Newsletter of
WANTFA
Western Australian No-Tillage Farmers Association (Inc)

SURFACE MAIL | POSTAGE PAID

PP 634505/0010 ISSN 1329-7600

GRDC

May 2000 | *"Sustainable high production agriculture – now!"* | Vol 8 No. 2 pp 317–336

Raised beds reducing risk in wet areas

Tim March's canola at Esperance on raised beds.

Farmers in wet areas who have increased their cropping areas due to poor wool prices have found raised beds provide some risk management comfort. GRDC funding of a Project, supervised by AGWEST's Greg Hamilton, has encouraged many WA farmers to experiment with raised beds on their own farms.

To establish the raised beds, there is a fair bit of cultivation required. This has been hard for some farmers to come to grips with after having been no-till farmers for many years. The practice requires applying gypsum, deep ripping and then raising the beds. Tim March has managed to create a machine that rips and raises in the one pass.

This newsletter features the experiences of three WA farmers (Tim March, Harvey Morrell and Steve Marshall) who now have significant experience with raised bed farming. Also featured is researcher Dr. Derk Bakker from AGWEST, Albany, who shares his raised bed trial results from the 1999 season. Derk showed an average grain yield increase of 20% from his eight research sites throughout WA in a relatively dry season.

Dwayne Beck inspires thought!

Few world agriculturalists have such a good understanding of the importance of appropriate rotations for stubble retention farming systems as Dwayne Beck.

Dwayne explains his understanding of how drought tolerant these warm season crops are.

His visits to WA, in 1996 and again this February, have encouraged us to think laterally about our rotations. We are not using enough of the water that no-till helps to preserve.

CONTENTS

WANTFA Administration,
Suite 5, 110 Robinson Ave,
Belmont, WA 6104
Ph (08) 9277 9922, fax 9475 0322
admin@wantfa.com.au

Bill Crabtree, WANTFA's Scientific Officer is funded by:

Dwayne is confident that cool-season-only rotations will lead us into significant pest and water (salinity) problems and he confidently encourages us to keep researching broader rotations that include warm season crops. For more see his talk in the Science section (page 325).

Potassium—a key to waves!

AGWEST Northam researcher Dr Bill Bowden presented 9 trial results (4 with grain yield) on the effect of variable cereal crop growth in the year following canola. The grain yield difference between canola dumped rows (from the back of headers) to areas without stubble is Bill Bowden's work (see table below). It can be found at the AGWEST's Website (and via wantfa.com.au).

Year	Farmer	Location	Grain yield (t/ha)	
			On	Off
1998	Packard	Badgebup	2.23	1.08
1998	Henderson	Varley	2.36	1.93
1999	Mayfield	East Hyden	3.43	2.32
1999	?	Kukerin	3.36	1.65
1999	?	Kukerin	3.07	2.09
1999	?	Katanning	1.56	1.22
1999	Davies	South York	5.25	2.10
1999	?	Darkan	3.38	1.87
		Average =	3.08	1.78

Bill found that P, S and Zn sometimes caused poor performance at several trials and potassium was the main offender. Bill's work goes a long way to untangling the riddle of waves—but he admits that there may also be other factors involved. If you see waves of healthy and poor cereal crop occurring this year after canola, call Bill on 9690 2190.

Banded Urea increased wheat yields

In three trials during the wet 1999 season, Patrick Gethin and other CSBP future-farm staff showed that banding urea 3–4 cm below and 2–3 cm to the side of the seed resulted in 8–15% more wheat yield than topdressed urea. At one site with a loamy clay soil, banding urea directly below the seed reduced plant density by 21%. Banding urea below and to the side virtually eliminated urea toxicity to seedlings and N supply was better matched to crop demand. This method appears to be a real option for those with the appropriate machinery and may result in benefits that other N sources claim to deliver—but at a fraction of the cost.

Wave in the Meckering cation trial. The canola was grown in 1997, then wheat in 1998 and here (WANTFA September 1999) the barley shows the characteristic wave effect in the old canola header rows.

Claying can be hostile to lupins

Several farmers last year were surprised at how poorly their lupins grew in clayed, repellent patches. There are two likely compounding reasons for this. One; simazine is more active in clayed soil that has a more neutral than acidic pH and, two; brown spot is more virulent when the spores are mixed through the topsoil by clay incorporation. Also, the stubble levels, which suppress brown spot splash, would be depleted by the incorporation of the clay (or burning—if it was done).

If you find yourself in this situation, don't panic—it does not guarantee problems. Other farmers have successfully sown lupins into clayed soils. However, if the paddock fits the following criteria:

- a long history of lupins in a tight rotation,

Steve Pink's lupins at Munglinup struggled with brown spot and activated simazine as a result of clay additions during 1999.

- brown spot has been a problem in the past, and
- the subsoil has a pH of 7 or higher,

then there is some risk of brown spot damage. Compound this with simazine, which is likely to be more active from claying, and there could be some seedling death. To minimise the problem, use a seed dressing (at the higher rate) and monitor crop emergence and growth carefully. It may also pay to reduce pre-emergent simazine levels by 30–50% from what you would normally use.

Canola affected by wheat residue—survey!

PhD student, Sarah Bruce, from Charles Sturt University is seeking your experiences with the above issue, and also the effect of canola residue on plant growth. Many farmers in WA have experienced problems with poor canola growth when canola is no-tilled into thick wheat stubble. Sarah is conducting a survey that will help determine the factors that affect this poor result.

Prof Jim Pratley spoke about these issues at our recent conference and introduced us to Sarah's survey. If you are interested, please contact Sarah and request a survey form. A summary of the information will be presented in a future newsletter. The survey might take 30 minutes. Sarah can be contacted on (02) 6246 5387 or fax 99 or s.bruce@pican.pi.csiro.au.

Don't forget the double knock

Many WANTFA farmer members are very familiar with the idea of using glyphosate and then SpraySeed before seeding. We have long reasoned that this approach dramatically reduces the risk of no-till farmers losing glyphosate as our most powerful tool. A study by the Western Australian Herbicide Resistance Initiative (WAHRI) with AGWEST, has confirmed our thoughts on the value of this tool.

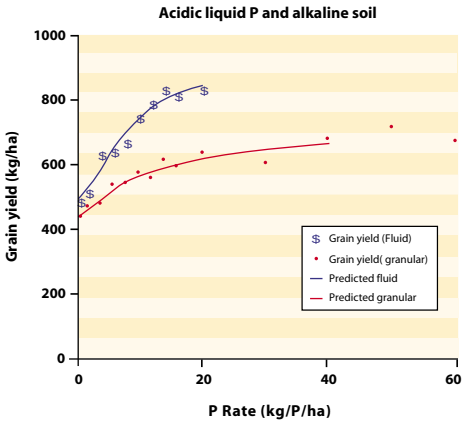
Researchers Paul Neve, Art Diggle and Steve Powles conclude that the double knock is the best strategy for conserving glyphosate susceptibility. Their simulation model demonstrates the potential benefits of the double knock (sequential pre-seeding application of glyphosate and paraquat at full rates) for conserving glyphosate susceptibility in annual ryegrass. The model simulates the rate and probability of glyphosate resistance evolution under a number of scenarios for pre-seeding knockdown herbicide use. A brief summary of the results are in the table below. For more information visit the AGWEST or WAHRI web sites (both are easily found at WANTFA's website, www.wantfa.com.au).

Strategy	Probability of glyphosate resistance evolution
1. Glyphosate every year	0.64
2. Alternate glyphosate and paraquat	0.35
3. Paraquat following in-crop glyphosate	0.46
4. Double knock	0.00

Interestingly, every time I visit the Eastern States I am surprised how few farmers and researchers know of the double knock strategy—yet many realise they will lose glyphosate with its constant annual use.

Acidic liquid P and alkaline soils

In the last *Newsletter* (page 298), there was discussion of Dr Bob Holloway's innovative research from Minnipa Research Station, SA. As a follow up, here is the grain yield graph that Bob generated.



The N and P fertiliser used was MAP plus ammonium nitrate. All plots received 15 kg/ha of N and 2 kg/ha of Zinc. Liquid P, at low application rates (< 14 kgP/ha), was applied with 400 L/ha of water while higher rates were applied with 750 L/ha. The wheat was Frame with P applied in a highly calcareous grey sandy loam at Yandra in 1999.

Thanks to members for information

In the last 9 months WANTFA has updated its membership list. Many thanks for completing the form. To those who have not yet renewed their membership—now is the time. Please call Mary on (08) 9277 9922 for details.

Claying reduces frost

There was clear evidence of this presented in the last WANTFA newsletter (January 2000) on page 308. Is it possible that the below photo shows the same thing? I think this is possible—although we can't be sure. The light golden coloured crop in the background yielded nearly 3 t/ha, while the darker foreground crop yielded only 0.3 t/ha.

The crop establishment seemed similar in each case, but the heads were full of grain in the background and not in the foreground. Where the crop

Ian Mickel of Esperance observed better crop colour at harvest time where the soil was clayed at high rates and not incorporated.

changes colour is the exact line of where the clay was placed. Yet the clay was not incorporated and was often 2–3 cm thick over the surface (likely 250 t/ha). This small sandy hill area did not receive the planned incorporation. Perhaps the better grain yield is due to leaf disease—but the response is too large for this. The only likely suggestion to me is frost damage and the farmer did get areas of frost damage on the farm. Note, this is not a recommendation to forgo incorporation!

For data hungry farmers!

The Australian Grains Field Research Manual is full of excellent current (1999) trial results from all over Australia. The manual is edited by SA agronomist Erick Braunack-Mayer and is a compilation of highlights of trial results from leading farmer groups. It comes with a CD-ROM which includes other GRDC Crop Update data and their Projects list from across Australia. The 90-page book and CD are good value at $20 with lots of colour photos. The CD includes some financial and water use calculators and ABARE's financial review. The package can be obtained from Lloyd O'Connell at Australian Grain on (07) 4659 3555.

South Australian Agronomist and Editor, Mr Erick Braunack-Mayer believes that a manual which presents farmer directed trial results is invaluable to others.

Erosion continuous

Any grazing of pea stubble is enough to allow a sea breeze to lift the soil. This photo taken down south in December is a reminder of the fragile soils we farm on this old landscape.

Just one focal point is enough to get the sand moving. Grazing sheep should be monitored closely to avoid this problem.

Survey for knockdown resistance in WA wheatbelt

Paul Neve (WA Herbicide Resistance Initiative) is co-ordinating a survey of WA growers to determine if, and to what extent, resistance to the knockdown herbicides, glyphosate and paraquat exists in the WA wheat belt. The application of knockdown herbicides to millions of hectares across the wheat belt can act as a mass screening for resistance to these chemicals.

The researchers are seeking the help of growers and agronomists to locate suspect populations. When control failures occur following herbicide and where resistance is suspected we are requesting that growers or agronomists send samples of excavated ryegrass plants (30 to 50 seedlings) to Paul's group. These seedlings will be tested to ascertain their resistance status. Pre-addressed kits are available on request. These will comprise Express Post envelopes and a short questionnaire to give details of herbicide applied, rate and timing of application and herbicide and cropping history.

Please contact Dr Paul Neve, Western Australian Herbicide Resistance Initiative, Faculty of Agriculture, University of WA, Nedlands WA 6907. Phone (08) 9380 7872, fax 34.

Coming Events

Where?	Meckering R&D Site
What?	Post seeding field walk
When?	Wed 19th July
Where?	All over the state
What?	Local WANTFA days
When?	Through August
Where?	Meckering R&D Site
What?	Major Spring field day
When?	Tue 19th Sept
Where?	To Be Confirmed
What?	Annual Conference
When?	19–27th Feb 2001

WANTFA Members' Website

Your username is: **wantfamag**

Your password is: **member**

…until the next newsletter.

Presidents Report

Geoffrey Marshall, Hyden (08) 9880 0038, fax 18

The opportunity to communicate briefly with members seems to come around very quickly as we pursue our busy lifestyles.

U.S. Trip

As planned, Bill Crabtree and I flew to the US on the 2nd of January for two weeks of full-on No-Till travel. This was bad timing, as harvest was not complete and family holidays were shortened markedly. However, the trip was mentally very stimulating with many renewed and new contacts for both of us. Bill is excellent to travel with - there is never a dull moment. His ability and energy to seek out detail and develop contacts is powerful - thanks Bill. Overall, the trip was of great value and reassured us that no-till in many countries is moving forward strongly on sound principles and is firmly based on the necessity of diverse rotations.

Dwayne Beck

Dwayne Beck's visit can only be described as fantastic! Dwayne has given us lots of powerful reasons for thinking outside the box. He presents such logical, extensive and challenging reasons as to why we must open up our minds to introducing new crop types which will increase the power of our "rotations". A number of people having heard Dwayne at least once before, and again recently, have commented to me that they realise they must take his "rotations" experiences more seriously.

Seasonal Notes

I have always found the period just before and during seeding very challenging. We try our best to manoeuvre spray programs and seeding detail to achieve the least cost and best net result at harvest.

An interesting year has developed with another frost and rain affected harvest, severe flooding in January, locusts and other insect threats, plus stem rust. Most farmers, both here in Australia and in other countries, are feeling the tough economic climate. We are all trying to contain cost inputs whilst attempting to be positive about future price direction. If, as a farmer, you are able to understand and absorb all the fundamental changes that are taking place, and still maximise your returns, you deserve an Olympic Gold Medal. My heart goes out particularly to those who have experienced severe adversity, such as two or three major frost events in consecutive years. In tough times it is easy to cut costs by lowering inputs. Experience tells me that whenever I have done this I have lost out badly, particularly with herbicide use.

Warm Season Crops

A few points of interest:

- There is a greatly expanded area in 1999/2000 with many more farmers, Landcare groups and researchers involved - this is encouraging.
- Some good looking crops from small trials to whole paddocks.
- There are now at least three precision seeders in WA for these crops—2 owned by WANTFA.
- Developing packages around various crops is progressing.
- Recognition of how these "alternative crops" can play a part in a constantly evolving system is increasing.
- The pace, and need for change appears to be increasing (remember - don't be too drastic unless you can afford to be. Make sure your core business works well).
- Cover Crops are now being talked about more. They are well-developed in South America and are another way of adding variation to our farming system.
- Crops suppressing germination of weeds (such as sweet clover in the Canadian work described by Jill Clapperton), offer huge potential.
- Warm Season Crops Seminars are planned for July - watch for later details.

Committee

From the A.G.M. on 8th March we welcome four new committee—Toll Temby (Bodallin), Richard McKenna (Mullewa), Colin Pearse (Meckering) and John Stone (Borden). We say farewell to Jim Baily (Wellstead) an original WANTFA committee member, Chris Gilmour (Wellstead) past Treasurer who has been involved with WANTFA from its origin, Colin Green (Hyden), Derek Chisholm (Morawa). Thank you for your valuable inputs to WANTFA and No-Till.

Life Members—one of the few. Welcome Ken de Grussa as a new Life Member. Ken was presented with Life Membership at Esperance at our March Seminar. Both he and Audrey were totally overwhelmed by this award, but it was most deserved because of Ken's constant commitment to WANTFA over such a long period of time.

Ken de Grussa receives life membership.

Membership fees

Strong support was given for a motion at the AGM to increase membership fees to $100. This will mean that your next renewal will reflect the increase, and for most this will be Jan 2001.

I wish you every success with your seeding programs—until next time—good luck!

Over 800 at Conference 2000

Neil Young, VP and Conference convener

Mind broadening is the best way of describing the recent annual conference and pre-conference seminars. Over 800 people attended the events, where they had the opportunity to listen to a series of stimulating and challenging speakers. The content is well covered elsewhere in this and future newsletters.

Audience response sheets indicated great satisfaction with the content, and full credit must go to Bill Crabtree for locating the speakers. Over 90% of respondents indicated they were satisfied or very satisfied with the events.

Those people who attended the main conference and AGM at Muresk had a burst of pre-cyclonic heat and humidity which was more than the hall cooling system could cope with, and a hiccup in the booking computer system caused frustration at Katanning, so I thank those affected for their patience.

Prof Dwayne Beck, Dr Jill Clapperton and Prof Jim Pratley were key speakers at the WANTFA conference.

Planning for next year's conference is already under way with Carlos Crovetto from Chile as the lead speaker. He has studied and demonstrated the benefit of full stubble retention as an essential part of no-till on his own property, and published a book covering his experience titled "Stubble over the Soil". Available from The Rural Store in Victoria, phone (03) 5782 1118.

All suggestions for making the conference better are most welcome, or indeed even a complete change in format may be appropriate. If anyone knows of a venue to handle the crowds in comfort, with a relaxed atmosphere, good caterers, low cost, and the ability to provide reasonable accommodation please let us know. John Duff and Associates again provided conference co-ordination under contract to WANTFA making such a complex event possible—thank you John and Mary.

AGM Happenings

Kevin Bligh, Committee-member
(08) 9755 7589

The last two Annual General Meetings, held on the second morning of WANTFA's Annual Conferences at Muresk, have continued to put new blood onto our Committee. In 1999, Derek Chisholm of Morawa, Colin Steddy of Narembeen, Owen Brownleigh of Lake King and Matthew Jones of Esperance were elected, while other commitments prevented Paul Maisey of Dowerin and Colin Pither of Ongerup from renominating.

Minutes of the 1999 AGM are unavailable, however, because as stand-in minute-taker, I lost my notes of the Meeting! I remember looking for them, unsuccessfully, to write up the Minutes a couple of weeks later! Then I forgot all about it until this year's AGM! I tender my sincere apology to the WANTFA membership, for mislaying my notes. I trust that the following recalled account may serve some purpose as a stand-in record.

General Business

I have spoken to the mover of the principal motion in General Business, John Hicks of Pingrup, for accuracy. John's motion was to the effect that Committee-members should be reimbursed for out-of-pocket expenses while engaged on WANTFA business. As a former Committee-member ('94–'98), John said that obstacles to attracting people onto the Committee should be minimised, because Committee-members were already giving much valuable time. The motion was seconded, and passed without dissent.

Reports

The President's and Treasurer's reports were accepted with a little clarifying discussion, as I recall. Geoffrey Marshall of Hyden and Neil Young of Kojonup were re-elected as President and Vice-President, respectively, in both 1999 and 2000. Tony White of Miling was re-elected as Secretary in 1999, and Chris Gilmour of Wellstead as Treasurer.

New Treasurer

At this year's AGM, pressure of other business prevented Chris from continuing after two years as Treasurer. Tony White was elected in his place, and Ric Swarbrick of Gardiner was elected as Secretary. Derek Chisholm of Morawa and Colin Green of Hyden ('98-'00) and Jim Baily of Wellstead ('94-'00) were unable to make themselves available for re-election because of other commitments. Richard McKenna of Mullewa, Colin Pearse of Meckering, Toll Temby of Bodallin and John Stone of Borden were then elected.

WANTFA Committee

I believe the WANTFA Committee continues to have strength in depth with its new members. Richard McKenna completed an agricultural science degree at UWA, and converted the family farm at Tardun to no-till. Colin Pearse hosts WANTFA's Trial Site on his Meckering property, operated by a sub-committee of farmers and consultants. Toll Temby has been a keen practitioner of no-till at Bodallin, near Southern Cross, since 1994, while John Stone started no-tilling at Borden in 1992, with his brother Andrew.

Honorary Life Membership

At the Esperance Pre-Conference Seminar, a well-earned Honorary Life Membership was bestowed on WANTFA's President from 1994-97, Ken de Grussa of Neridup. As Secretary, I observed at first hand, Ken's genius for determining what the Committee wanted in any situation, and going out to achieve it.

How right Foundation President, Ray Harrington of Darkan was, when he said, as he stepped down, knowing the kinds of obstacles that lay in front of the fledgling WANTFA; "Ken's the only one who can do the job!" And Ken went the 'hard yards' to contribute to the now-flourishing WANTFA!

Thanks

I would also, if I might, take this opportunity to draw members' attention to the pioneering work retiring Treasurer Chris Gilmour and long-standing Committee-member Jim Baily, did for profitably conserving Western Australian soils through no-till sowing. After more than twenty years managing the Subasio Downs property at Wellstead, Jim has gone on to work on GPS-type applications, based in the nearby Porongorups.

Chris took the initiative in 1991 with another Wellstead farmer, Bill Jensen, of arranging and hosting a visit by John Baker from New Zealand, the developer of the Cross-Slot no-till seeder. Sowing through heavy stubble with uniform seed depth is the disc-and-point-combination Cross-Slot's forte. Chris, Bill and John and Andrew Stone bought them.

Ever since WANTFA formed in 1992, it has seemed to me that many good ideas have come through Chris' strategic thinking - always articulately stated, with an irrepressible sense of humour! Something must be right with an association when you're having fun!

WANTFA's website

In mid-January 2000 we launched our website at www.wantfa.com.au. Until now, the site has been open to all. From now on members will have benefits not open to all and you will need a user name and password to get in. Until the next *Newsletter* the user name will be "wantfamag" and the password will be "member". Please encourage others to visit the general section. WANTFA trial data is also posted on the website—take a look!

Please suggest improvements and links that would be of interest to other WANTFA members. You can access no-tillage sites from all over the world—including Dwayne Beck's site at www.dakotalakes.com. Don't forget to ask Dr Dirt your soil microbiological questions.

Imaging Paddocks - Powerful New Tool!

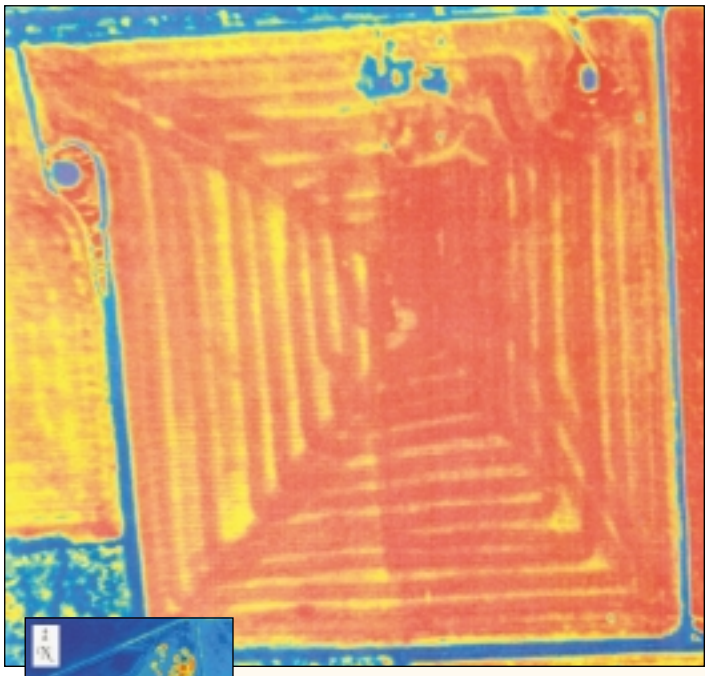
Jim Baily, Narrikup (08) 9853 1038, fax 98

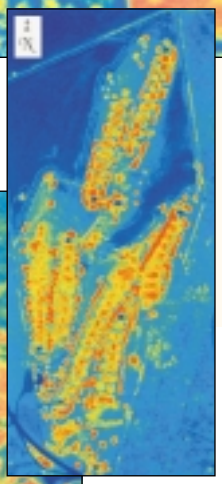
(Editor: Jim has just retired from the WANTFA committee and has been involved in managing a broadacre farm on the south coast for nearly 20 years. He is a keen pilot and believes that this new imaging tool has the potential to improve crop management. Jim has spent a lot of time checking crops from the ground—not always finding problems as fast as he would like.)

I feel that the MAVIS (Multispectral Airborne Video Imaging System) system has some great advantages to offer farm managers and agronomists. The Farrer Institute, at Charles Sturt University, Wagga Wagga, NSW has been researching the imaging of crops from the air for several years. MAVIS allows farmers to assess crop growth and pinpoint areas with anomalies. The farmer and agronomists can then make the most appropriate management decisions.

The changes in "near infrared reflectance" which MAVIS detects can be done well before the human eye can see the changes in the plant. The image records plant stress. The system involves a plane fitted with a digital camera and recording equipment. On the ground, the images are enhanced by a computer program. Five days later the colour-processed images are available for distribution.

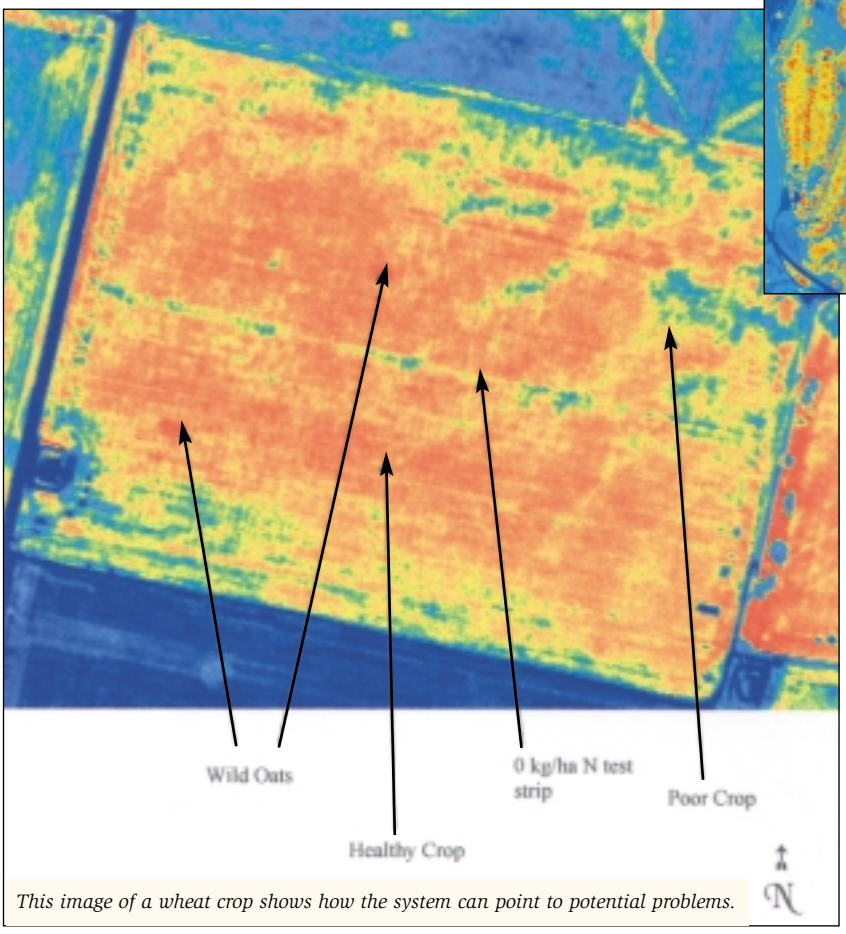
Satellite images also play an important role in district yield forecasting, however, they are limited by cloud cover, the frequency of passes and low image resolution. Images from satellites also take time to be released and you can't be sure that you will get the information you need.





Above: Urea application was not done properly - red is adequate N. Note, the right half of paddock (fence removed down middle) had a better legume history than left half - see less yellow. The middle-upper dark red square was where the last extra bit of the urea was applied.

Left: Golf green irrigation—shows the power of the tool. The circles are where the water has been applied.



This image of a wheat crop shows how the system can point to potential problems.

The MAVIS system is now providing 2-metre resolution for broad acre sites and down to 25 cm for research sites and other intensive agricultural operations. The data is available within a few days of the completion of a successful flight.

The system provides a scientific means of generating meaningful data. The data then needs to be confirmed on the ground. It will help maximise crop yields and enable us to manage paddock variation. The system is likely to cost $3–4/ha, but is reliant on farmer groups working together.

The system provides the following advantages:

- Eliminates random sampling
- Highlights areas of problem crop establishment
- Identifies areas of pest and disease impact
- Able to produce weed control maps
- Objectively measures crop performance

- Identifies stress before visual symptoms occur
- Maximises inputs
- Assesses fertiliser trials in a timely manner
- Identifies yield limiting areas within and between seasons.

Cover Crops

Bill Crabtree, WANTFA's Scientific Officer

Dwayne Beck also encouraged us to consider cover crops (brown manure) in our rotations. Dwayne says that these crops can increase the intensity and diversity of rotations where cash crops are; not possible, unprofitable, or are excessively risky. In warm and wet environments (or during wet summers), the goal should be to have something growing while the soil has a chance of being wet.

In areas with a limited growing season, this will require the use of cover crops and/or forage double crops. In sub-humid, semi-arid, and arid environments, cover crops can be used to increase organic matter and biological activity. Cover crops can:

Prof Dwayne Beck

- use excess moisture saved by no-till
- promote soil structure and diversity in soil fauna
- provide N for the next crop
- aid in nutrient cycling
- reduce erosion
- minimise N leaching
- suppress weed seed germination
- "false-out" some disease organisms
- change previous crop residue colour.

National USA No–Till Conference

Bill Crabtree, WANTFA's Scientific Officer

During January, Geoffrey Marshall and myself were privileged to attend two no–till conferences in the USA (in Oregon and Iowa). It was an excellent networking opportunity and we would happily encourage you to go to their next one, on 10–13th January 2001 in Ohio (see www.lesspub.com/ntf). Rubbing shoulders with 715 other no-till farmers and researchers was good knowledge building material.

Farmers from 1,500 km away congregate in Des Moines, Iowa at a round table session of the National No-Till Conference.

One aspect of the National Conference (which Tony White also attended) that we could adopt into our WANTFA conference is the Round Table discussions sessions. Here, a group of 10–40 farmers sit in a circle, sometimes around a table, with a farmer facilitator. The facilitator walks them through specific, pre-determined topics, such as press wheel design or setting up a Flexicoil seeder. The farmers find these 60-minute segments very useful. Thanks to Frank Lessiter, Katherine and Eric for making our visit so pleasant and for the financial assistance which enabled me to speak at this conference.

No-Till Without Glyphosate?

Letter to the Editor from Kevin Bligh, Committee-member

Dear Bill,

Glyphosate-resistant ryegrass has been confirmed at two sites in the Eastern States, which raises the question; is it possible to farm profitably without glyphosate, with or without tillage? Most of the alternative selectives have bigger resistance problems!

If I had been asked forty years ago to describe the ideal knock-down herbicide, it surely would have been very like glyphosate; only slightly toxic to humans and animals, yet capable of replacing tillage for weed control.

Tillage is a catastrophic event, as Dwayne Beck articulated at WANTFA's recent Annual Conference. Soil structure declined rapidly when tractors replaced horses in the 1930s.

In the Chapman Valley near Geraldton, water erosion increased thirty-five times following tillage after eight years in a no-till and pasture rotation. Wind erosion also follows tillage on many soils, and usually, reduced the diversity of soil micro-organisms.

No soil treatment as radical as tillage exists in nature. But only one seedling of resistant ryegrass could end no-till forever. Farmers are therefore faced with a stark choice; be very careful using glyphosate, or return to less profitable tillage - and erosion.

Resistant ryegrass only took 17 years to develop on Derek Barnstable's

Echuca, Victoria property (see April '98 *WANTFA Newsletter,* P. 171). Resistance specialist, Professor Jim Pratley told our Annual Conference, that few new herbicides are being developed.

Israeli Professor Jonny Gressel, President of the World Weed Science Society recommends using high rates of glyphosate about one year in three, in order to buy time until the resistance mechanism of ryegrass is better understood (see November '97 *WANTFA Newsletter*).

He believes that by using low rates of glyphosate every year, as Derek Barnstable did, Australian farmers are unwittingly encouraging resistance. Resistance can also develop following regular high rates—but by varying rates, its development can be slowed. Using SpraySeed after glyphosate also reduces the risk of resistance to either.

Using glyphosate on firebreaks, year after year, definitely is not a good idea! Resistant ryegrass seeds will quickly spread into the paddocks. With the typical massive increase in seed numbers, you may not know you've got resistance until you hit the wall!

Since glyphosate resistance is forever, avoiding it critical to no-till—maybe even to profitable grain-growing. Do we really want no-till to disappear in a puff of smoke?

Open letter from Dwayne Beck

www.dakotalakes.com

(Editor: Dwayne was the keynote speaker at our annual conference and after his time with us he reflected on our situation. Here are his thoughts. I will publish his conference talk in the next Newsletter.)

Prof Dwayne Beck

It would be wonderful to visit Australia without having to make the flight home, however, it does beat the alternative of taking a ship. I would like to thank everyone for the hospitality we experienced whilst in WA, and I hope that our observations were of some value to you. It never ceases to amaze me that the laws of nature are fundamentally similar in all environments (at least they are in those that I have been able to visit).

I thought it might be of value to review the main areas we covered, and the observations we made whilst in WA, in case some of these points were not made at every meeting or farm visit. The schedule was sufficiently rigorous for things to get missed from time to time, and conversations with consultants, producers and scientists throughout the course of our visit also brought to light factors which may not have been evident during the first few days.

First of all, I would like to compliment all of the producers, consultants, and scientists that I met on their awareness of the problems occurring, and their enthusiasm for finding workable solutions to these problems.

The order used to discuss the following issues has no relationship to their importance. In a weak link analysis or systems approach, their relative importance will vary among producers.

Soil and climate

The first issue that needs to be addressed is the difference between your soils and our soils. Prairie soils are wonderfully forgiving living organisms. They have taken substantial amounts of abuse over the last 80 to 100 years and yet still remain reasonably productive. Australian soils are not as resilient. They are older and more fragile, and consequently, it is more important that they be managed properly. In other words, the fact that Australian soils are different to prairie soils is a major reason why they should be managed in a sustainable manner. Failure to do so will lead to far greater and far more rapid productivity losses than we would ever experience with our prairie soils.

As well as this, there are major differences between our climates. This does not mean that basic biological principles change when we cross the equator. The principles are the same, but they must be applied to different (both favourable and unfavourable) weather conditions. The approach used at the Dakota Lakes Research Farm has always been to attempt to understand how basic biological principles work in our ecosystem, and then to design farming systems that match the plant diversity, water use, and nutrient cycling of the ecosystem as closely as possible. We believe this approach has substantially decreased the amount of time it would take to develop sustainable systems using more traditional methods. As with the soils issue, I would agree that it is probably easier to emulate a prairie ecosystem with annual crops than it is to mimic the ecosystem that you call 'the bush'. The European cropping systems brought to North America by my ancestors did not work in a prairie ecosystem, so we certainly cannot expect them to work in the Australian climate.

Natural water cycles

Many of the problems being experienced in WA appear to be as a result of not matching natural water cycles. The most obvious symptom of low water use efficiency is the dramatic increase in salinity that has occurred in the 4 years since my last visit. Many of the present approaches to dealing with salinity fall into the category of treating the symptom (salt) rather than the cause (inefficient water cycling). The construction of drainage ditches and the sowing of salt tolerant species in low-lying areas merely treats the symptom. The cause of the problem is water in the upper landscape not being cycled properly. Applying water using management strategies to the lower landscape does nothing to stop the loss of nutrients (and soil acidification) associated with the 'leakage' in the system. The expense of building the drainage system, in my opinion, will pale in comparison to future expenses associated with taking this approach.

Amongst these future expenses will be the negative environmental impacts this drainage water could have downstream and the associated damage that would do to agriculture's relationship with the urban community. Also included will be costs associated with increased regulation of agricultural inputs because they will certainly be detected in the drainage water. Having nutrient or pesticide concentrations in drainage water at lower levels than current standards, or than what is already in a stream, will not be good enough in the future. It will have to be as low as what would occur if agriculture were not present. Those that question this happening should review the history of the Kesterson Reservoir in California and the more recent issues surrounding the growth of the hypoxic zone in the Gulf of Mexico. Planting salt tolerant specie in the low areas will only slow the growth of the size of these salty areas. It is not a long-term solution.

The long-term approach

Planting trees in strips or along contour banks in the upper landscape partially addresses the problem of utilising the water in these landscape positions. There are two issues that limit the long-term viability of this approach. The first, which was discussed at length, is that trees limit efficiency in farming operations and create an environment where weeds, diseases, insects, animals, birds, and the trees themselves from these strips may negatively impact the cropped areas between them. A more long-term concern is that these tree rows will accumulate the nutrients from the inter-row areas into the biomass and soil in the strips where it is not free to cycle to the crop. Strategic planting of trees for water use is better than allowing it to accumulate in low areas or drain to the ocean, but it is less than ideal.

The only way that trees could make more efficient use of available water would be if the natural bush was 'copied' to a certain extent, and trees

were established as the dominant specie on the landscape. This approach would have a profound impact on farming communities, small towns and agribusiness, unless it was limited to critical areas, or involved trees that have value on an annual and ongoing basis (fruits, nuts, flowers, etc.). Producing trees for lumber or oils, which are harvested only once in a lifetime, requires very little infrastructure. This approach should, in our opinion, be viewed as a last resort.

Salinity requires a mix

The ideal solution for salinity control and nutrient cycling is to have a mix of crops that cycle the nutrients and water on all areas of the landscape. The nutrient and water use efficiency must be fixed in order for the farming system to be sustainable. This will require the use of some species in the mix that grow in the warmer times of the year over all areas in the landscape (not just the recharge areas). This may take the form of perennial sequences (like lucerne), warm-season annuals (like safflower, sorghum, forage sorghum), warm-season cover crops, or some combination of these approaches.

Warm season crops will become a part of the rotation, and will help improve water use efficiency (water cycling) and long term profitability. Growing warm-season crops as a cash generator is a noble goal but in the short run some producers may not be able to make this happen. Their use should first be viewed as a way of reducing the cost of producing traditional crops by stabilising the system. I have no doubt that with more research and farmer experience, ways will be found to produce these crops profitably. It was exciting for me to see the level of commitment some producers, scientists, and consultants had developed toward addressing these problems by utilising more diversity. It will be even more exciting for me to witness how it finally turns out.

Determining how to balance the water use while maintaining short-term profitability will be the biggest challenge facing producers in WA. Covering all the potential strategies that could be tried goes beyond the scope of this article. The fact that the sorghums and cotton were behaving as perennials in several locations we visited indicates that they may be much better at cycling deep water and nutrients than would be expected if they behaved as annuals.

Resistant weeds

The other issue that needs to be addressed is the one of resistant weeds. Herbicide resistance is a symptom of rotations that are not sufficiently diverse. Other symptoms of this lack of diversity include many of the disease and insect problems that are occurring. There probably is time in most cases to clean up the problems if steps are taken to diversify the cropping rotations, increase competition, reduce disturbance, and limit movement of resistant biotypes from one paddock to another. In short, every effort must be made to reduce the selection pressure exerted by the herbicide program. Short rotations make the selection pressure both predictable and frequent. Companies are not producing any new magic. Even if they were, the same fate would befall it unless the selection pressure is reduced.

No one paid much attention in 1996 when we proposed that ryegrass would develop resistance to the chaff cart technique. That happened first with the development of early shattering ryegrass. This required the use of swathers in conjunction with the carts. The next step will be the development of a lodging biotype that will escape the swather. The point is, if you provide a predictable opportunity, certain species will develop a predictable response by utilising that opportunity.

Growing crops with varied seeding dates removes the predictability from the system. Stacking crop types within rotations will allow use of both long and short-residual programs to vary selection pressure and reduce the frequency of application of any given mode of action. High disturbance systems negate some (if not most) of the value of these approaches.

Efforts need to be made to determine how to handle problems such as root diseases and 'tillage responsive soils' in alternative ways, so that low disturbance techniques can be employed. With good rotations, root diseases disappear. What about tillage on tillage responsive soils? Find a way to provide that without the tillage.

Good-luck. May you have a safe and prosperous season.

Soils are alive!

A/Prof Lyn Abbott and Dr Daniel Murphy,
Centre for Land Rehabilitation, UWA (08) 9380 2503

Micro-organisms—The living soil organic matter

Your soil is full of millions of unseen workers—these are the microscopic organisms, which form the living component of soil organic matter.

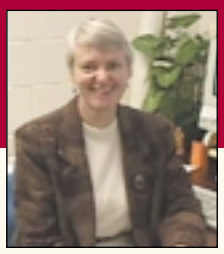
Sustainable management of soil is essential for the viability of our agricultural sector. The amount of organic matter (OM) in a soil is an important factor in controlling the potential sustainability of a system. The challenge is to identify profitable and sustainable management practices for WA soils which promote soil OM formation while ensuring profitability.

Soil OM plays a key role in plant nutrient supply (especially C, N, S and P). OM influences soil-buffering capacity, binds pollutants, and acts to improve soil structure. Agricultural practices and plant inputs influence both the quantity and quality of soil OM retained in a soil. We cannot always rely on 'best practices' developed elsewhere because of our low natural fertility and often unique soils properties. The challenge is to determine the best management practices in each region and identify what level of OM is sustainable in all WA soils.

We can learn more about soil OM decline or build-up more quickly by examining more 'active' OM components. This is because total OM changes very slowly (many years/decades). Because micro-organisms are the living component of soil they are sensitive to soil conditions, climatic changes, land use and management practices. They are often used as an early indicator of changes in 'active' OM—well before a difference in total OM is detected.

The living component

Soil micro-organisms (bacteria and fungi) only account for a few percent of the total OM, but this still equates to hundreds of kilograms of living organisms per hectare. The total nitrogen content in soil and the amount of nitrogen and carbon contained within the micro-organisms for the surface 0–7.5 cm layer



Our regular Soil Biology segment continues…

Dr Daniel Murphy and A/Prof. Lyn Abbott

for a range of WA soils is shown in the table below.

Land use	Total Nitrogen (kg N per hectare)	Microbial-Nitrogen (kg N per hectare)	Microbial-Carbon (kg C per hectare)
Pasture - site 1	750	45	315
Pasture - site 2	1500	68	476
Wheat	450	28	196
Forest	4125	58	406
Native Bush	900	33	231

These micro-organisms continuously 'turn-over' as individuals divide, grow and die. They use the dead soil OM as a food source and supply of nutrients. As they breakdown OM (ie. gross mineralisation) excess nutrients are released into the soil in plant available forms. Soil animals such as earthworms also play an important role in breaking up OM into smaller pieces but it is the micro-organisms that are responsible for the actual release of nutrients. Soil micro-organisms are also responsible for the immobilisation (microbial consumption) of mineral nutrients such as ammonium ($NH4+$) which they require for their own growth. Immobilisation reduces the availability of plant available nutrients. It is the net difference between these two opposing processes which determines the amount of soil derived nutrients that are available for plant uptake or potentially lost from the soil (Table 2). Whether net mineralisation or net immobilisation occurs is closely linked with carbon availability and the C:N ratio of the OM.

The below table shows that the amount of N released, during the wheat-growing season in the surface 0–10 cm of a WA duplex soil, from the micro-organisms as they 'turn over' was of similar size to the measured net mineralisation rate (ie. resulting product of the two opposing processes). This illustrates that the micro-organisms regulate soil N supply as they decompose dead OM and then, themselves die, releasing the nutrients back to the soil. (Data from Murphy et al. (1998) AJAR 49:523).

Microbial process	N turnover (kg N per hectare)		
	Land use		
	Wheat	Lupin – Wheat	Annual pasture
Gross mineralisation (total release of N)	100	120	282
Immobilisation (consumption of N)	57	61	160
Net mineralisation (resulting product)	43	59	122
Estimated microbial N 'turnover'	45	76	89

Considerations for soil OM formation in WA soils

WA soils are naturally infertile with low OM contents—but this still equates to tonnes of OM per hectare. They are also generally sandy with a low clay content. Generally, greater clay or OM content means the soil can better protect and provide suitable environments for soil micro-organisms. Addition of clay to the soil (effectively changing soil texture) is a possibility for increasing micro-organisms and nutrient storage in water repellent soils.

Increasing soil OM levels will improve soil fertility and structure everywhere. To maintain or improve soil OM levels we need new OM from plant debris and/or animals to exceed the rate of soil OM decomposition (mineralisation). Natural systems conserve nutrients - inputs and outputs are balanced. Over time an equilibrium in soil OM level occurs. The level reached is dependent on plant inputs, climate and soil texture. Farming systems have traditionally 'mined' the soil for nutrients causing soil OM levels to decline–. A new equilibrium can be reached in some soils. Otherwise the soil continues to decline in fertility until management practices are improved. Following are three considerations of how soil conditions influence OM formation.

Soil erosion

Animal waste and plant material (except deep roots) are returned to the soil at or near the surface. Soil OM therefore accumulates at the soil surface. Since OM is food for micro-organisms which are also concentrated in the surface few centimetres. The loss of a few thin layers of surface soil during wind or water erosion results in a disproportionately large reduction in OM and microbial activity. This problem is increased in our soils as they lack soil structure and have minimal plant cover during the summer months. Reducing soil disturbance, creating wind breaks, maintaining crop cover or increasing clay content are all practices which can help to minimise soil loss.

Soil disturbance

Large losses of soil OM can be attributed to cultivation, which makes previously protected OM available to microbial decomposition. No-tillage overcomes this problem. Whilst no-tillage reduces soil erosion it also encourages further stratification of the micro-organisms in the soil surface. This increases the potential for loss of soil fertility if bad management practices are subsequently introduced which cause soil loss.

Lack of summer rainfall

The absence of plant growth during summer months limits the production of new OM and restricts microbial activity. Increasing the period of active plant growth tends to increase the amount of soil micro-organisms. This will be a result of greater plant debris and root turnover—food sources for microbes. Strategies including: perennials, warm season crops, brown manuring and phase cropping with trees will increase annual returns of OM and aid with maintaining summer active micro-organisms. Concentration of the micro-organisms in the surface layer increases the importance of temperature and rainfall as factors influencing microbial activity. This means that small rainfall events (especially over hot summer months) can have a large influence on OM mineralisation and subsequent release of nutrients. These nutrients may become available to the subsequent winter crop if they are not leached during opening rains. Alternatively, when possible, summer cover crops may be used to 'trap' these nutrients in an organic form through plant uptake and growth.

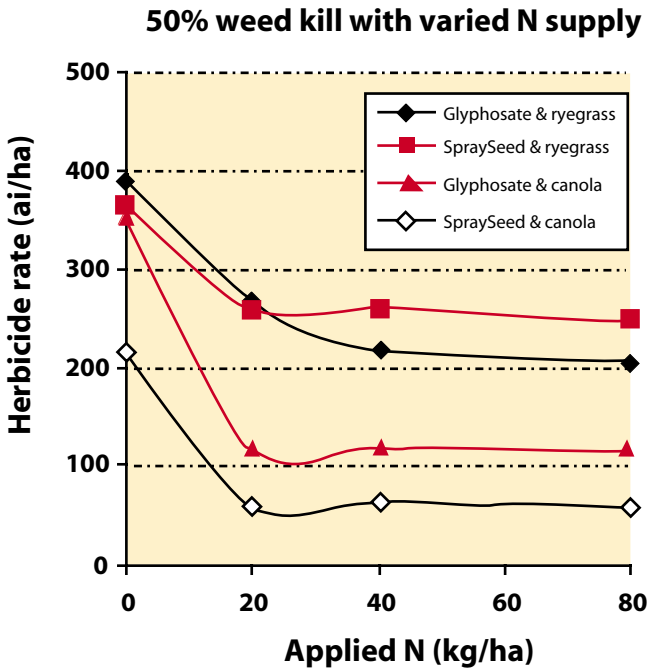
Glyphosate & Sprayseed work better if weeds have adequate N

David Minkey, AGWEST Merredin (08) 9081 3111

An accurate prediction of herbicide efficacy can ensure the most appropriate herbicide use rates. Then managers could opportunistically apply low herbicide rates with confidence and avoid herbicide failures. While researching for the Herbirate model, which attempts to determine the herbicide rate required in a given situation, I conducted a weed-nitrogen by herbicide rate trial. It was done in pots to determine if weed N status had any effect on glyphosate and SpraySeed efficacy.

Dave Minkey believes principles explored through the Herbirate project still has lots to offer WA farmers.

The results were quite startling. They showed that 2–3 times more herbicide was needed when wheat, canola, capeweed and annual ryegrass were severely N deficient.



Materials and methods

A deep sandy virgin soil from Kojaneerup was dried, sieved, sterilised then placed in pots with all nutrients applied—except N. The soil pH was 5.5 (CaCl2) and seeds of four plants (wheat, ryegrass, canola and capeweed) were planted at 3-cm depth. These were thinned to 10, 20, 10 and 10 plants per pot 2 weeks later. The pots were well watered, and kept outside on benches.

A week before applying the glyphosate and SpraySeed, nitrogen were applied at the equivalent of 0, 20, 40 and 80 kgN/ha. Glyphosate 450 gai and SpraySeed 250 were applied at 16 different rates from 0–2000 gai/ha and 0–4000 gai/ha respectively. The dose required to achieve 50% control (ED50) was calculated.

N deficient symptoms were severe and growth stopped on all plants before applying N. There was no effect of N on root growth. Applying any amount of N gave healthy green growth on all plant species.

Glyphosate efficacy

Applied N improved the efficiency of glyphosate and the size of the response depended on how much N and the weed species. Wheat usually had a lower ED50 than other species. Ryegrass was harder to kill than capeweed at low and high N rates and similar at mid rates. Ryegrass was more tolerant to glyphosate than wheat, although they had a similar reaction to N addition. Canola only required 20 kgN/ha to give maximum sensitivity to glyphosate.

SpraySeed efficacy

For all species, SpraySeed efficacy improved with applied N and was greatest on canola followed by capeweed, annual ryegrass and then wheat. SpraySeed was generally less sensitive to the level of than glyphosate—provided there was some applied N.

Mechanisms involved

Previous workers have shown that absorption of glyphosate is not affected by N deficiency but translocation was, which gave poor performance. We believe that glyphosate is less effective on N deficient weeds due to its poor translocation to the site of action and an interference with its mode of action—due to less production of phenylanaline. Decreased SpraySeed efficacy in low N conditions is from less photosynthesis activity and a direct reduction in their mode of action.

How to apply this knowledge

Weeds often become N stressed within a few weeks of germination, particularly if the paddock contained no legumes the year previous. Knockdown herbicides are generally applied at about this time and this may account for their sometimes-poor performance during this period. Therefore, if farmers were able to apply N a few weeks before spraying (perhaps before a rainfall event) then their herbicide efficacy could improve significantly. The same benefit could be possible with selective herbicides and N nutrition.

In the field, it is hard to determine weed N status—which varies with weather events. A simple measure of weed N status could be useful. This work showed that by taking plants and monitoring the rate of new leaf addition correlated well with nitrogen status and herbicide efficacy. Therefore, farmers could monitor the change in leaf numbers over the week proceeding spraying to improve herbicide rates.

It would appear that if grasses were growing at more than 0.3 leaves per week then lower rates of glyphosate or SpraySeed could be used. Similarly, canola needs to be growing at 0.75 leaves per week and capeweed at 1.5 leaves per week for maximum herbicide efficiency. These 'rules of thumb' need testing under field conditions.

Raised beds improve cropping of waterlogged soils

Dr Derk Bakker (with G Hamilton, D Houlbrooke, C Spann & D Rowe)
AGWEST, Albany (08) 9892 8464

This is the third year of a five-year GRDC project on the application of raised beds to waterlogged soils in the Great Southern. There are eight sites which vary in size from 6–66 ha (average 27 ha).

Seeding was done with a new air seeder tailored for high mobility to service the raised bed sites and equipped with

John Walker disc openers. Good crop establishment was obtained at all sites—except in the furrows at South Stirlings. A wet start to the season and below average rainfall during June and July was experienced at all sites with a drier July at Badgebup (Katanning) but average conditions in Esperance. Harvesting was done with a commercial harvester equipped with narrow dump truck tyres to fit the furrows.

The raised beds increased crop grain yield on average by 20%, with a range of –4% up to 43%. The biggest responses came from the wettest sites.

Usually where there were no responses, the sites were dry (like Badgebup). At all sites the dry matter (DM) from the beds-only out-yielded the control, by up to 50%. At South Stirlings no crop was established in the furrows—producing no DM, therefore the grain yield from the beds came from the raised section only (none in the furrows).

Derk with assistant David Houlbrooke measure soil water movement in the beds.

Location	Crop Type	Dry matter (t/ha) in:			Control DM (t/ha)	Diff (%)	Grain yield (t/ha)		Diff. (%)
		Bed	Furrow	Total			Bed	Control	
Beverley	Peas	5.1	0.9	3.9	4.0	-3	2.0	1.4	41
Woodanilling	Peas	5.2	2.1	4.3	4.0	7	1.5	1.0	43
Toolibin	Canola	5.8	1.0	4.5	4.9	-9	1.3	1.2	14
Badgebup	Canola	6.9	4.2	6.1	6.4	-5	1.8	1.8	-4
Cranbrook	Wheat	7.0	1.4	5.4	4.7	16	2.4	2.0	18
MBRS	Canola	6.8	2.1	5.5	4.7	17	2.2	1.9	12
South Stirling	Wheat	9.2	0.0	6.6	8.0	-18	3.4	3.4	1
Esperance	Wheat	6.9	3.5	5.9	5.0	19	3.6	2.7	34
	Average value =	6.6	1.9	5.3	5.2	3	2.28	1.93	20

Soil water relations

The establishment and maintenance of good soil conditions in the raised beds are essential to maximise their benefits. The beds should have a well-structured root zone to ensure rapid drainage and aeration shortly after rainfall. Of the beds measured, after 2 years they have maintained a higher topsoil conductivity than the control areas. Summer grazing at Cranbrook reduced the conductivity of the beds, but it still remained high compared to the control areas. Conductivity was reduced between autumn and winter at Toolibin in the beds and the control, but here, bed conductivity remained high—even during winter.

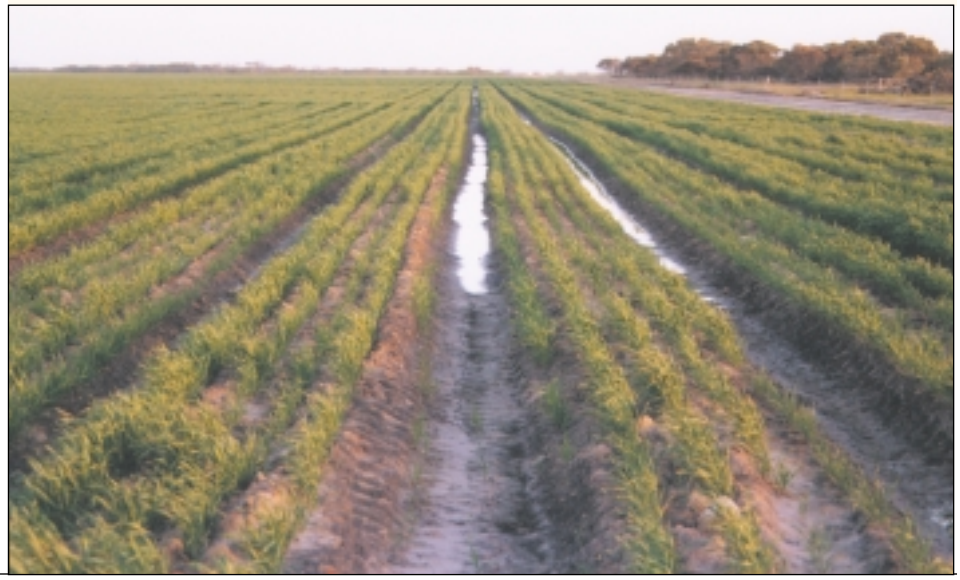
Shallow placed tensiometers showed that raised beds dry faster than the control. This explains the substantial capillary rise that was observed in the subsoil under the beds and also why the profile dried out faster than the control. Run-off was measured at 3 sites. There were no significant run-off events generated throughout 1999.

Conclusion

For the third successive year raised beds have proven to be a robust soil management system—producing yield advantages for a range of crops, climatic conditions and soil types. During this time the soil conditions have remained such that rapid drainage of the beds is ensured to eliminate waterlogging and reduce the potential for recharge. However, the raised beds do not necessarily increase runoff—which is affected by rainfall patterns, intensity and stage of the crop growth.

Above: Run-off is measured during high intensity rainfall events.

Below: Water ponding in the bed furrows at the South Stirlings trial site on Mark Adam's farm – the beds can still be effective even if they run through slight depressions.



Fate of ryegrass when sheep graze chaff heaps

Keith Devenish, AGWEST Northam, Lisa Leaver, Muresk honours student

The aim of this Muresk Honours based Project (sponsored by WANTFA and Monty House: Minister for Primary Industries) was to measure the impact on the spread of ryegrass seed when sheep graze chaff cart heaps in wheat stubble. There were two trials conducted, one at Mingenew and the Honours project site was at Yerecoin.

Keith Devenish, AGWEST Northam, Piers Blake, farmer and Lisa Leaver.

Catching weed seeds by towing chaff carts behind harvesters can collect up to 80% of ryegrass seed from wheat crops. Burning the chaff heaps can destroy these seeds. However, farmers were concerned that grazing spreads the ryegrass seed back into the paddock and may make a hot burn less achievable if sheep spread the heaps out too far. Chaff cart heaps can burn for up to four days, creating a fire risk, and smoke emitted from the heaps has a social impact. Burning is also time consuming.

Spread of ryegrass through the faeces

Studies on ryegrass viability, after being ingested by sheep, show that 1–3% of ryegrass seed is viable seed in sheep faeces. Observations suggest that small numbers of ryegrass seeds germinate in sheep camps where faeces are concentrated and a 100g faeces collection produced only one viable plant. A larger number of viable ryegrass seed do pass through cattle. Some farmers have noticed that cattle spread the heaps more than sheep and soil them with urine and faeces. Therefore, grazing cattle on chaff cart heaps will leave more ryegrass than sheep would.

Two trials

The Mingenew trial was on a sandplain paddock where ryegrass seed spread was measured from chaff cart heaps as a consequence of sheep grazing. At harvest, the chaff cart heaps were dropped in a 120 ha paddock of wheat stubble in a row at right angles to the direction of travel—without stopping the header. An ungrazed treatment was fenced to exclude stock while the second treatment was grazed and burnt. The third treatment was grazed and left unburnt.

After grazing, the germinated ryegrass plants were counted at 1, 2, 4 and 8 m distances in each direction from the heaps—after it rained. The first count was after a March rain, before the weeds were sprayed out, and a second count was in June after winter rains—when the crop was sown. Three block treatments were applied to 15 chaff cart heaps with 5 heaps in each treatment. A similar trial was conducted at Yerecoin where germination counts and soil samples, before and after grazing, were taken to measure ryegrass seeds.

Results

Perhaps surprisingly, grazing did not reduce the number of germinated ryegrass plants at the measured distances from the chaff cart heaps at both Mingenew and Yerecoin (see table below). There was also no detectable difference in total ryegrass seed numbers where soil samples were collected before and after grazing at the Yerecoin trial. Also, there was no direction effect on the spread of ryegrass from prevailing winds at either trial.

Distance from heaps (m)	Mingenew			Yerecoin	
	Grazed not burnt		Ungrazed and burnt	Grazed & burnt	Ungrazed & burnt
1	345	380	395	219	278
2	309	291	352	259	242
4	288	282	358	207	208
8	270	297	334	156	199

Spread of the heaps

Grazing did reduce the volume of the heaps from 10.5 m3 to 6.3 m3 and increased the heap area three-fold. The spread happened within 2–3 weeks of grazing, suggesting that sheep spread the material while foraging for grain and other fine residues (fines). Initially, weaners were grazed at Mingenew, but didn't target the heaps so were replaced by adult ewes grazed at 5–6 hd/ha. In both trials the adult ewes tended to graze the heaps intensively, yet there was only minimal contamination from faeces and urine.

Sheep feed value

Neither dry matter digestibility (47%) nor crude protein (5.6%) were affected by grazing the heaps at Mingenew. These levels are too low to maintain grown sheep liveweight, and explain why the sheep targeted the fines and foraged for the best feed immediately. The hectolitre weight reduced from 74 to 50 g/HL by grazing, but remained the same for ungrazed heaps. The ewes appeared to maintain weight (although this was not measured).

Heaps remained defined

Grazing reduced the height of the heaps from 1.0 m to 10–15 cm. Importantly, the edge of each heap remained well defined and there was no difficulty in obtaining a hot burn to destroy ryegrass seeds. Grazing, and the spreading of the heaps did help them to burn more quickly.

Cropping over unburnt heaps was possible

After grazing, the no-till knifepoint seeder easily passed through the grazed and unburnt heaps. Seeding did not distort the heaps excessively and burning after this was still possible—an advantage for fragile soils! Heaps do need to be burnt at some stage—to destroy the ryegrass.

Thanks to:

The farmers: Piers and Robin Blake from Mingenew and Tom, Beth and Richard Field from Yerecoin for their support. GRDC for funding Keith. Danny Roberts from AGWEST gave valuable advice and Dr Gaye Krebs who supervised the Honours project.

Too wet for no-till alone

Harvey Morrell, Beverley (08) 9646 0154 p/f

We farm 963 ha of mostly heavy low-lying soils 33 km east of Beverley in the 375 mm rainfall area. I farm with my son Scott and wife Dianne. We crop 48% of the farm and run pasture on the remaining. We also have 40 ha of saltbush grazing land, which provides a grazing capacity of 50% more than other annual pastures (on an annualised basis). Liming has recently become an obvious need, with many of our soils having a pH in the mid-4's.

Harvey compares the difference in root growth from within the bed against the control.

History of no-till adoption

We began reduced tillage in 1985 and reduced this further to direct drilling (of one pass with a combine and scarifier hooked together) in 1990. We did this because we had a major waterlogging problem on our Salmon gum clay and shallow duplex soils.

We began no-tilling with Super Seeders and home made closers. Then we changed to Harrington knife points, with extension to 18 cm, in 1996. Until 1996, we were seeding with a Massey 80 combine, then we purchased a Shearer TCD that gave us the benefits of higher breakout pressure and better trash clearance.

Harvey's seeding system.

Deeper tillage with knife-points improved root development but it is difficult to prove any yield improvements. Nutrition and limited soil life seem to be yield limiting factors, which we will be attempting to improve through trials (and stubble retention).

Weed issues

Weed populations have increased during our time of no-tillage adoption. Also, the level of ryegrass that is tolerant to Fop and SU herbicides is a concern. Silvergrass is our next most prominent weed—which seems to be increasing! Both of these weeds grow well in the furrow that is created by our knifepoint seeding system.

During the last two years we have increased our seeding rates and used a shallow tickle at the break of the season. This combination seems to have reduced weed competition. Another tool that we use discretely is fire.

Raised beds

We have been experimenting with raised-bed farming in conjunction with AGWEST during the last three years. We have large areas of low-lying land that regularly waterlogs for long periods during winter—despite our modest annual rainfall of 375 mm/year.

Most of these low-lying soils are shallow duplex with 50–80 mm of sand or loam over clay. Our average wheat yield over the experimental area for 21 years is only 1.3 t/ha. We needed to radically improve this. No-till did help improve infiltration, soil structure and trafficability, however, the soil just could not handle the excess water during winter *(Editor: Could sorghum have a role here?)*.

To establish the raised beds, we first applied gypsum, and then deep ripped and raised the beds (see similar photo in Tim March's story). In the first two years of crop establishment we used the Great Plains and then in 1999 the Walker triple disc drill. These zero-till seeders maintain the shape of the beds longer than other seeding systems.

The first two seasons of the trial were in dry years, with oats and then canola sown. Despite the years being dry there was still a slight yield advantage for the raised beds (see table). In 1999, the trial was sown to field peas and this was a considerably wetter season. The yields from the control plots were 1.39 t/ha and the raised bed yielded 1.96 t/ha. The yield variation over the control plots was 22% and for the raised beds it was 4%. The uniformity of yield in the raised beds was six times better than in the control. The 1999 season was the first year where we had enough rainfall to cause run-off from the beds or waterlogging in the controls.

Year	Crop	Raised bed crop yield (t/ha)	Control crop yield (t/ha)	Grain yield increase (%)
1997	Oats	1.44	1.14	26
1998*	Canola	0.94	0.98	–4
1999	Peas	1.39	1.96	41
2000	Wheat			

canola sown too deep in the beds.

Raised bed potential

I'm quietly optimistic about the potential of raised beds on large areas (30%) of our farmland. The benefits include; reduced waterlogging and ground water recharge, enforced controlled traffic, trafficability throughout the season, potential to collect runoff and use it for lengthening the season or in other enterprises and the potential for making saline areas profitable. All these benefits increase gross margins.

Some disadvantages we've observed at this point are; the need for specialised machinery for construction, adjusting track widths to suit, higher maintenance if grazing is to continue and the difficulty the beds impose for controlling fires.

Raised beds and continuous no-tilling

Steve Marshall, Dalyup, Esperance (08) 9076 5046

We farm west of Esperance on the sandplain in 500 mm rainfall country and in transitional mallee country (350 mm). Ten years ago, we were mixed farmers—with sheep and cereals. Our cropping methods included two full-cut workings and one full-cut seeding. Farming was tough. Sheep and wool prices were down, the clays were getting harder and the sandplain was at great risk of wind erosion. It was time for a change.

1992 was our first year of single pass direct drilling. The recreational tillage was replaced with Roundup and our first crops of legumes were sown. We used a full cut, but had heard about no-till, so we decided to investigate. After seeing the success of some local farmers pioneering no-till we decided to make the change.

In 1993, we seeded using knifepoints and press wheels and the crop still grew! The sheep had all but disappeared, and were replaced by more crop legumes in the rotation. We started using early knockdowns to "make our break" to the season by taking advantage of early stored moisture. We could now start sowing on 10 mm of rainfall instead of waiting for 20 mm.

In 1994, the driest year on record, we only had a limited rainfall window for sowing and growing a crop. The advantages of no-till farming were clear. The last sheep had disappeared and we were in a full crop rotation. It was our first year of dry sowing. We were amazed at how many seeds germinated and grew in limited moisture using no-till furrow sowing.

In 1995, we added leading angled coulters in front of the knifepoints and press wheels. The clays were getting softer and the sand plain had full stubble cover. Our yields were 'on the improve'.

In 1996, stubble handling had become our biggest problem so we seeded using all discs, a leading coulter and double disc openers. We became concerned about our fertiliser being placed too close to the seed affecting the germination—especially the smaller grains.

Soils now getting too wet!

In 1997, we noticed paddocks becoming wetter, not just in isolated water logging areas. We also split our seed and fertiliser and put the fertiliser down with the leading coulters. We sowed our first summer crops of grain sorghum and sunflowers. It was a very dry summer, but they still grew and were harvested—grain sorghum showing most potential. However, with a limited domestic market and with low feed prices it made the economics questionable.

In 1998, waterlogging on the sandplain again was our biggest problem. Years of stubble retention were keeping the rain where it fell. Paddocks were like sponges; even sloping ground was waterlogged where it had never been waterlogged before. Weed management had become a major problem under these conditions and our crop yields were down. The crops on the sorghum and sunflowers still became waterlogged, however they survived three weeks longer than crops on our winter-only rotation.

Raised beds explored

We heard about Tim March who was pioneering raised bed farming out east of Esperance (see his story next). We visited him and we liked what we saw. His crops on the raised beds were healthy while crops on the flat were showing early signs of waterlogging and reduced vigour.

Then in 1999, we adopted raised bed-farming while placing our seed and fertiliser with the discs. The use of discs is an important part of the raised bed farming system—they preserve the beds and can handle high levels of stubble. Controlled traffic is a bonus. The raised bed machine we use has ripping tines every 400 mm and furrowing tines every 1.8 m and bed shaping boards at the rear.

Making raised beds in stubble has a few challenges. However, it can be used to advantage to help protect the freshly made beds against wind erosion. We increased the angle of the bed shaping boards as much as we could and widened the exit distance to help with stubble and soil flow. This year we are using spring-release shaping boards to make the job even easier.

The weed bank was huge after 2 wet years and presented us with our biggest problem after the beds were formed. We used every technique we knew to overcome this problem—even up to 5 knockdowns on some paddocks. We tried late sowing with shorter season varieties. We used gramoxone 7

days after sowing, plus crop topping any hot spots. The results were spectacular and we were back in control. We had 850 mm of rain 330 mm above our average (on the sandplain) and we survived what would normally have been a wipe-out!

What have we learnt over the last ten years?

We have to have the whole package. It is essential to have grass free legumes. They are the engine room of a successful crop rotation. Long-term no-tilling and stubble retention greatly improves our soil structure on all soils leading to higher production and reduced wind and water erosion.

Raised-bed farming systems, in the higher rainfall farming areas, can minimise the risk of failure from waterlogging and maximise yield potential to levels not seen before.

Our annual water use has to improve, using longer growing varieties, and incorporating summer crops into our rotation to help control a rising water table and salinity. Our yield potential has almost doubled leading to greater nutritional requirements.

Issues with a no-till farming system that concern us in the future, are the emergence of hard-to-kill weeds like marshmallow and windmill grass and our reliance on glyphosate as the major knockdown herbicide.

Rules of thumb learnt about no-till seeders

- Discs or tines don't matter—except when incorporating trifluralin.
- Stubble handling ability is a major priority.
- Soil should be loosened under the placement of seed.
- Seed should be placed accurately.
- Fertiliser should be placed away from the seed.
- Expensive machines are not necessarily better—but are usually harder wearing.

Raised beds reduce risk

Tim March, Condingup (08) 9075 0028, fax 80

I farm in a 575 mm rainfall zone, 85 km east of Esperance. We suffer from some form of waterlogging nearly every year on our farm. I have been a no-till farmer for six years, but have changed from a knife point no-tiller to a raised-bed farmer—which requires severe cultivation intensity. We have to rip, create furrows and form a 1.8 m wide bed to a depth of 200 mm.

Recently, farming has become a serious form of gambling. After suffering a couple of financial loss years due to waterlogging, I decided to do something about it. After talking to Greg Hamilton (AGWEST, Perth), who has GRDC funding to research raised beds, I decided the principle had merit.

Drains take the water off the paddock – the raised beds cut across this drain.

I then went to Queensland, with Brian Kerr, to look at the furrow forming equipment they use to make raised beds in irrigated agriculture. Their laser levelled paddocks are flood-irrigated and this can cause crop damage, consequently they developed raised beds. Seeing this, and understanding their logic, helped convince us that it was appropriate for us, so we ordered the components to develop a bed-former. We made a few small changes to make it suit our soft soils and we were able to make a machine that could rip, furrow and form—all in one pass—that was ready for seeding. We could probably also add a seeder to this for greater efficiency.

Mental and practical barriers

There are a few mental barriers to overcome when embarking on raised-bed farming. The first is that you are actually going to rip up your paddocks. Thought needs to be given to wind erosion, and sometimes we do lose some seeding timeliness, as we wait for soils to wet up. We also run the beds north-south across the prevailing winds.

Raised beds can be formed in the one pass.

Much of the currently available machinery is not suitable to our conditions. We modified and traded to keep within our budget constraints. However, it can be done on the cheap if necessary. New custom-made machinery is very expensive.

Drainage needs to be planned and every paddock is different. Our sandy soils are not deep enough for laser levelling so some sort of drainage plan is needed. It is not as big a problem as you may think, as less water runs out of the beds than from a flat paddock. This is probably due to the greater water holding ability of the aerated beds compared to a flat, compacted paddock. Also, drainage can be expensive and we have left some areas to pond and act as sacrificial sumps.

Ripping and aeration benefit is greatest

I feel that the ripping and aeration provide most of the raised bed benefit. This allows the soil to hold more water. The furrows make up the next component and provide the insurance policy, or safety valve, which lets excess water run—in the event of a sustained heavy rainfall. The other minor benefit is the control traffic gains. Our soils seem to settle after time, so I am prepared to reform the beds in every cropping year–. Better soils probably don't require this.

Our rotational system is two pastures followed by two crops. Pastures are sub-clover based and the crop sequence is normally canola followed by a cereal then back to pasture. This is the first year that sheep are returning to our first bedded paddocks for the pasture phase. It does not seem to be a problem other than requiring some thought on mustering them off the paddocks. We will be reseeding some of these paddocks, so I may develop the combined ripper/seeder to reduce the beds in a single process. Otherwise, we are happy to put up with the beds, which are in a somewhat weathered state anyway.

Give it a go!

I happily recommend raised-bed farming to those in rainfall areas of above 450 mm. It has taken a lot of the stress, and gamble, out of my job—and made it both a bit more fun, and more profitable. The ultimate goal of 100% reliability of cropping, in high rainfall areas, may be possible as a result of raised bed farming.

Herbicide mixes with limesand

Winston Broun, Coorow (08) 9951 1205, fax 148

Our previous farming practices dictate, to a degree, what we do in the future. In our case the over-use of herbicides, early in their release, has created resistance to Fop's, Dim's and SU's. We now rely heavily on trifluralin to control ryegrass. A major problem with using trifluralin with water is that it gets tied up on the stubble, often giving very poor results.

It is obviously not sensible to overuse trifluralin either. Therefore, our desire is to use trifluralin on paddocks where we have retained stubble and which also have a known resistance to the other herbicides.

Why mix the two?

Since we need to lime large areas of our farm, and we also wanted to use trifluralin, we decided in 1998 to try mixing the two. Perhaps the trifluralin would get through the stubble, and onto the soil's surface (where the weeds are) if we mixed it with lime.

Sadly, I got little encouragement from some consultants and company representatives who market trifluralin. When asked about trifluralin's ability to mix with limesand and their likely combined effectiveness, their response was "no trials have been done—so it is not likely to work".

Mixing them

At the time we were using 2–3 L/ha of 480 trifluralin on canola. Despite little encouragement we decided to try it any-

Above: The following treatments were applied to a wheat stubble. L–R: Chained & raked; raked; chained, raked & tickled; burnt & tickled; burnt only. All had limesand mixed with herbicide. Far right is burnt stubble with liquid Treflan applied.

Above: Winston could clearly see the effect of trifluralin applied with limesand on the right.

Left: Area near drum had a tarp placed on ground and limesand mixed with trifluralin spun over the surrounding area.

way! We mixed enough herbicide (trifluralin, simazine and atrazine) through an auger, to do about 8 ha. Water rates for the limesand were 17–19 L/t of lime or 34–38 L/ha. It was about half this for the granite dust—as granite is impervious.

All seeding was done with SuperSeeders, press wheels, 9" spacing, 7–8 km/hr and with 5 kg/ha of Karoo canola which was sown in the bottom of the furrow. The rate of limesand was 2 t/ha.

The results were outstanding! It appears that the 1.0 t/ha rate of limesand might not be enough, certainly the 0.5 rate was too low.

Our 1998 experience convinced us to do more in 1999. We planted 850 ha of canola and 120 ha of lupins. We contracted Peter Nunn from Dongara to make up a belt fed heavy-duty auger. This worked very well with mixing capacities of between 75–90 t/hr. We mixed 1,700 t of limesand and 250 t of granite dust (experimental) and, as a side trial, Impact-in-Furrow onto fertiliser. Again, the results from the 1999 work were as pleasing and convincing as those in 1998.

We did some demonstration strips of different rates of limesand with the one-herbicide mix (3 L/ha of trifluralin (480 gai), 0.6 kg/ha of Atrazine and 0.6 kg/ha of Simazine). Mark Chmielewski, from Three Springs AGWEST, was kind enough to do plant counts, help harvest grain and measure oil content and admixture. Note: the strips were not replicated and the data shown in the below table have no associated statistics.

Limesand added (t/ha)	New soil pH (CaCl2)	Canola yield (t/ha)	Ryegrass plants (pl/m^2)	Oil Content (%)	Admix. (%)
0.0	5.1	0.66	>400	42.5	11.2
0.5	5.4	1.15	50–150	42.7	4.9
1.0	5.8	1.22	0–25	42.5	3.0
2.0	6.8	1.28	0–25	42.0	3.0

In a separate, and adjacent, strip we incorporated the limesand/herbicide mix three weeks before seeding. This gave the best ryegrass control, with less than 2-ryegrass plants/m2, compared to 25 plants/m2 with the knifepoint seeding operation only.

Trifluralin left on surface—worked!

In another strip we topdressed trifluralin and limesand onto the surface for 4 weeks—with full stubble, before incorporating it. Then, 3 weeks after this incorporation, we seeded. This also gave good ryegrass control—but we need to do more trials on this before we are confident of doing it on large areas.

We also experimented with granite dust fines (from a quarry) to see if it would substitute for the lime when seeding lupins. Lime applied before lupins usually reduces the yield. These fines were also effective on ryegrass control—but the 250 tonnes used completely wore out the multi-spreader spinners.

Other questions

This has been an exciting discovery for us, but it has raised lots of other questions, like:

1. How much herbicide gets tied up by the carrier, (ie. what is the true rate needed)?
2. Some soils don't need lime, so what other carriers should we use?—Perhaps gypsum?
3. A more accurate spreading system is needed—as wind affects evenness of coverage.
4. The need to, and timing of, incorporation—time is precious at seeding.
5. Will other added chemicals have an inhibiting or synergistic effect by being mixed with the lime?
6. What herbicides can be used?
7. What is the effect of different soil types?

Possibly there are many other questions that need to be answered. But, with our recent experiences, we are happy with the results of mixing solid carriers with some herbicides so far.

(Editor: Winston inspired the WANTFA lime and trifluralin trial at Meckering [and the East Maya trial with the Liebe group] this year—see the results in this Newsletter. Many thanks to Winston for having a go—when others doubted.)

ROTATE, AND BE CONFIDENT YOUR RESISTANCE MANAGEMENT PRACTICE IS UP TO SPEED

A VICIOUS CIRCLE

With broadacre farmers becoming increasingly reliant on knockdown herbicides as part of their minimum/zero tillage programs, the problem of herbicide resistance is quickly eliminating the number of effective weed control options.

This is particularly true of ryegrass, where there have been a number of documented cases of resistance to glyphosate; the most widely used non-selective herbicide in the world. So it's time for alternative thinking.

ROTATE TO SPRAY.SEED®

For maximum weed control and long term viability, leading researchers and Avcare (AHMC) confidently endorse the strategy of rotating group M herbicides (glyphosate) with Group L herbicides, such as the unique paraquat chemistry of Spray.Seed.

Rotation strategies can include the "double knock" approach, where the application of glyphosate is followed 7-10 days later with Spray.Seed. But rotating to Spray.Seed has many other key advantages as well.

THE QUICKEST GOING ROUND

No other herbicide gets you ready to sow sooner than Spray.Seed. It's rainfast in minutes, and it can be applied at any time of day (even in dull and cloudy weather). What's more, you can start sowing an hour after application. Turn your thinking around. For speed and confidence, ask your local Crop Care dealer about rotating to Spray.Seed.

Crop Care

SPEED WITH CONFIDENCE.

Spray-Seed is a registered trademark of Crop Care Australasia Pty. Ltd. ACN 061 362 347.