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Western Australian No Tillage Farmers Association (Inc)

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Spread that straw!

Are you planning to no-till next year? Then you must cut the straw short, chop it up and spread it evenly (unless you are zero tilling you may prefer long and ungrazed stubble). You may even need to go to wider rows and spread the tines out to get through the stubble.

But right now, at harvest, you have the chance to save a lot of pain and frustration at seeding. See the July '98 newsletter advertisements for two units that will do the job for you. The Redekop choppers are available from Agrow Machinery on 9671 1311 and the Kirby straw spreader is available from Burando Hill on 9821 4422.

Is no-till really declining in WA?

Comments heard on my recent visit to SA and the Hart Field Day could have made me think that herbicide resistant weeds had forced WA farmers to abandon no-till. Is this true?

Interestingly, my understanding is that the opposite is true! Many farmers have adopted no-till as a means to fight resistance. And no-till is still being adopted at a rapid rate in WA.

Perhaps 45% of the state is now no-tilling with knife points or discs. In many areas - everyone is no-tilling! In some areas only a few are no-tilling, but there is lots of interest! Most of WA sandplain farmers are no-tilling with confidence and many farmers with the grey clay (Sunday) soils would strongly resist the move back to slush or concrete experiences of the tillage days.

In contrast to no-till, there is a decline in direct drilling. And this is no surprise! Direct drilling is the worst of both tillage worlds for weed control, seed placement and trash flow. Direct drilling stirs up weeds with aggressive soil movement and does not allow the weed seed placement benefits that no-till provides.

The photo below, taken in September this year, clearly shows the weed control benefits of the least tillage system. The trial has been conducted by David Bowran (AgWA Northam) and now is being managed by David Minkey (AgWA Merredin). After 6 years of the same herbicide and tillage treatments the no-tilled plots are much cleaner that the direct drilled plots.

David Minkey inspects lupins no-tilled (on left) or direct drilled (on right) at Avondale research station

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

GRDC

Grains Research & Development Corporation

Left hand plot is no tilled, right is direct drilled.

Right hand plot is no tilled, left is direct drilled.

Trifluralin damage again!

Once again there were many reports of trifluralin damage with no-till. In the northern sandplain it was quite clear what went wrong (see Mike Doherty's story in this issue). Trifluralin applied on dry soil and then no-tilled without stubble saw lots of soil move into the furrows - taking trifluralin with it. This was a sad combination for many.

In the central wheatbelt I saw two cases of soil wash causing the same problem. High rates of trifluralin were applied to 'heavyish' soils without stubble and wide rows were used. This probably would have been okay if heavy rain hadnot fallen soon after seeding and causing the soil-and-trifluralin to move into the furrow. Heavy stubble levels at a Brookton trial site (see photo in weeds and no-till issues story) has still resulted in good trifluralin results.

Trifluralin damage again!

Dry sowing questioned?

Just think how much you are shortening the effective life of the triazines, trifluralin type and SU herbicides every time you dry seed. It would be much safer to preserve these herbicides by waiting for 7-10 days after a break and then apply a knockdown herbicide to reduce the selection pressure. However, I know this is tough to do in the wheatbelt where rains can be scarce and there are often canola and lupin yield benefits to dry sowing.

A sensible compromise might be to only dry seed each paddock every 4-5 years, only seed into paddocks with low weed levels and only do it if there is enough trash to stop wind and water erosion. Remember too that if you are no-tilling and have sprayed out any early weeds then the soil will be somewhat moist and you may be surprised at how well no-tilled crops emerge in apparently dryish soil.

White ants in 11 month old Canola stubble.

How sustainable is canola without soil?

I sat frustrated as I heard a friend talk at a "Kick Start Canola Meeting" early this year. He told us that we must sustain the

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Dwayne Beck uses a disc plus a residue manager to move stubble from seed row.

Residue manager from Yeltex

Ausherman's residue manager.

canola industry, and the 50 of us were told that the biggest threat to the canola industry was black-leg and that stubble reduction was critical.

I couldn't help but think 'just how sustainable is the canola industry if we expose the soil to wind erosion by removing the stubble?' Any soil loss is not sustainable. The most important black-leg carrying agent is the root material just at the soil surface - not the stem and leaf, as many believe. And removing canola roots is a scary thought!

Canola has a chance of coming back, like it has done once already - but soil does not!

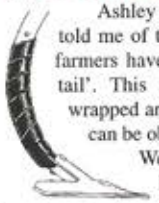
In mid-October at north Kelleberin, Kit Leak and I discovered lots of white ants eating last years canola stubble. By destroying stubble these opportunities have a reduced chance of expressing themselves.

Spreading straw evenly can act as a weed controlling agent and even chaff spread will improve the effectiveness of all herbicides - the weed challenge is spread.

Residue manager

An important goal of our trip to North America was to look into residue managers. Frequently farmers have observed crop damage when crops, particularly canola, are sown into thick cereal residue. Above are some residue managers that are made or are being experimented with.

Pigs tail for better trash flow



Ashley Mead from NSW Agriculture at Cowra, told me of the great improvement that many NSW farmers have had with trash flow from using 'pigs tail'. This robust "glad wrap" type material is wrapped around the tine for a cost of $3-5/tine and can be obtained from a Brisbane company called Weldalloy (ask for Scott Bartlet or Andy Lawson (07) 3271 4630 fax 32).

Are they knife or blade points?

There is confusion with the above terminology. As I understand it, blade points refer to one manufacturer's product, while knife points are a general term. Perhaps we should all use the term knife points unless we are referring to that one specific company's product.

Mushroom magic

Mushrooms are showing up in huge numbers when tillage is reduced, especially with no-tillers. Like earthworms, mushrooms indicate that there is a change happening in the soil - a mostly good change! Cultivation favors bacteria, while no-till leaves the fungi and earthworm food on the surface for 3 square meals a day."

"This activity also means that nutrients are more slowly released from the soil complex. And it explains why many no-tillers think that it takes about 5 years for stubble to really start to work for you. This is an argument that suggests some caution with the desire to strategically burn."

The magic of Mushrooms in no-till soils.

TOPICAL SECTION

PRESIDENT'S REPORT

Geoffrey Marshall, Hyden 9880 0018, fax 38

The bus was not big enough! But you should have all come with us to experience the fantastic things that our US & Canadian tour group have. Strenuous, well organised and very ably led by Bill and Monique Crabtree and Wayne Smith, this group of 46 people have shared a lot with farmers, researchers and many others. This, and subsequent, newsletters will attempt to share some of those experiences.

Dwayne Beck on his research farm was, as expected, a two-day highlight. His systems approach using longer rotations, retaining crop residues, no-till crop establishment and ensuring different crop types are included, makes good sound logic. To see the application of his theories along with his deep understanding of so many issues, is such an inspiration.

'Beck' will be talked about a lot more, as his rotations approach to solving 'all' present production problems is challenging to farmers and researchers anywhere. This ability to raise yields and lower input costs is being achieved. Dwayne's more challenging necessity is to include deep-rooted warm-season crops into the farming system. Many of the tour group are sowing these type of crops now to test their value in our system. Good luck to all those who are accepting this challenge - my 22 ha of grain sorghum is just emerging.

The vision of your committee for over two years (inspired by Dwayne) has been to have a similar 'rotation-type' demonstration site here in WA. We have just received correspondence from NHT that our application for some of the required funding for this project has been successful. This is great news as we have a start now and are optimistic that other funding options will follow to allow such a valuable site to be established in WA. Thanks to those responsible for showing their faith in our application.

We arrived home on the 17th of September to enjoy the best wheat crops ever, for just a few days, before nature delivered a cruel blow. Yes! A year that will be remembered as 'the one that nearly was' by so many farming families. Costs of this severity must be put into the one in fifty year event category with the need to be calm about decisions made for following years. The need to plan on a paddock by paddock basis to give the best chance to next year's crop, will be very important before harvest with stubble management in mind. I wish you well with your harvest and sincerely hope you are pleasantly surprised.

Meetings planned for February are focusing on weed biology and herbicide resistance with excellent speakers and I look forward to meeting you there. See inside for details.

ANNUAL CONFERENCE 10-16TH FEB '99

Bill Crabtree - Scientific Officer, 0417 223 395

An exciting group of scientist and farmer speakers will be the highlight of our next annual conferences. Speakers include Canadian weed ecologist Dr Doug Derksen, local UWA Professor Stephen Powles, Victorian farmers Allen and Yvonne Postlethwaite, Lake Grace farmer Steve King, WANTFA Scientific Officer Bill Crabtree, AgWA Merredin researcher Dave Minkey and many more - stay tuned!

We plan to take the speakers to meetings at Geraldton on the 10th February and Esperance on the 11th - 12th before the SEPWA meeting. We will have a full two day event at Muresk Northam on 15-16th, just before the AgWA Crop Updates. We intend to have some dedicated discussion sessions at the Northam location. Topics are likely to include disc zero-tiller sharing group, new no-tillers, herbicide resistance and weed ecology.

CLARIFYING WAYNE'S COMMENTS

Bill Crabtree - Editor

As I suspected Wayne Smith's 'Consultants Perspective' in the July 98 WANTFA newsletter stirred many within the agricultural community. Many people were thrilled to read the free flowing independent critique of seeders, fertilisers, herbicides and tillage, so thanks Wayne for your thoughts!

However, after discussions with industry, there is a desire that I elaborate on the issues that Wayne raised. There is no doubt that the no-till machines and openers that Wayne commented on are miles ahead of older cultivation based cropping tools that we used to use. Compared to the hit and miss of direct drilling systems, all no-till openers are desirable and quantum leaps ahead.

Also for many farmers, the specific weaknesses that Wayne referred to are not always a problem as Wayne would and does acknowledge. Many excellent crops are established with Harrington Agmaster points, in fact the first 10 t/ha crop grown in Victoria occurred last year with these points.

Farmers who seed faba beans with the DBS reverse the seed and fertiliser tubes to ensure deep seed placement. Some of the best crop establishment on Sunday soils that I have seen has been with a Ausplow DBS machine. Also, many of WA's very successful farmers have used the Biomax and its precision technolgy with great success - in the absence of heavy loads of cereal stubble.

I should also applaud Wayne for his long association with no-tillage in WA. In September of 1991 he wrote a profound and lengthy letter to Dr Graeme Robertson of AgWA about the need for experimental no-till drills to be brought into WA through AgWA. His advice was taken and many other predictive comments that he made in that letter have been shown to be right. His insights were also greatly appreciated as co-organiser the recent North American Tour.

My comments in the July 1998 article were indeed suggesting that I think we need higher rates of trace elements (Zinc and Copper) in'each' granule.

I have requested Wayne to also further clarify the trace elements issues. He says "I would like to say more in a future article as it is a serious concern, but would like to state that trace element deficiency is very wide spread, even on paddocks that have recently had full rates of trace elements (eg Superphos CuZnMo at 200kg/ha) and been cultivated in."

"Many such paddocks have also been seeded with products like Agflow CuZnMo, and DAPSZC, but the crops are still showing clear Zinc deficiency symptoms."

"Copper levels in tissue tests are also marginal. I am convinced we do need to use products like Summit's 'No-till Special' and CSBP's equivalent and that the old rule of trace elements once every 10-20years (mixed in) is no longer valid in today's agriculture. Nematode problems also appear to be controlled with trace element applications, but more about that in a future article?"

LETTER TO THE EDITOR

Wayne Pluske, CSBP 9377 9177, fax 33

I refer to the article 'A Consultant's Perspective' in your July 98 edition. While it was a very interesting summary of how growers at the cutting edge are tackling new challenges, I feel it is necessary to clarify the point made in relation to trace element fertilisers. I am well aware we are dealing with new seeding systems, but new seeding systems or not, the principles influencing the effectiveness of trace element fertilisers are the same.

From my reading of the article, I think Wayne is suggesting higher rates of trace elements in fertilisers can compensate for lack of mixing through the soil in no-tillage systems. This is not necessarily the case, not just in no-tillage systems but in any system. The fact is the effectiveness of copper containing fertilisers is largely influenced by the number of copper containing granules per unit volume of soil and the position of these granules in the soil in relation to plant roots.

Let me explain the background leading to such a conclusion. Copper is immobile in the soil because soil constituents have a very strong affinity for it. Copper from fertiliser granules is retained in the soil very adjacent to the granules. If a plant root is to adsorb copper the root has to enter the immediate vicinity of fertiliser granules. So to be most effective, fertiliser granules should be where roots are likely to intercept them. Copper won't move to the root so roots have to move towards copper.

The zone of soil around a granule of copper containing fertiliser has more than enough copper to satisfy the plant's requirement, even where granules with low copper concentration have been applied. A fertiliser with an even higher concentration of copper will simply add more where there is already more than enough. It is an expensive option which, from research to date, one would have to say has little chance of success.

What we need to focus on is geometrical distribution of copper through the soil so roots have greatest chance of intercepting copper. The evidence is unequivocal that factors which improve distribution through the soil (e.g. finer fertiliser granules, narrower row spacings, cultivation) improve effectiveness of copper containing fertilisers. The trick in no-tillage systems is how to achieve good distribution.

The maintenance strategy of applying a little each year has merit, not so much because it increases the amount applied but because it increases the chances of mixing. Copper applied in one year can be mixed through the soil in subsequent years.

The effectiveness of such a strategy will obviously vary between seeding systems depending on the extent of soil movement. The whole basis of the maintenance strategy is to maintain copper at adequate levels. This makes it virtually impossible (especially in the short term of 5-10 years) to determine if any one maintenance strategy is actually working. Plants can already access enough copper (because copper levels are adequate) blanketing any measurement of the effectiveness of fertiliser copper. This is why research on copper fertilisers is conducted on sites with less than adequate copper, but because such sites are responsive, maintenance strategies are impossible to evaluate.

On responsive sites we know effectiveness is improved by better geometrical distribution of copper. Mixing of the soil is the key to this. Adopting a maintenance strategy will not alleviate a copper deficiency in the first year (and maybe not for many years) because copper cannot be distributed through enough root pathways. In a copper deficient situation where soil mixing is not an option, the option may well be to monitor copper levels through plant testing and repeatedly use foliar applications.

Wayne is right, there is a need to develop better strategies for trace element applications in no-tillage systems. However, from what we know, increasing the concentration within fertiliser is not likely to be one of these strategies. CSBP, AgWA and WANTFA are already collaborating to examine some application techniques. *(Editor: the results of these trials will be published in our next newsletter).*

FIELD DAYS, SEMINARS AND CONFERENCES

Kevin Bligh, Committee (08) 9755 7589, fax 90

Nearly 300 people attended WANTFA's Claying Sands field days, held jointly with Landcare officers and AgWA, at the end of June. Farmer Clem Obst from Bordertown SA, was the key attraction and he described details of his April '98 WANTFA Newsletter article, and the carry graders or clay spreaders now used in SA.

Richard Souness President of WA lucerne growers (top right). WANTFA field day inpecting Richards lucerne at Borden.

The 70 who attended at Badgingarra, 30 at Wellstead, 35 at Jerramungup and 40 at Munglinup heard WANTFA Scientific Officer, Bill Crabtree, local farmers and scientists. Discussing possibilities for reducing non-wetting, by putting on up to 200 t/ha of clay, to raise the clay content of the topsoil by about 2-3%. Areas with shallow clay may lend themselves to simply ripping the clay to the surface using delving tines or using lower rates of clay.

At Condingup and Gibson, east and north of Esperance, the 80 and 35 who attended, respectively, were particularly interested in machines for applying the clay. Several local farmers visited a Victorian carry-grader manufacturer in the following couple of weeks, and Clem has had many visitors from WA, enquiring further details since his return.

WANTFA thanks RAFCOR, who assisted financially with Clem's visit and the field days. Thanks to the speakers Margaret Roper from CSIRO Perth (see her talk in this issue), Dan Carter and Rob Hetherington from AgWA Albany (see next issue for their talk) and Paul Blackwell AgWA Geraldton.

Thanks also to keen local organising assisters Rebecca Carter, Caroline Daniel, Andrea Hills and Julian Gardner. Then in early August, about 430 people attended WANTFA's No-Till Field Days at Narrogin, (50), Borden (100), Karlgarin-Hyden (120), Miling (70) and Mullewa (90). Bill Crabtree and WANTFA's Vice President, Neil Young (Kojonup) and foundation President, Ray Harrington (Darkan) and local farmers, including WANTFA President Geoffrey Marshall (Hyden) described their no-till systems and rotations.

A week later Bill Crabtree, Geoffrey and Vivienne Marshall, and Committee-member Jim Baily (Wellstead) left for North America in a party of 46 people, for a month's no-till visits arranged by Bill Crabtree, his wife, Monique (who also took part in the tour) and Albany Consultant Wayne Smith. WANTFA members look forward to hearing their stories, and what they gleaned from their experiences, in future WANTFA Newsletters and field days. (Bill Crabtree has already addressed about 500 farmers at field days since his return.)

On 13-14 August, about 100 scientists and lucerne-grower Geoff Bee of Jerramungup (see his article in the May '98 WANTFA Newsletter on reducing groundwater levels using lucerne) attended a Sustainability of Farming Systems Forum in Perth. Organised by the CLIMA and the Soil Science Society the conference focused on future management of water and nutrients.

Frank Dunin of CSIRO observed that doubling crop yields may only increase water use by about 20 mm, because the extra crop water use largely replaces direct soil evaporation. He advocated reducing salinisation of cropland using phased rotations, consisting of several years of lucerne followed by several years of continuous cropping. (See my article, 'No-till can slow salinisation' in the July '98 WANTFA Newsletter.)

Dr Mike Ewing of CLIMA/AgWA raised the possibility that pasture topping for seed-set control, may unwittingly be

increasing groundwater recharge, by reducing water use at a time of the year when temperatures are rising, and potential water use is high. Dr Ian Fillery of CSIRO advocated investigating summer cover-crops, not only for reducing saline groundwater recharge, but also for reducing acidification deeper in the soil profile, by maintaining nitrogen nearer the surface.

Sally Marsh of Agricultural and Resource Economics at the UWA was asked to speak finally on "How can we make it all happen!" Her response was that scientists can't, but farmers can! Sally says many scientists afterwards expressed a willingness to work cooperatively with farmers, to reduce the salinisation of some 30% of cropland officially expected in about the next 30 years.

Dr John Williams of CSIRO, Canberra described programs aimed at minimising salinisation at the Land Management Society AGM in Perth later in August. His book "Farming Action: Catchment Reaction" written with two co-authors (450 pages, CSIRO, $89.95) describing water use efficiency issues was launched at the meeting.

Then in late-September, about 100 engineers and scientists attended the 10th Agricultural Engineering Conference, held in Perth for the first time. Glen Riethmuller and Mohammad Amjad of AgWA Merredin, and fellow organising-committee members, successfully engendered an international flavour, with over 20 engineers attending from the Middle-East, China, Pakistan and South Africa, in particular.

Keeping permanent wheel-tracks or tramlining, known as controlled traffic (see Paul Blackwell's report in the November '95 WANTFA Newsletter) featured strongly. Dr Don Yule from Rockhampton Queensland reported that some 400,000 ha are now cropped using controlled traffic in Queensland and Northern NSW. If interested in see the controlled traffic work then please call Paul Blackwell at AgWA Geraldton.

Also Conservation Farmers (Inc) based at Dalby, Qld are holding a ConFarm conference on 17 -19th February '99 for 3 days. They are keen for two WA farmers to speak at the conference and others to attend, if interested please call Michael Burgis on (07) 4638 5356.

Controlled traffic may be seen as a logical extension of no-till sowing, further improving soil condition and crop yields by confining the ill effects of compaction to permanent sacrificial wheel-tracks. Measurements show that 25-50% of no-till paddocks are compacted by wheels each year, by tractors, sprayers, seeders or headers. Controlled traffic also minimises overlap, and makes spraying and seeding easier because there are definite unsown wheel-tracks to follow.

Of course, machines used in controlled traffic systems must be multiples of each other's widths, and have the same tread widths, and single tyres or tracks. Tractor, air-seeder bin and sprayer tread-widths are then confined to the same permanent wheel-tracks. Typically the width of sprayers are twice the width of seeder bars. Because non deep-ripped soils are relatively strong and largely able to resist compaction at harvest, header tread-widths may perhaps be less important in a dry harvest in WA, though still something to consider in the medium-term.

The economics of new equipment likely to be required for controlled traffic, need to be carefully assessed. Paul Blackwell has been measuring effects of controlled traffic with GRDC assistance, for two years on deep-ripped sandy soil on Tony and Judy Critch's Tenindewa property east of Geraldton. Improved soil structure was observed when WANTFA Immediate Past-President, Graeme Malcolm tramlined in a clayey paddock on his South Morawa farm several years ago.

In Queensland, water erosion on clayey soils may be 100 to 1,000 times greater than in WA. Lay-outs directly up-and-down slope then actually reduce erosion, by limiting rill catchments to the area between the wheel-tracks. Lay-outs across the slope are likely to be required in WA, in order to reduce soil loss to the same order of magnitude as estimated soil formation rates, thus enabling sustainable agriculture in the long-term.

OIL MALLEES FOR PROFITABLE LANDCARE

Ric Collins, Admin, Oil Mallee Assoc. 9478 0330, fax 33

Farmers throughout the WA grain-belt are investigating selected species of mallees that have a high eucalyptus oil content. These mallee trees should help us in our fight to control waterlogging and salinity and are compatible with cropping and grazing systems. This story briefly outlines some developments with oil mallees in WA. For more information please call me and we can post you some extra pamphlets.

There are specially selected local species of mallees that may provide a commercial return from the eucalyptus oil, bioenergy use of residues as fuel for electricity generation, and carbon credit benefits in the root. The high oil content mallees are grown from selected seed which is collected in conjuction with CALM.

So far the Oil Mallee Association (OMA), which is a grower managed association, has supplied about 10 million seedlings for planting from Northampton to Esperance. This planting is expected to double in the next two years. Oil mallees are eucalypts with the mallee growth form and they sprout (or coppice) from the stump after each harvest.

Mallees are usually planted in hedge rows across paddocks at widths that enable cropping equipment to operate efficiently between the rows. Mallees can be planted in blocks if there is heavy seepage. They should not be planted in saline areas if commercial production is expected. A hedge is two rows of trees, 2 m between the rows. There are 1,330 trees in a km of hedge.

Usually the planting density is 260-400/ha. This represents 15% revegetation which is considered necessary to control water logging and salinisation. One hundred hectares of planting are ideal for future cost effective harvesting. Local mallee species are chosen to suit soil type, rainfall and position in the landscape. Seven species are commonly used.

Best results come from treating mallees as a tree crop with good site preparation. Ripping and weed control are the two most critical aspects. If done properly, 95% survival should be expected from seedlings arranged by the Oil Mallee Association.

Mallees are best sown during a cropping rotation which allows minimal grazing of stubble by stock in the first summer. After this the roots are usually sufficiently well established that the mallees will survive if they are inadvertently grazed by stock. By the time the mallee are 18 months to 2 years old stock usually avoid grazing them. This eliminates the need for fencing.

Cropping can occur right up to the edge of the mallee hedge rows. Mallees don't need special application of fertiliser. They can access their nutritional needs from deep down in the soil profile.

Farmer observation of the benefits of mallee plantings are numerous. Monitoring sites will soon provide quantified evidence. Large numbers of trees are necessary to have a meaningful effect on waterlogging and salinity. Mallees planted across the farm use the water where it falls. This will help ensure that trees planted in natural waterways survive.

Current yield assessments of mallees planted in hedge rows 4-6 years ago indicate that they can produce 10-15 kg of biomass (leaf and wood above the ground) at first harvest of 4 years and 10+ kg when harvested two years later. This yield is expected to continue for the life of the mallee which should exceed 100 years. Yields should be higher where mallees have access to more moisture. Block plantings at higher density may not achieve such good yields.

Planting to achieve 15% revegetation should provide 3.6t of biomass per 0.15 ha (or 20+ t/ha). Biomass can be used for:

1) Oil at 300 kg oil per 20 tonne biomass at a possible $1.00/kg represents a net return of $300 per hectare per harvest,
2) Energy - value still not properly defined and
3) Carbon credits & OMA may negotiate returns on behalf of all members.

Once established (2 years) oil mallees need virtually no maintenance, hence no ongoing costs. OMA is working to plant 500 million oil mallees in the next 25 years. This is only a portion of the trees that need to be planted for Landcare.

OMA Region Managers work closely with all local Landcare groups to help ensure comprehensive catchment plans are implemented. OMA supports biodiversity plantings for wind breaks, shelter belts, waterways plantings and also encourages revegetation of natural stands of timber. Like most other trees, oil mallees qualify for Natural Heritage Trust funding.

The recently formed Oil Mallee Company of Australia (OMC) is currently funding new harvesting and distillation R & D to place eucalyptus oil into very large markets at a competitive price. The company is investigating the use of leaf and stem for energy generation. The OMC has joint projects with WA Universities, CALM, Felton Grimwade Bickford (Australiaís largest eucalyptus oil retailer) and is working closely with several large companies with interests in energy and solvent markets.

SCIENCE SECTION

1998 WANTFA STUDY TOUR

Angie Roe, Farm Focus Consultants (08) 9622 5095

I have just returned from an inspiring three week study tour of the USA and Canada. At Bill's request I will provide a technical overview and outline the key messages which we might be able to apply to our own farming systems.

Forty six of us travelled for three weeks in the biggest bus in the world through Colorado, Nebraska, South Dakota, North Dakota, Manitoba, Saskatchewan, Alberta, British Columbia, Montana, Idaho and Washington, looking at no-tillage cropping systems and high water use with no-till rotations for salinity control. As a group, we came home feeling inspired and motivated, with a better understanding of the principles of conservation and sustainability, and the confidence to either have a go at, persist with, or continue practicing no-till in WA.

The 1998 North American WANTFA study tour party, in the Peace Gardens at the Canadian - US border.

In my mind, the most important message that the North Americans have for us, is that environmentally sustainable food production is both possible and profitable. And it is an absolute must if future generations are to remain on the land and continue as a nation.

Conservation is no longer just the domain of greenies, or the responsibility of state and federal governments, it is the responsibility of all land holders and owners. And so far, the most significant step towards sustainable agriculture in both America and Canada, and also Australia, has been through

the adoption of no-till cropping systems and all that goes with them.

The main difference between us and those we visited is that they are looking at a bigger picture. They are not just adopting no-till because it is more profitable, or because it will preserve the farm for the next generation. They are well aware of the negative effects agriculture has on the environment, on soil and water health, wildlife habitats, biodiversity, global warming, and the existence of civilisations (for more: see July '98 WANTFA newsletter story 'Feeding The World Sustainably by Canadian, Bob McNabb). They are also aware of how they can counteract these effects, and that it is their responsibility to do so.

Professor Dwayne Beck

We spent a fascinating two days with Dwayne, at the Dakota Lakes Research Station and surrounding area near Pierre, South Dakota. He is Dr 'infotainment' - an intensely energetic man with a very sharp wit and lots of information to share. He is both farmer and researcher - with a short stint as a school teacher (having a chemistry degree). He has a special interest in biology and a simple, hard hitting, and painfully obvious philosophy - think like a plant!

Dwayne Beck holds speaker as one of his key farmers tells us that because of his rotations and no-till he has never needed to use a grass selective herbicide in cereals.

Dwayne explains that plants like a healthy soil. A healthy soil drains well and contains organic matter and soil organisms, amongst other things. He gave us some soil to smell which allowed us to differentiate between a healthy and an unhealthy soil.

Liquid fertilisers are commonly used among North American no-tillers.

We need to think about how 'mother nature' establishes her crop, and attempt to copy this system. One way of doing this is to practice no-till, and Dwayne uses an analogy between buffalos, birds and native prairie grasses to explain how his seeding machines imitate nature on the Great Plains. Buffalo one (the front disk) creates an impression in the ground as it walks across the prairie. A grass seed (crop seed) then blows into the hole, and a bird deposits fertiliser as it flies by. Buffalo two (covering disc and press wheel) comes along and scuffs soil over the impression made by the first buffalo. This analogy gave me another angle to think about with no-till!

Dwayne also drummed home the importance of stubble retention, crop diversification and wider cropping rotations, or varying cropping intensity in the no-till system. These three important factors were echoed again and again throughout the trip, by researchers and farmers alike.

We were also exposed to two other very exciting concepts, which deserve a mention. The first is that we should be trying to use all the available moisture in each rotation, and the second is that we should consider no-till as a means of weed control. More on these later!

Retain that stubble !

Obviously, stubble retention prevents wind and water erosion. It also acts as a form of weed control, reducing the amount of light that hits the ground, which prevents weeds from germinating. But perhaps most importantly, stubble retention helps to build a healthier soil, which, with diverse crop rotations, builds a healthier plant. Stubble is converted into organic matter by the organisms which live in the soil.

No-till soil for twenty years (in the centre) has reversed the cultivation damage (see left) common in Canadian prairies. The native soil (on right) still looks the best.

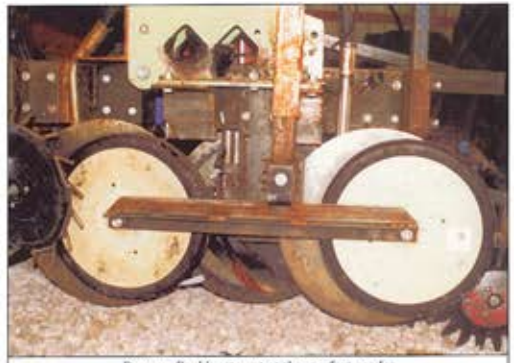
Millions of bacteria, fungi, viruses, algae, protozoa, mites, nematodes, ants, earthworms, maggots and insect larvae, recycle the stubble into forms which can be used by plants. If left undisturbed, as in a no-till cropping system, their numbers increase, and they improve the structure, drainage and overall productivity of the soil. These organisms are vital to no-till because they cycle nutrients and break down crop residues, reducing toxicity, hairpinning and

The effects of Glomalin " from VAMs as they build up in the no-till soils in Colorado. Clear water means most Glomalin

residue handling problems at seeding.

At the Central Great Plains Research Station near Akron, Colorado, we were introduced to one of these organisms, Vesicular Arbuscular Mycorrhizal (VAM) fungi. These fungi live in a beneficial relationship on the roots of plants. From the roots, they extend their cotton wool like hyphae into the soil where they absorb water and nutrients, particular P and Zn, which they exchange for carbon from the plant. They also produce a recently discovered protein called Glomalin, which is a sticky substance that binds soil particles into more stable aggregates (see photo).

Tillage discourages the presence of VAM fungi and lowers glomalin levels in the soil. VAM fungi contribute to the overall health of the soil and plant and they enable plants to survive droughts better (we always drought in October). VAMs form a relationship with most agricultural plants (except canola and lupins!). They can be encouraged to be part of the soil ecosystem through the use of no-till. Dr Marcia Monreal taught us that VAMs leave 'glass like' filaments or tubes in the soil which can be re-used by subsequent VAM crops in later years. This is provided that they are not shattered by tillage.



Dwayne Beck's attempt at the perfect seeder.

Diversify crops grown and intensify rotations

Growing crops with different characteristics is an important management tool in a no-till cropping system. Rotating cereal, legume and oilseed crops allows for better management of weeds, diseases and insects, and more efficient

Farmer groups in Washington state are attempting crop diversity like Dwayne Beck is advocating.

nutrient cycling and moisture use.

Alternating high residue producing crops such as cereals, with low residue producing crops such as legumes and oilseeds, helps to manage the residue by preventing it from building up to levels which the system cannot handle. Diversification also reduces market and seasonal risks. Different crops can be grown in order to meet the demands of the market, the season, or the environment.

During the three weeks we saw wheat, barley, oats, corn, sunflowers, canola, flax, millet, linola, sorghum, chickpeas, soybeans, field peas, lentils and alfalfa (lucerne) being grown in a variety of rotations of varying intensity, as a means of achieving profitable and sustainable no-till farming systems.

Use all available moisture

Aim to use all the moisture that is available in a crop rotation with specific seasons, from both annual precipitation, and the soil profile. This means planting crops and growing rotations which match the moisture available. Stored moisture can be determined using a soil moisture probe. In many dry areas of North America and Australia, maximum water usage means maximum crop growth.

Crops like alfalfa, sunflower and canola use more water than cereals, peas, lentils, beans, millet and flax. As well as this, high water using (intense) crops are deeper rooting and draw moisture from deeper in the soil profile. Sowing these crops is an effective way of reducing the water table and preventing salt from rising to the surface. In many areas of North America alfalfa and other intense crops are used to reclaim salt scalds.

Alfalfa is similar to the native prairie grass, in that it dries out the soil profile. After a few years, the salts can be leached from the surface and the land can grow crops again! Obviously, our salt problem is a bit more permanent, as we have chloride and not sulphate salts and our native vegetation would preclude, or greatly restrict cropping. But the principles could be valuable to us in WA.

We also discussed row spacing and plant density and its effect on moisture use with a number of people. Row spacing ranged from 7-12 inches, with the average often being a compromise of 8-10 inches. The most efficient canopy for weed competition is a narrow row spacing. However, wider rows allow better trash flow and the trash reduces evaporation and suppresses weeds. We also heard many farmers say that high seeding rates were desirable with wide row spacings which helps with weed competition.

Adopt no-till for weed control!

This is an unusual concept for us to come to terms with, as many of us have associated no-till with an increase in the use of chemicals. But after looking at no-till systems which have been in place for around 10 years or more, and which have adopted a systems approach incorporating stubble retention, diversification, intensified rotations and increased water usage, we realised that weeds can, in fact, be squeezed out of the equation! Imagine being able to reduce those chemical bills, and spend more time off the boomspray than on it, which is what many long-term no-tillers talked about. The mind boggles!

Put simply, a no-till system leaves the weed seeds on the surface instead of planting them. Stubble retention reduces the amount of light getting through to those seeds, which in turn reduces the number of weeds germinating. Increased insect and microbial activity also kills many seeds left on the more "alive" soil. Diversified and intensified rotations allow for more effective herbicide use and better weed kill in each crop, while increased moisture use by the crop means there is less moisture available for the weeds. In addition, narrower row spacings allow for better canopy cover and better weed competition. The result? Less weeds and less chemicals.

Stripper headers work well with disc zero - tillers and may have a role in our agriculture

Strippers

We also saw a Shelbourne Reynolds stripper front which was harvesting a cereal crop near Beach, North Dakota. The stripper removes only the heads of the crop and weeds and leaves all the straw standing in the paddock. This allows maximum stubble retention - without the need to spread the straw which increases the capacity of the header and decreases crop losses and reduces the amount of straw lying on the ground at seeding time.

Less matted straw means less hair-pinning, less toxicity, and less residue handling problems at seeding. Perhaps most importantly for North Americans is that standing stubble increases the amount of snow caught during winter. This snow melts at the end of winter to provide the spring crop with the moisture it needs.

Do we need to keep that much stubble in WA? Will it pull the whole plants out in our sandy soils? I doubt that it will perform on canola?

Summary

It would appear that we need to adopt a systems approach to no-till farming. There are complex ecosystems, operating within our farming systems, in which everything is inter-related, and is affected by management. The tour gave us some fascinating insights into profound principles which, in part, can be transferred into our own farming systems.

My messages are just some among many, and are a reflection of my big picture....

(Editor: there are many more specific issues which will come through in subsequent newsletters. Angie has nicely threaded the most powerful lessons that we learnt. Well done Angie and thanks!)

NO-TILL HELPS FIGHT WEEDS!

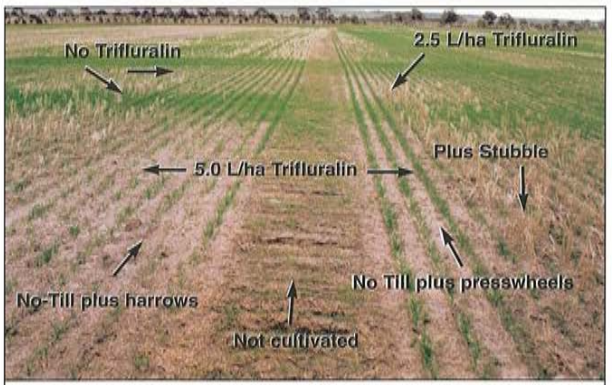
Bill Crabtree, Scientific Officer 0417 22 3395

It is old-hat that an autumn tickle stirs up weeds. But where is the data that shows what happens if they are not stirred up at all - with zero-till? And why the constant press espousing tillage for weed control when many long-term no-tillers have very clean paddocks? Where is the no-till weed data, apart from what has already been presented in the WANTFA newsletter? No-till must be a part of integrated weed management systems.

Why is there so little data showing what leading edge no-tillers have been talking about for years. It is good that David Minkey of AgWA in Merredin is now researching these issues and that he is working with WANTFA farmers.

I just visited one of WA's leading farmers on yellow sandplain soils. He hit the herbicide resistance brick wall 6 years ago. He tells me that he tried cultivating and harrowing to stir up and kill the weeds - but that failed! He believes that his adoption of no-till greatly reduced his in-crop ryegrass germinations. Chaff carts were also greatly beneficial.

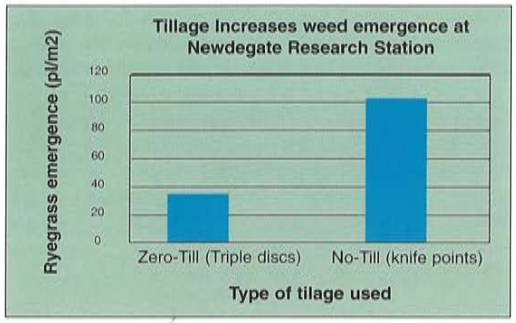
Jim Williams of Esperance shows how precise seed placement can be achieved with zero till seeders



Lamond Burgess & Associates Trial funded by GRDC at Brookton

No-till, swathing, chaff carts and diverse (4 crops) rotations as well as wet seeding only, are now this farmers main resistance fighting bullets. Dry seeding puts too much selection pressure on residual herbicides. He took me past some pretty clean crops and said, "these same paddocks were a sea of ryegrass 6 years ago!" He has decided that it is better not to stir up his "sleeping dogs but would rather just let them lie".

For a full discussion on how no-till can help with herbicide resistance, I refer you to: "Tackle herbicide resistance with no-till" in the May '96 WANTFA newsletter. But in short, weeds that are left on the soil surface with no-till are easier to target with residual herbicides (triazines, trifluralin, Logran and duiron) and are more effective with less toxicity. (See also "Trifluralin - the Giant Awakens" in the November '97 WANTFA newsletter by Peter Burgess).



Surface weeds are less likely to germinate throughout the year. Also those that do germinate are likely to germinate before, or with, the crop. This allows timely and effective use of Gramoxone or SpraySeed as the cereal is germinating, with perhaps 80-90% of emerged weeds killed. Triple discs give the greatest spraying window due to precise crop emergence.

Knife points (left) have 3 times more weeds than triple disc (right).

A trial at Newdegate Research Station conducted by AgWA and myself for WANTFA (GRDC funded) clearly shows the dramatic emergence reduction with double disc seeders compared to knife points.

When the knife point was used in 6 passes in immediate succession, there was the same number of weeds as the one pass from knife points. However, there was perhaps 3 times more ryegrass growth with the 6 passes than there was with the knife points used once (Ross Ramm, personal communication).

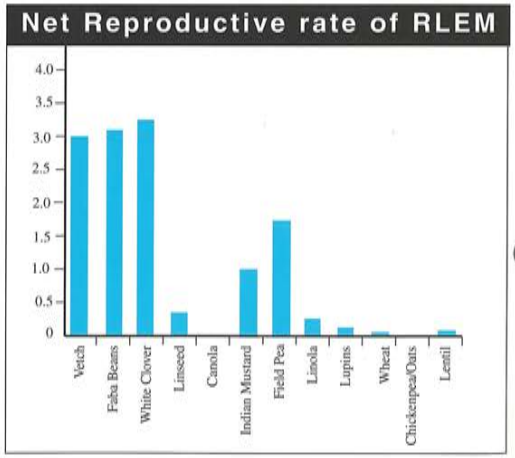
INFLUENCE OF NO-TILL ON RLEM

Melina Miles & Garry McDonald, VIDA (03) 5362 2111

Reduced tillage results in higher mite numbers than in conventional tillage systems, if we assume the same crop and pasture rotations. This is because cultivation mechanically damages mites, their food and their environment.

Cultivation over summer, or in early autumn, exposes mite eggs and emerging nymphs to potentially lethal summer conditions. Mites, particularly early stage nymphs, are highly susceptible to dehydration. Stubble retention reduces the chance of death by exposure to dehydration and high temperatures. Stubble retention and reduced soil disturbance promotes the abundance of micro flora (mosses, algae, lichens, bryophytes) which have recently been shown to be an important source of food for developing mites.

In a no-till system, mites can be controlled with rotations, increased plant resistance and by applying synthetic insecticides. Some excellent work by Garry McDonald, and others, has shown that lupins, chickpeas, lentils, wheat and oats are poor hosts for RLEM. Good hosts include vetch, faba beans, whiteclover, field peas (see graph). Field trials have shown significantly reduced populations of RLEM within non-host crops, provided the non-host crops are kept free of broadleaf weeds.



Chemical control can be achieved with bare earth, seed dressing or post emergence applications. Bare earth applications of endosulfan or bifenthrin (Talstar) are often used prophylactically (to give protection). A sounder (environmentally and potentially economically) approach is to use bare earth insecticides only when the risk of mite attack is considered high. For example, following a pasture or when a highly susceptible crop is grown. Note that bifenthrin does not control lucerne flea.

Seed dressings, generally provide poor protection under high mite pressures. There is evidence of tolerance to omethoate in some populations of mites in Victoria, where post emergence applications have been used repeatedly over

a number of years. Therefore it is prudent to only use insecticides when mite populations are threatening crop safety.

Proposed economic thresholds for RLEM, in mites/100 sq cm are: 50 for cereals, 10 for canola, 50 for pulses and 20-30 for emerging pasture (or 8 of 40 plants showing damage).

BIOREMEDIATION OF REPELLENT SOILS

Margaret Roper, CSIRO, (08) 9333 6668

Water repellence is caused in part by the formation of a skin of hydrophobic substances around the sand grains and this appears to be derived primarily from plant waxes and their biodegradation products. In a five year GRDC funded project, completed last year, I investigated ways to improve soil wetting by enhancing microbial degradation of waxes that cause water repellence.

Water repellence occurs in about 5 million hectares of sandy soils across southern Australia. Annual losses in crop production are estimated at $150 million. Water repellent soils typically have reduced and uneven water infiltration that leads to uneven and delayed germination of plants, poor stand establishment and increased risk from wind and water erosion

Repellence was monitored using the molarity of ethanol drop (MED) test after soil drying at 105^{o}C. Wetting soils have a MED of 0 while highly repellent soils typically have a MED of around 4.

Changes in water repellence were monitored in soils inoculated with wax-degrading microorganisms - which were isolated using woolwax as a food. The soils were then subjected to different environmental conditions.

Rhodococcus Bacteria including shine!

Sixty-seven different wax-degrading bacteria (which include actin mycetes) were isolated from non-wetting soils and soils enriched with waxes and fats. We found a predominance of actinomycetes with the majority being Rhodococcus, which use a wide range of organic compounds as sole sources of carbon for energy and growth. We also assessed their ability to produce biosurfactant (wetting agents).

Obviously, the more efficient their growth on hydrocarbons, the greater the chance of them being able to 'eat' waxes on sand grain surfaces. The production of biosurfactants is relevant because they can release hydrophobic substances from soil particles and make them more susceptible to break down. The reduction of surface tension (mN/m) of the growth medium (compared with the uninoculated medium) was used as a measure of biosurfactant production.

Out of all the microbial isolates capable of growth on wax as a sole carbon source, 7 were efficient surfactant producers. Most of these grew well on hydrocarbon as a sole carbon source. We then put these microbes into repellent soils, which initially, was unsuccessful. So we investigated ways to stimulate them.

Irrigation

Water is one of the main limiting factors for microbial activity in water repellent soils. And we found a gradual improvement in soil wetting through time in moist (12%) and warm (30^{o}C) conditions. We found the same effect in the field, where irrigation over summer improved soil wettability. This gradual change suggested that this was a biological effect.

We also found that some soils, which had been dry for some time, needed to be inoculated with Rhodococcus and kept moist and warm in order for repellence to diminish over time. However, in most farmers fields these microbes are usually present in varying degrees. These results have significance for application in agriculture and horticulture, particularly where natural microbial populations have declined due to long periods of dry and sometimes hot conditions.

In the above experiments, changes are slow and dependent on the maintenance of moisture over time. Where irrigation is practised this is not a problem, but under dryland agriculture, adequate soil moistures are rarely maintained for long periods. Water repellent soils take time to wet up after the beginning of winter rains, and drain rapidly between rain events.

We need to find ways to increase the rate of improvement of wetting in the soil during the times when soil moistures are ideal. There has been quite a lot of work done in SA and the south coast of WA that shows how clays improve soil wetting. However, application of clay is only economical if they exist close enough to the site. Claying may not be an option for some farmers with deep sands.

Lime additions at Gerald Kilpatricks Woodgenellup farm in 1987 showed improved wetting in left foreground.

Lime and clay additions

There is much anecdotal evidence from farmers who say that water infiltration is increased by the application of lime. We decided to see if lime had any effect on repellence

In a laboratory experiment we were able to show in the laboratory that additions of lime or kaolinite clay to moist soil had significant effects on repellence. The addition of lime (1% or 10 t/ha), in acid repellent sands, caused a rapid drop in MED in the first 3 weeks, followed by a slower change thereafter until the soil was almost fully wetting. The slower second phase was considered to be due to microbial decomposition of waxes.

The addition of clay (kaolinite at 0.5% or 5 t/ha) also

Clem Obst is very happy with his claying results of 30 years ago. But now he needs to clay the more shallow soils (in foreground).

resulted in an early rapid drop in MED, but thereafter the second phase was slower in comparison to the soils with water or lime. The mechanisms of this are not certain, but it is likely that clays covered the waxy surfaces of the sands making microbial access more difficult.

Twelve months after the end of the experiment, both the clay-amended and lime-amended soils retained their wetting status. This is despite them being held at high temperatures, and being wet and dried. This indicates that the changes induced by lime and clay were stable in this closed system.

Subsequently, in an irrigated paddock, the addition of lime had an almost immediate ameliorating effect on soil wetting. It reduced repellence virtually to zero. However, under dryland conditions the effects were slower and, of course, dependent upon rainfall.

In this experiment, water repellence was monitored over time, and after the onset of rains in the second season, significant differences in repellence between limed and unlimed treatments were evident. The dryland field experiment indicated that lime not only reduced repellence but also increased wax-degrading microbial populations.

Whilst this is not direct evidence for an increase in wax-degrading activity by these populations, there does seem to be a link between the changes in soil wettability and the size of microbial populations responsible for wax degradation. The results show potential to improve soil wetting, either through water, lime or clay applications and possibly through inoculation of soils with wax-degrading bacteria.

FARMER SECTION

NO-TILL AT DUMBLEYUNG

Matthew & Jeremy Williams (08) 98637215, fax 20

We farm 3,500 hectares at Dumbleyung, spread over two properties. Our home farm, "Brookville", is 12 km north of town and consists of gravelly-loam to hard-setting grey clay soil types. "Kalamunda", our other property is 16 km south of town and consists of gravelly-loam to heavy red-loam soils. Both properties sit in a 350-375 mm rainfall zone.

Our decision to go to no-till was basically made for us. After purchasing Kalamunda in early 1996, we decided to go continuous crop in order to maintain cash-flow. This meant more than doubling our cropping program in one year from 900 to 2,000 ha. We quickly found that over-use of the match on a soil-type we weren't used to, had led to massive wind and water erosion. We knew that we would have to look at other options for the following season.

After hearing a talk by Ray Harrington and visiting Steve King at Lake Grace, we were convinced that adopting the no-till package was the way to go. We traded the old air-seeder in on a new Flexi-coil unit consisting of an 8 tonne bin and 50 foot bar on 7.2 inch spacing. We chose the Flexi-coil bar because of its depth-control and trash-flow abilities. We also sold our second tractor and scarifier. We kept one scarifier in the shed, just in case! We set the machine up with the Harrington/Agmaster system, being knife points, side-by-side banding boots and rotary star harrows.

We went against many peoples advice and went 100% no-till in the first season which gave us an extremely steep learning curve to follow. When the break came, we felt a little strange to be apparently sitting around and waiting for weeds to germinate while the neighbours burnt the midnight oil on their tractors. Once we got going, however, we found the program to be relatively straight-forward.

Our knockdown was a good rate of glyphosate (0.8-1.0 L/ha) with a spike added depending on the target weeds and the crop to be sown. We found the boom-spray had to be in 10 places at once to get the job done. We began sowing by putting in 130 ha of oats where we were able to fine-tune the machine. We then moved into our small 120 ha trial of Karoo and T I 10 canola, sown at 5 kg/ha with 140 kg/ha Agras #1. Then came 620 ha of Stirling barley sown at 60 kg/ha, with 140 kg/ha Agras #1 also. The wheat followed with 1150 ha being sown. This was made up of Cascades, Tincurrin and Datatine varieties sown at 70 kg/ha with the same 140 kg/ha of Agras #1. We used no follow-up application of nitrogen, which in hindsight was a factor limiting yield potential.

A successful chemical program became very important, and the advice from our agronomist was a necessity. The oats had 15 g/ha Glean and 0.8 L/ha diuron up front. They needed no follow-up treatment. The canola had 2.0 L/ha of atrazine put down with the knockdown and another 2.0 L/ha at 6 weeks post-emergent. Dry conditions meant that this didn't catch all the ryegrass that was present, but this was more cosmetic than yield affecting. Wheat and barley had trifluralin at 1.7- 2.0 L/ha up-front, with diuron added at 750 mL/ha for wheat and 500 mL/ha for barley. We also added SpraySeed at 400 mL/ha to this brew where there was any sign of young weeds present.

Overall, the resulting establishment was very satisfactory. The combination of 7.2 inch row spacings and harrows that were a little too aggressive meant we had some triflu-

ralin damage in the wheat. Luckily, a reasonable sowing rate had made up for this. The barley leapt out of the ground and never looked back. We noticed that the surface crusting problems commonly found in our hard-setting grey-clay soils were not an issue. We also saw a large vigorous root system and an increasing worm population from day one which was heartening to see.

The crops were clean right from the start, even in our known ryegrass and wild-oat trouble spots. An unusually dry finish, particularly in the south of our district, led to small grain problems for everyone. We found much to our surprise that we had relatively minimal problems with grain quality. Whether or not this was due to no-till we are unsure (*Editor: this was a commonly reported benefit of no-till in the early 1990's on the south coast. Farmers often reported that there were half of the screenings with no-till compared to when direct drilling. This is not as commonly reported these days*). We still managed up to 2.4 t/ha of wheat, 3.1 t/ha of barley and 1.5 t/ha of canola which we were more than happy with considering the finish.

What did we learn? The system will fall over without a suitable rotation. Our 'one-in one out' or, in some cases, 'wheat on wheat on wheat' rotations, are no longer possible. We had to start from scratch as we had never grown a legume until this year. Canola has also become a big part of our program (650 ha) and after last year's success it promises to be a valuable break crop if managed correctly.

Nutrition has also proved to be very important. We found no-till exacerbated various trace-element and mineral deficiencies. We will be moving to apply trace-elements every year to ensure they are always available to the plant. This is important particularly with copper, which is not mobile in the soil. We also find that high rates of N with knife points is doing more seedling damage than is allowable. The move to wider (9 inch) row spacings this year also increases seeding toxicity and we will be reviewing our fertiliser strategy for next season.

We currently have our second no-till crop in the ground. Good rains and minimal disease influence has given them great potential. We went out to nine inch spacings this year in order to overcome chemical damage and increase trash-flow. We are often told that wider rows are a compromise but we see many benefits that counteract this. We added a Kirby spreader to the back of the header for last years harvest which paid dividends. The near elimination of header trails vastly improved pre-sowing chemical efficacy, and trash-flow problems were non-existent.

It seems that many stubble retention problems can be overcome by the removal of sheep. We have decided to take this action for next season. This will mean a further increase in the cropping program to 2,600 ha. We are currently investigating the use of site-specific technologies, and the recent purchase of a new header will see us moving into yield-mapping this harvest.

We are constantly learning more about the 'Art' of no-till and we seek information at every opportunity. We recently had the privilege to join 44 other Western Australians on the WANTFA Study Tour through the Northern Great Plains of the U.S. and Canada. This gave us a fantastic insight to the advantages and potential downfalls of various methods of cropping. It was also a first hand look at how agriculture is managed and practiced in other countries with different soils, climates and governments. We enjoyed interacting and learning from the people and farmers from those countries as much as we did from the other members of the tour party

NO-TILL FITS WELL WITH STOCK

Kieran Forrest, Narrogin Ag. College (08) 9881 4136, fax 2938

In 1980 the cropping program at the college consisted of approximately 200 ha of which about 25% was direct drilled. This was my first experience with using herbicides to establish a crop. The yield compared favourably with the conventional program.

We were on about a 1 in 3 rotation and I recall that the pastures were generally poor. Usually the pastures following conventional crop were not good, possibly about 30-40% of a third year pasture.

Kieran Forrest shows his modified seeder.

In an attempt to achieve better pastures we began cropping some paddocks continuously which allowed the better pastures to remain longer in pasture. This was okay, however, the continuous crop did experience weed problems, particularly in the header rows.

Pasture manipulation was carried out on pastures before the crop phase, and clover content improved. In addition some clover was resown. In fact since the mid-80's approximately 40 ha is sown annually, normally after a fodder crop.

From the early 80's the direct drilled area increased and we stopped using the scarifier in 1986. I believe we were experiencing germinations of barley and brome grasses as a result of the full-cut from the seeder. This was particularly noticeable where unseeded areas with weed control (diuron and chlorosulfuron) were totally clean, but weeds had germinated in the seeded or cultivated area. It begged the question, "why do a full-cut?" as we really only wanted to introduce seed and fertilizer to the soil.

I approached a local agent on the configuration of a new seeder in the late 80's. Ideally, I wanted a 24 row seeder that could be configured to a 6 row operation and then be converted to sowing only. I believe that it was a Baker boot or some such. However, such a machine was some time off and we eventually opted for a John Deere 746. This appeared to allow some flexibility in configuration.

In 1992, we established some crops using the 3 rows for cultivating 20 mm deeper than the following 3 sowing rows. We had found a way of trapping and securing the front tines up out of cultivation. Sowing tines were equipped with Super Seeder points and a crop of wheat was established with sowing tines only. The crop established well, despite some imprecise seed placement.

The following year, that paddock returned to such good pasture, dominated by clover, that I decided to crop it the next year, giving us a 1:1 pasture crop rotation. This next crop was established using Agmaster knife points. After the initial success of no-till establishment, all but one paddock were sown with no-till.

These times, I must say, were very difficult for me. I believed I was on the right track, however, I experienced constant harrassment from students who had lost the opportunity to indulge in recreational tillage. Negative comments and scepticism came also from over the boundary fences from the wider community.

We pressed onwards and began to observe good things happening. Earthworm populations increased and flourished. Erosion didn't happen anymore, the ground was easier to dig when inspecting root systems and so on. The first paddock has now had a crop every other year and is back into wheat again this year.

After the 1996 harvest of barley, the Angus breeder mob rushed into the paddock as the header went out the gate. They left the paddock in December '97 to go to another stubble paddock. However, their place was taken almost immediately by another mob of similar size. The Angus mob of 35 cows calved and reared their calves and were joined during the year by up to 600 sheep for periods up to 3 weeks as we implemented a spray graze strategy. The paddock only consists of 30 ha.

The remarkable thing was that by July of 1997, virtually no stubble could be found in the paddock. By the spring of 1997 using Pasture Pic publication, I estimated about 5 t/ha of dry matter with a possible contribution of about 50 kg/ha of N to the 1998 crop.

With this paddock as the model, we plan to develop the area available to crop on this system. As a result, the crop area will effectively increase without a decrease in stock populations.

In fact, recent stock numbers have increased marginally while a further reduction of 30 ha of available crop area goes to agroforestry. The interesting thing is that this year, several neighbours have come during seeding and had a closer look at the system.

I believe that there are many more people wanting to make the change to no-till and will commit in the next few years. From our experience, modification of existing equipment is readily available and I believe that almost any reliable combine could be adapted to a no-till program.

Currently, we still run the 746 combine, though this year we fitted a Harvestaire blower kit to enable the sowing tines to be fitted across the 6 rows of the frame. We have achieved a wider row spacing (210 mm) and increased the sowing width from 4.6 m to over 5 m. With this of course came radically improved trash flow. This was the major reason to change, and enabled crop to be established on about 400 ha of 1997 stubble.

Currently with the acquisition of 300 ha of neighbouring land in the last two years - the cropped area at the college has extended to 500 ha of cereal, pulses, canola and fodder crop. In addition, some 70 ha was sown to pasture (clover and serradella) in 1998.

Yield mapping of this years crops will no doubt form the basis of the development of machines to accommodate variable rate technology.

In closing I would like to thank many people who have contributed to no-till development in WA and at Narrogin Agricultural College. Particulary WANTFA and also Agmaster - for assistance with machinery modification. If I'm to single out any one individual, then may I thank Ray Harrington for his support.

The Narrogin Agricultural College is strategically located in an area for mixed farming operations. The coeducational residential college, 190 km SE of Perth, provides education and training in all the mainstream agricultural industry pursuits and as such is an ideal learning environment for students with a passion for agriculture, animals and the outdoors.

NO-TILLING IN THE MID-NORTH OF SA

Brett Roberts, Balaklava (08) 8862 1214 p/f

Along with my brother Gavin and father, Kevin and our wives we continuously crop about 3,000 ha around Balaklava, 100 km north of Adelaide. Our annual rainfall varies from 300-550 mm. Our soil types range from red brown earth to mallee loam and sand, with about 20% of the farm having limestone reefs.

Our current rotation is flexible and involves wheat, barley, canola, peas, lupins, oaten hay and chemical green manuring. Our first pea crop was in 1979, chickpeas were first grown in 1986, canola in 1994 and hay in 1996. In 1980 we began continuous cropping and sold our last sheep in 1985, we stopped stubble grazing in 1990 and removed most fences. We started no-tilling in 1994.

Our nutrients inputs are 60-100 kg/ha of N on non-pulse crops, 20-25 kg/ha of P and 10 kg/ha of S. Approximately 12 kg/ha of elemental zinc has been applied over the last ten years with leaf test results showing 30-60 ppm of zinc.

We have two seeders. We adapted 25 m Shearer Flexmodule wide-seeder, boxes were removed and an 11 tonne Simplicity airseeder with a 3,000 L tank for herbicide application is towed behind. The tines are Primary Sales coil tines with Super-Seeder points and an AIS plastic double shoot-boot. Tine spacing is 270 mm and we use Janke press wheels. An Airtech spray line is in front of the frame to apply trifluralin, simazine and sometimes SpraySeed.

Brett's 84 foot seeder puts out Trifluralin plus Spray Seed before seeding it sure goes yellow!

Our second seeder is a 15 m Gason 5100 which is hooked to the same air-seeder hopper and does about 25% of the cropping program. This machine has a 170 mm tine spacing with a home made seed splitter to put the seed either side of the fertilizer. A wide share is used to cut some hard to kill weeds. This bar is used to sow hay and some wheat to improve yield and weed competition from the 80 mm row spacing. Our boom sprayer is a 28 m Goldacres with Airtec Jets which can do 40-60 ha/hr which includes fueling time.

There are several agronomic problems that we are struggling with. They are snails, mice, saltbush, wattles and other weeds. Resistant ryegrass is a challenge, marshmallows are hard to kill and the following weeds need some attention: cudweed, caltrop, panic grass, radish, bifora, paddy melon and potato weed (heliotrope). Paraquat at 1-2 L/ha does a pretty good job on potato weed.

I am sure that our current weeds can be controlled with better chemical mixes combined with perhaps an occasional full-cut every so often. Our summer weed spray mixture has mostly been 500-1,000 mL/ha of glyphosate, 200-300 mL/ha of Ester and 100 mL/ha of Garlon. Amitrole has been added to this mix but was not cost effective. We have tried trifluralin, atrazine and diuron type residual brews after harvest with some good results. But more work is needed with this approach.

Snails are a hastle to SA farmers where free limestone exists.

I have been told that we need to incorporate grazing into our summer spraying. However, we consider the savings in the headland costs of having no fences far outweigh any benefit of stubble grazing. Also we think that heavy sheep grazing does more damage to the soil than a light and slow 2 cm deep discing.

Our main reason to go no-till was for erosion control. With continuous cropping, even under a min-till regime, we were getting too much wind erosion. Other big no-till benefits that we have found are; being able to seed on time and saving valuable soil moisture. I have come to the conclusion that if we are going to use high inputs of fertilizer, in our marginal country, then we are going to have to spray summer weeds and then no-till to make the crops finish without haying off.

However, no-till without sheep has made some problems worse, like snails, mice and summer weeds. The snail population explodes if the stubble is left standing over summer. Snails and mice can be successfully baited and summer weeds can be sprayed to suit our no-till system - but at a cost! This cost has averaged $30-50/ha in the last few years, over a conventional system. However, the benefits from stubble retention are hard to determine in the short term. These are the biggest threats to no-till that I perceive in our environment.

Some stubbles are disked in after harvest, this slows the breeding of mice, puts the snails on the ground and creates a tilth for dry sowing canola. This seems to work well. However, I have seen these paddocks suffer moisture stress quicker than the no-tilled paddocks.

We have tried green manuring - both with a plough and a 'drum'. While both techniques improve grain yield somewhat, we have not seen any grain yield advantage from using the plough over glyphosate.

In conclusion, I think that if we were to put a cost on conventional cultivation of moisture loss, soil degradation and the extra work involved it would be higher than the perceived high cost associated with no-till. I think we must constantly step back and look at what we are doing. Long-term profitability is imperative - not any particular farming system!

WIDER ROWS HELP STOP EROSION

Mike Doherty, Mullewa (08) 9923 1514, fax 009

After shifting from Cunderdin we started farming on sandy surfaced soil north of Mullewa in 1980. It soon became apparent that if we couldn't do something about wind erosion we wouldn't have a farm. We tried sowing wheat into wheat stubble, but found it difficult to get through the trash and the varieties we were using had a lot of disease.

In 1982 we bought a Fusion Sabre scarifier and air seeder. It had 12" spacings and while lupins grew well, wheat yields were still disappointing. We changed to 16" sweeps and inverted Y boots to give 6 " rows. We bought an Ausplow deep ripper and wheat yields improved although we didn't quantify them. Seeding depth and trafficability were big problems.

We started direct drilling lupins five years ago using 2" cast points and covering them with a prickle chain or packer. About this time Peter Newman (then AgWA, now with Elders Geraldton) put in a farm scale demo for us. He used ,7" and 14 " spacings, wide and narrow points and scarified and direct drilled and deep ripped 1/3 after direct drilling. The results showed no difference with wide and narrow spacings when the land was deep ripped and the deep ripping increased yields from 2.0 to 3.0 t/ha.

So three years ago we got some more tines to give us 10" spacings and fitted them with DBS knife points and fitted Yuna spring boots and covered with a Phoenix prickle chain. We managed to sow about 1" deep but the chain pulled many seeds up into the dry soil and we had only 100-120 plants/m2.

As a member of the Tenindewa Topcrop group I had learnt to monitor and record and learn from my mistakes, as well as setting achievable benchmarks to aim for.

Two years ago we used a Flexicoil land packer to level the soil. Our lupins and wheat were okay, but the canola only came up through the bottom of the furrows made by the packer. We also left one paddock in furrows and thought we could use the higher trifluralin rates others were talking about.

This year we bought a set of Manutec press wheels and no-tilled all of our crop with press wheels in the furrow. Well, it didn't rain until 11th May so we dry seeded our lupins and canola. We had 70 mm of opening rain and some of the furrows filled in from this rain. This was despite the fact that we did not graze our stubbles with sheep (for the first time). The lupins eventually came up, but some of the canola didn't. We needed to go slower, perhaps 7-8 kph, and sow shallower when doing it dry. We tried to get the points in too deep, 5" is about maximum, so the tine is not in the ground, only the point.

With our canola we swath and keep the chopper and spreader off when harvesting and burn the windrows. The roots and stalks of canola wrapped around the points and filled in the furrows. I think we might have to go slower, lift the machine out a bit and perhaps add leading disc coulters. If we don't have enough trash on the soil to stop furrows filling in during a dust storm, then we will need to sow immediately after rain. This will lesson the damage from trifluralin being washed or blown into the furrows in the absence of trash or stubble.

The benefit of no-till is that in 20 years time I believe I will still have a farm. If Kevin Bligh and Daya Patabendiga are correct, my organic carbon levels will slowly increase with good rotation and no-till. Then the farm will be in better shape than it is now.

On thing that continues to surprise me is the emphasis placed by some researchers and others on the yield losses being experienced by farmers who sow crops on wider row spacing. When I look at the results of Peter Newman's demo I am not losing anything and no-tilling on wide spacing fits in with the overall program. Even if it does cost me 3-5% of yield then I believe that would be a small price to pay to save my farm from blowing away.

THE PRECISION OF DISCS AND THE OPTIONS THEY CREATE

David Brindal, Mingenew (08) 9927 6033, fax 64

The use of the triple disc concept to establish crops is not new even in WA. My first experience was at Condingup, Esperance, where David Kettle used a Bettinson drill in the mid 60's and was also using a double knockdown. Later John Perkins of Irwin used an early version of the Walker Triple Disc in the early to mid 70's. Consequently, our familiarity with the system has overcome fears that so many others have with triple discs.

Our own system has evolved from reduced tillage in the 70's, working with David Rice of ICI to find a cost effective chemical way of reducing tillage, to direct drill in the late 70's. Our first no-till was with points with the wings cut off and dragging a small chain in the furrow to cover the seed.

However, the time arrived to replace our equipment and we needed to do more acres. The new system had to meet certain criteria of:

a) Accurate seed placement (and rates),
b) Ability to handle heavy trash,
c) Minimal soil disturbance to minimise wind erosion and leave weed seeds on the surface,
d) Split fertiliser and seed to reduce toxicity from high rates of high analysis fertiliser and also feed the seed more efficiently,
e) Simple to operate, set up and robust enough to cope with our operations and
f) An ability to handle a wide rage of soil types - espe cially in the same paddock.

After years of tines and the cultitrash, we were just getting ourselves into more trouble, especially with ryegrass. We had to find a better way of seeding, so we saw many local demonstrations with Great Plains and other machines. We sought information from Ag Department personnel like, Kevin Bligh and Bill Crabtree, and numerous others who indicated the ability of discs to handle copious amounts of stubble and seed accurately. We needed to find a machine that met all our criteria and a system that worked for us, consequently we trialled a Biomax for a couple of years, until we ironed out the glitches in the system.

We then got re-introduced to a modified Walker triple disc being trialled by Neil Reid at Arrino. The seeding bar is a 40 foot Walker multibar fitted with triple disc modules at 9" spacings. The module consists of an 18" ripple coulter offset at 6 degrees which is independently adjustable for depth and pressure followed by 14" double disc openers. The seed and fertiliser rate is accurately delivered from an 8 tonne Simplicity box.

The double disc openers have a depth controlled by a height adjustable press wheel, with very little pressure on the press wheel. The leading coulter does all the work and can cultivate 70-80 mm below the seed. Being offset from the double discs allows the fertiliser tube to be fitted next to the coulter to band about 20 mm away from the seed and alongside it. The seed is delivered into the double disc opener. Furrow filling is with the following press wheel.

The triple disc is one of the few pieces of machinery that has met all of our demands. However, the different versions of the triple disc are performing to expectations.

The system has some other powerful positives. These include, lower HP requirements (ours is a 275 hp Cat 55), can continue seeding through dry periods, a high work rate (speed is not limiting), low down-time for setting up, reduced seeding rates, less non-wetting problems and reduced rhizoctonia bare patch.

Accurate seed placement means higher average tillering and consequently head numbers that are unsustainable with our current agronomy packages, unless seed rates are reduced. We now use 65-70 kg/ha of wheat - depending on seed size and quality. The wheat seeding rates are now 15% lower than they were four years ago.

Our non-wetting problems will probably get worse again with our current rotation. But the precise seeding, of the triple disc, has greatly reduced the problem. The timing of our deep ripping creates far more problems with non-wetting soils. Rhizoctonia bare patch was always bad in some paddocks with the cultitrashes but has greatly diminished. Interesting to note that rhizoctonia is very noticeable on a block we purchased last year which was farmed more conventionally.

Problems that have to be thought through:

i) Necessity to deep rip in cereal phase - some form of vertical cultivation is absolutely necessary to maximise yields of cereals in our area. The timing and depth are still debatable,
ii) Initial learning curve with herbicide knockdown strate gy - we now use a double knock at 5 day intervals using robust rates. SpraySeed follows the glyphosate,
iii) Seed placement - know your soil diseases and seed requirements. These machines are so accurate that ignorance can catch you out,
iv) Inconsistent results with trifluralin - some years good, others ordinary. No problem with pre-sowing triazines, diuron and other soluble soil active herbicides as rain fall is good for incorporation,
v) Hair pinning can be a problem in very heavy stubbles. Canola in cereal stubbles is more of a problem than lupins,
vi) Changes in weed species - we are already noticing a change in volume of weeds particularly on loam soils that are totally zero-till. Changes are more slow where soils are deep ripped. Brome has almost gone and there are less radish and double gee. The increase of silver grass and marshmallow is a problem and we may have to develop a mix of strategies or else a spectrum of even worse weeds may develop.

Zero-till with discs has assisted us to deal with a wide range of problems and with further ideas and development I am sure we will overcome others. Our attitude is to remain flexible and receptive to all concepts.