear farmer Hugh Ball from NSW speak more about this subject. Geoff Fosbery will also speak on this issue and on the wide versus paired spacing trial at Meckering at the CSBP WANTFA Annual Conference (brochure inside).

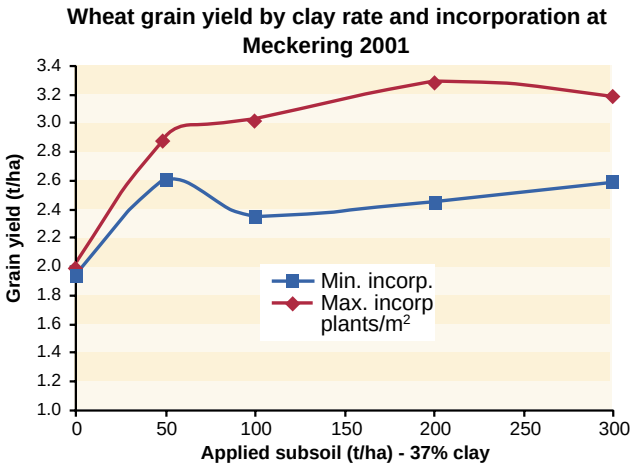
Claying boosted grain yields

As predicted the claying trial at Meckering has greatly increased wheat yields - from 2.0 to 3.3 t/ha (see below graph—with plants/m² shown also). The subsoil that was applied contained 37% clay and had high levels of K. The response was clearly evident from the beginning of the season with greatly improved crop emergence (see photos) and dry matter.

Above: Plot on left is 100 t/ha of applied subsoil, with high level of incorporation, compared to no subsoil clay applied (right).

Left: These lupin rows were sown at 1 m row spacings with the WANTFA disc precision seeder . The residue managers were used on the left hand side but were removed on the right.

Photo from the same plots in early spring (unclayed on right).

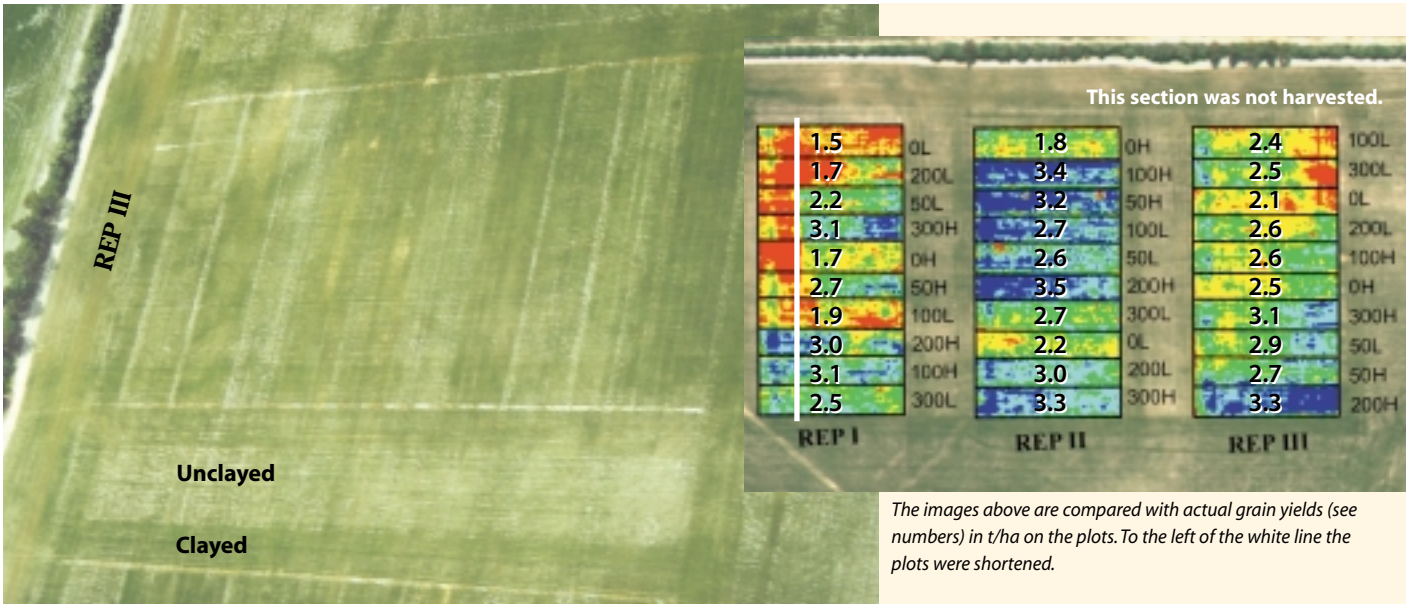


The dry matter cuts were taken by Bill Bowden (Northam Ag Dept) and peaked at 7.5t/ha on the 300 t/ha of applied subsoil with maximum incorporation intensity. Note the area around the trial was clayed also—these 15m wide strips also are clearly seen. Likewise the 2m wide gaps of no clay, between the plots (15m wide by 85m long), can be clearly seen and the spare clay that was applied in a narrow strip in the crop on the right side of the photo.

Imaging was accurate

The image shown in the last *WANTFA Farming Systems* magazine of the trial site and repeated below was accurate. The actual grain yields of the plots (middle 11.7m harvester width) have been overlaid on the image. Likewise, a calculation of grain yields from the image was done by SpecTerra Services (through Jim Baily) after they were given the top and bottom yielding plot values. They achieved 87% correlation which is quite good.

Below: Photo of the third replicate of the trial in late September.



The images above are compared with actual grain yields (see numbers) in t/ha on the plots. To the left of the white line the plots were shortened.

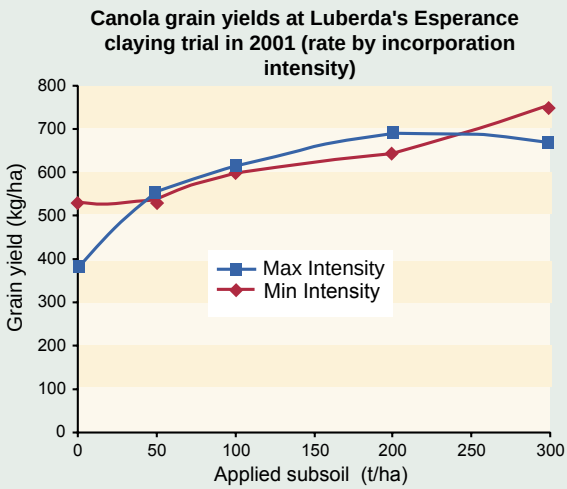
Esperance claying increases canola grain yields

The Esperance clay trial results have come through and similar large yield responses have occurred with the crop.

In this trial there was no difference between tillage intensity used during the subsoils initial incorporation three seasons ago—in early 1999.

Thanks go to the combined help of John Luberda, Andrea Hills (Esperance Ag Dept), Esperance Laser Leveling, Mitchell Spreading Services and David Phelps (CSBP futurefarm).

The site is responsive to K and S and would benefit from luxury doses. The clay used in this trial is not releasing the K and has not overcome the K deficiency.



Sulphur nutrition of wheat

Dr Geoff Anderson, Northam Dept of Agriculture, (08) 9690 2000

Sulphur (S) is a macronutrient required for the growth of crops and pastures. Over the last four years I have been working with Dr Ian Fillery (CSIRO Perth) on a GRDC and CSBP futurefarm funded project to explore soil processes which influence the capacity of the soils to supply S to the growing crops.

A wheat crop of 2–3t/ha requires 6–8kg S/ha while a canola crop of 1.5–2.5t/ha requires 40–70kg S/ha. Like nitrogen (N), there are large soil reserves of S stored in organic matter. Soil organic S and N become available to plants (net mineralisation) when microorganisms break down the organic matter.

During the growing season, from May to November, a soil with organic carbon contents of 0.6–2.5% may have 2–16kg S/ha and 36–153kg N/ha mineralised.

There is less S mineralised compared to N because organic matter contains higher amounts of N compared to S. Hence, soils with a high organic carbon content (greater than 1.9%) will have the capacity to supply enough S for a wheat crop, but S fertiliser will be required for a canola crop.

The sandy soils of WA have a low capacity to adsorb sulphate. Hence, both soil and fertiliser S are easily leached from the soil profile.

Our work shows that, on sand plain soils in the high rainfall zone of the northern wheatbelt, a post-seeding application of S is needed to avoid S deficiency in wheat.

Critical levels determined

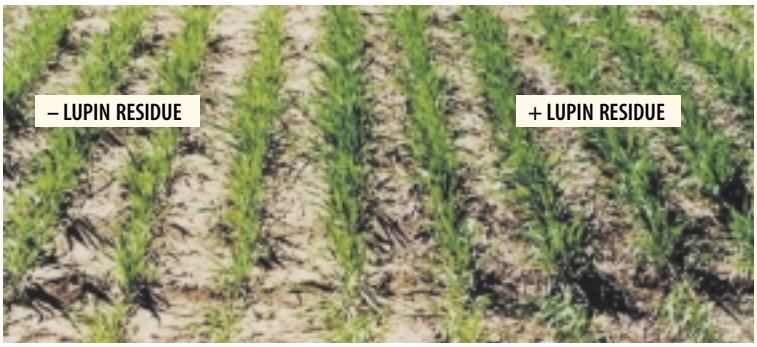
Low levels of organic carbon are associated with low levels of plant available soil sulphur (see photos right).

In these trials adequate nitrogen and other nutrients were applied as a basal.

The first photo in this article was taken in 1999 on the sandplain soil 10km south west of Moora and shows wheat growing on a soil with 1.2% organic carbon. Here S deficiency occurs in patches.

The second photo shows a close up of the patches that occur outside the header trail of the lupin residues. Clearly the mineralised S from the lupin residues has greatly increased wheat growth.

Sulphur deficiency on the left, but adequate on right within the header trail.



Sulphur deficiency wheat evident in patches where organic carbon is 1.2%. Note the header trail going across the plots.

At another site where soil organic matter is only 0.5 organic carbon, the S deficiency is more obvious (see photo below). For the low organic matter soil the availability of soil S is low and leads to widespread S deficiency and reduced wheat growth.

Sulphur-deficient wheat grown in a soil with 0.5% organic carbon.

Soil test now available in WA

A soil sulphur test has recently being introduced to WA. This is because recent developments in laboratory equipment have resulted in a new instrument being available which can rapidly measure the S content of soil extractants. Also, research at the University of New England in Armidale NSW has developed a new soil S test that measures both the soil sulphate and labile organic sulphur pool. The critical soil S test value for pastures has being defined as 6.4mg/kg.

A relationship has been defined between the soil S test measurements and the organic carbon content of the soil. A soil S test of 6.4mg/kg corresponds to an organic carbon content of 1.9%. In a farm survey conducted in 1999, this combination of soil S test and organic carbon content explained the S requirements of seven wheat paddocks.

It is recommended that annual seeding application fertiliser S be used when growing wheat on soils with a soil S test values of less than 6.4mg/kg and organic carbon content of less than 1.9%. Also, under seasonal conditions which result in 60–100 mm of deep drainage below 1.0m, which for deep sand is approximately 100–140 mm of rainfall four weeks after sowing. It is expected that wheat will be responsive to a post-seeding application of S fertiliser.

Classical Sulphur deficiencies

Bill Crabtree, WANTFA Scientific Officer (08) 9622 3395

To complement Geoff Anderson's article on S deficiency take a look at these close-up symptoms (again taken for the UWA series of books by Snowball and Robson called *Symptoms of nutrient disorders*). Like nitrogen, sulphur is essential for building amino acids and proteins and therefore, when S is in short supply, chlorophyll production is affected and this gives a similar symptom of deficiency.

Faba beans

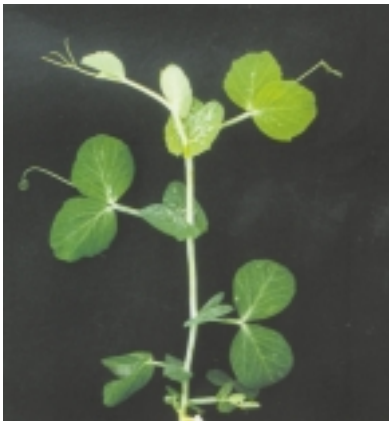
With faba beans the old leaves show mottled chlorosis and this can be over the whole leaf and may be without necrosis.

Sulphur-deficient (right) and sulphur-adequate (left) faba bean leaf.

Sulphur-deficient faba bean plant.

Field peas

With field peas S deficiency results in early reduced growth, like P deficiency, before any signs of specific leaf symptoms. As the deficiency develops, new leaves pale markedly and contrast with the older leaves.



Contrast between new and old leaves in sulphur-deficient Wirrega.

Symptoms of sulphur deficiency on a young tendril leaf of Wirrega.

Narrow-leafed lupins

With narrow-leafed lupins the response to S deficiency occurs simultaneously in both growth and colour. Through time, the whole plant will become pale with differences in intensity of chlorosis occurring between leaves of different ages. Many of the leaflets of old leaves exhibit total or mottled chlorosis and may shed independently of one another, even though no necrosis has occurred.

Leaves of narrow-leafed lupins showing symptoms of sulphur deficiency in old leaves. Leaf of sulphur-adequate plant shown on left.

Sulphur-deficient (right) and sulphur-adequate (left) plants of narrow-leafed lupins.

Wheat

In wheat, the symptoms of sulphur deficiency are similar to those of nitrogen deficiency—a general chlorosis of the leaf rather than the interveinal chlorosis that can be seen in other deficiencies. It differs from nitrogen deficiency in that the whole plant is pale with a greater degree of chlorosis in the newer leaves. With sulphur the entire leaf turns chlorotic with little graduation from tip to base.

Under severe deficiency and as the plant ages, wheat may show leaf tip necrosis (though this may be due to nitrate accumulation rather than a direct effect of sulphur deficiency).

The plant on the right shows severe sulphur deficiency. Control plant shown on left.

Sulphur deficiency in young leaves. Control leaves on left.

BEELINE-sown lupins with sub-2 cm accuracy in 2001.

Wide row lupins in 2000.

The wheel tracks become part of the system with heavier sown crops.

This shot demonstrates the accuracy possible with this new BEELINE technology.

Changing tillage through time

Miles Obst, Mingenew (08) 9927 5013, fax 01

It was 18 years ago when we put our first crop in—and steel was of the essence! As we now know our sand does not always benefit from ploughing and our yields were often quite poor. It was common practice to harvest 4–6 bags per acre of wheat or lupins but if the season went well we might achieve 8 bags/acre. Now, with the advent of various herbicides, including glyphosate, and one pass seeding, we do much better than this.

In 1987 we took our first step in reducing tillage. We slowed down and threw less soil by fitting narrow points and dropping off the finger harrows. In 1988 we bought Alice off-set discs. This improved our trash flow and reduced the time taken to sow our lupins through stubble and melons—without having to look back—although we did not improve our grain yields much with these discs. So we had to try something else.

We also purchased our own cheap deep ripper and got good responses from ripping after sowing—from 1.8 to 3.3 t/ha in some cases. The wheat grain yields improved greatly. We ripped the wheat with a fluted tine trash worker in conjunction with the 350 Panther.

Wide row research in 1990

We observed Paul Blackwell research in 1990 where he grew 2 t/ha of lupins at 30 cm spacings through water harvesting on the deep Allanooka sands. We then decided to modify the 1010 JD bar and removed every second tine. The boots we were using were not performing. This took us out to 36 cm spacings on our lupins.

Seeder boot invented

Necessity is the mother of invention. In 1993–4 while riding on the seeder bar we observed poor and uneven seed placement, particularly on soils that had been deep ripped—so we decided to develop a trailing seeder boot. This boot could sow wheat and lupins precisely in the bottom of the furrow in the softened soil with the 1010 JD bar.

Our row spacings were 15 cm for wheat and 30 cm for lupins. We were trailing a 180 mm rod and boot in the bottom of the furrow. For sowing lupins we had two adaptations on every second boot—making the change to wide rows simple.

On the stronger soils we towed light rolling chain behind, while on the lighter soils the soil flow alone gave adequate

Water ponds in the furrows after rain—wetting mostly only the furrows in water repellent soils.

Narrow-spaced lupins (on right), compared to wide row spaced lupins during the 2000 growing season.

Lupins benefit from the 30 cm wide spacings in water repellent soils.

coverage of soil over the seed. However, in order to maintain the furrow shape we had to go slower, but this was well worth it as we were now achieving excellent crop emergence.

Grasses loved the system

After several years of this approach we observed that grasses became hard to control. This occurred because the water was harvested into the row, leaving the inter-row dry initially. Hence the grass weeds were not germinating until late in the season, and this meant they escaped the in-crop selective herbicide applications.

In 1995–6 the local LCDC posed some good questions. We wanted to design a cropping system that did not require deep ripping as the ripping process dried the soil too much at a critical time of year. The cost of ripping alone was justified, given the consistent grain yield responses, but it was hard to swallow.

Rip while seeding

After the Mingenew Expo, we sat down with Terry Nichols and drew pictures on the back of coasters. I wanted to cultivate at depth but not necessarily deep rip. He searched high and low and then suggested that he make something. We ran with a 3-point linkage 10' Connor Shea for trials all through 1996. This concept was very exciting.

Then in 1997 we had a 40 foot prototype seeder that could rip and seed in the one pass. It could also sow shallow and split the fertiliser. This enabled us to get crops up on less rain. With this bar we found that, with the 25 cm row spacings, it was still hard to get through stubble without blockages. The next year we fitted a 30 cm concave coulter in front of the tine to shift trash and allow us to sow on the press wheels with no tine.

In 1999 we minimised the wheel marks and experimented with heavier sowing rates. The lupins 60–100 plants/m^2 and wheat was 250–350 plants/m^2 and this is still our practice now.

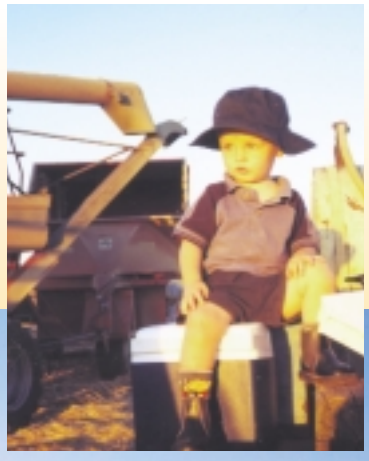
Controlled traffic emerges

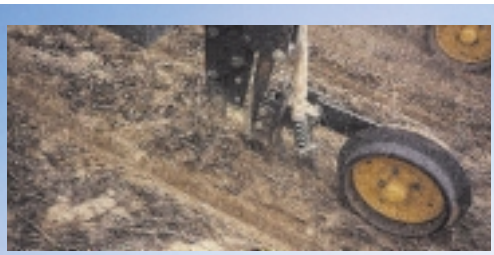
In 2000 we began using the same tracks for spreading and spraying. We use a 120 foot boom spray and a 60 foot Marshall spreader. Last year we put the seed box behind the seeder and were aiming for 3 m wide wheel rows. We are also fortunate to be trialling the Beeline Navigation System, thanks to BEELINE Agsystems and Dr Paul Blackwell. In 2002 we plan to do a bit of research on the wider rows and fertiliser placement issues *(Ed: See the last* WANTFA Farming Systems *[page 467] where Miles is working with agronomist Grant Thompson on fertiliser placement and where Paul Blackwell explains his tramline work [page 468].)*

Currently we are contemplating sowing on three point linkage by modifying the 13 m seeder bar. We will remove the front and rear rank and use the four wheels to assist in lifting the bar. We will use the same bar on 30 cm row spacings for wheat and 60 cm for lupins. We will fit a three point linkage 13 m shielded sprayer on our 270 hp Fendt tractor.

Below: Chaff and weed seed collection is part of an integrated weed management system.

Right: Rohan Obst contemplates a sustainable future in agriculture.





The Nichols opener can cultivate deep at the same time as sowing.

No-till 18 years on

Ray and Tim Harrington,
Darkan (08) 9736 3004 p/f

Since first dabbling with no-till in 1983 the system and results just keep getting better. Here I will give an overview of the current no-till practice on my farm 'Morlup Downs'.

(Ed: Ray was the inaugural WANTFA President in 1993 and, with his brother David, developed the Harrington knife-point.)

Our seeding system has changed very little in the last six years. My very affordable seeder has now sown its 19th crop. The importance of the actual sowing system is not as critical as I first thought it would be. It just needs to be able do the following 1, 2, 3:

1. Cultivate below seed.
2. Place the seed.
3. Cover the seed with soil.

Ray's seeder is not fancy but it has sown its 19th crop.

Rotation planning is essential

I feel it is important to have a 4–5 year plan for crop rotations. This is important for both optimal crop growth and herbicide use. It also has implications for residue management, macro and micro fertilisers and for disease control. The underground diseases are hard to see but are vitally important and are effectively managed by rotational diversity.

501 canola performed well

The current rotation being used is canola, barley, lupins, and wheat at 25% each. The wheat is noodle, the barley is malt, and the canola is TT. If it were not for the TT canola I would probably need to include sheep (with pasture) for weed control. Peas are also being trialled and have yet to be harvested. The first crop looks good but does not appear to have enough pods.

Ray Harrington in a healthy looking Gairdner barley crop.

Rotation rationale

The barley crops follow canola. This is to control protein levels on fully retained canola residue. The canola residue is fully chopped and spread with a Redicop on the header. Then in January, on those really hot days (>40°C), the stubble is smashed down with a set of 13 m fire harrows (obviously without the fire).

The lupins follow fully retained 23 cm high barley stubble which is chopped and spread and grazed with agisted sheep. The noodle wheat is on the lupin stubble, which is fully retained and chopped and spread. The lupin stubble in high rainfall can be hard to handle.

A burning confession!

The canola is grown on burnt wheat stubble—sorry about this! But, with the good yielding noodle wheat having lots of straw, and our cold wet winter rainfall, we have observed poor canola emergence and early growth in thick wheat stubble. I have tried fully retaining the wheat stubble, but it usually hurts the canola too much.

Raking and baling the wheat straw is not an option—it removes too many nutrients. We have done lots of baling in the past, but now the wheat stubble is ungrazed and burnt after the opening rains.

Fertiliser approach

All crops are top-dressed with potash at the same time as the knockdown spray. We have a dual-purpose custom-built spreader and spray rig that works very well as a precision spreader. The pockets of deep white sand in all paddocks are given double potash as this spraying is done. To do this I just turn off the boom and do the visible sand pockets twice.

All crops are treated with Zn and Mn seed dressing and all crops receive Cu, Zn and Mo with compound fertilisers at seeding. Barley has two more applications of nitrogen, at three and six weeks after sowing. When spraying for radish, and the aphid anti-feed, I add Cu (if the tissue samples taken earlier suggest that it is required).

The lupins receive high analysis P with trace elements. The wheat receives compound P and N with trace elements at sowing and the N is fully supplied PSPE (post-sowing pre-emergent) at the same time as the double knock with SpraySeed.

With canola, gypsum is applied on paddocks at 300 kg/ha before sowing. All P and some N is applied at sowing with a second application of N applied at four weeks after sowing with atrazine. Another application of N is applied with the second application of atrazine. We have applied the second N earlier this year as a result of Paul Carmody's (Ag Department) trial work. It appears to be more effective.

We have been applying 1 t/ha of lime on all lupin stubbles for the last four years. This gets lime as far away in the rotation from the lupins as possible. Our constant monitoring will show us if we need to increase or decrease this rate.

Herbicides

We have a boom mounted at both the front and rear of our seeding rig. We use no selective herbicides in cereals apart from trifluralin mixed with metribuzin, or trifluralin mixed with Dual Gold. All crops have the double knock with SpraySeed after glyphosate and before crop emergence.

We use selective herbicides in the lupins and we also trialled crop-topping the lupins in 2001. We will do all of this with a 36 m spray rig in the next season. With canola we apply paraquat on the swather for those small ryegrass that suddenly see the light after swathing and want to put on a seed head.

Nozzles mounted on the front of the seeder for timely trifluralin application.

Canola has performed well in Ray's program.

Seed set control—essential!

Perhaps the key focus of my farming program is weed seed set control. This includes swathing both canola and barley (including Unicorn) and is used on paddocks that are suspect with herbicide resistance or have critical levels of ryegrass. While swathing I apply a knockdown under the swaths.

I burn ungrazed wheat stubble only. As the ryegrass will not burn if it is trampled with grazing. I will use sheep (and pasture) as a weed management tool when returns from them are adequate—but at only $3.50/kg it is still a way off.

All header residues are chopped and spread—watch this space for a new way of achieving seed set control on the header. Seed set control with chaff carts is a proven important tool. I see this as a valuable method for sustaining my program.

For some six years we have talked about the "Cs" of weed killing, being: "Catch it, Cook it, Crush it, Cremate it and Cart it away." A prototype for the "Cs" is now being built (unfortunately, microwaves require the seeds to have an 18% moisture content for this to work, and it is expensive).

Farm hygiene is important and all margins of paddocks are sprayed each year. The wheat has a standard firebreak approach, while all other crops have the borders crop topped, as melons grow on firebreaks and this holds them back. Peas were introduced largely because they can be easily crop-topped. I use no selective herbicides in the peas. I began resistance testing two years ago.

General management

The general intensity of management of my no-till program is far greater than running a mixed grain and sheep operation. The greatest reward is seeing the results of increasing soil organic matter. Over these 18 years the levels have lifted from about 2.5 to 4.0%. Soil erosion is now virtually nil—in fact some small gullies have filled in.

The future!

I think it is important to keep looking 'outside the square' and I am aware of the need to be open to changing my thinking or approach. Weed seed set control is the key for me to help keep herbicide resistance at bay. Rotational diversity will continue to be a powerful tool for resistance and disease management. I have trialled summer crops for four years with limited success—the forest gravels are a bit challenging but I will keep an open mind.

My aim is to grow good average crops—year in, year out—with minimal costs. The very high yielding crop package invites the high risk of weather damage at harvest. We have just had 50 mm of rain in early December. In my 450 mm rainfall area I often see vigorous weed growth if I have blocked rows on 18 cm spacings, therefore if I were to change row spacings with my cereals it would be narrower rather than wider.

I plan no big changes to the seeding systems but will be looking at N timing and application method. I have introduced yield mapping this season with the view to improving those below average areas or I will decide if I will leave them out and plant them back to trees. My over-all farm crop yields give me great comfort that no-till is a very robust and reliable cropping system.

The peas are crop-topped. Note the small strip of non-competitive 'house peas' in the foreground—the ryegrass has grown well where the peas are sluggish.

Where blocked hoses occur, weeds enjoy the space—especially ryegrass.

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