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No-till fights the WA drought!

The devastating drought throughout the eastern wheatbelt has been tough to handle. All crops and many farmers have struggled to come to grips with losing grain yield potential. However, the no-till package has again given farmers great comfort that tillage could not give.

Adjacent paddocks on 17th July (when the Federal Minister came to town) show a cultivated paddock struggling to revive after 20 mm of rain the week earlier. By comparison, the no-till sown wheat (inset) was hardly set back by the dry conditions.

Above right: Wheat plants from fully tilled sandy loam soils enabled more vigorous early growth with greater early water use. These plants suffered perhaps a 40% mortality rate before the early July rain came, while almost no mortality occurred on similar no-tilled soils.

The no-tilled package of spraying out weeds after summer rains, retaining residue, strong tine penetration, no previous autumn tickle or cultivation and 22–30 row spacings has given wheat crops a fighting chance. These crops have hung on better, even in the heavy soils of the eastern wheatbelt.

On the heavy soils, even no-tilled crops suffered severely with the drought. However, their revival was markedly better than situations where the soil structure had been damaged by tillage.

Amazing revival of apparently dead plants. The farmer was sure the wheat was dead, but with rain and the no-till furrows on this heavy soil, they revived. For more on this, see Andrew Heinrich's story inside.

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Website password
Please note that your username and password for the website are: **wantfa** *and* **no-till**

Tilled soil did not receive the rain as well as soil that had softened through years of no-tillage. For wheat seeds that did not emerge early, the sealing of the surface makes it tough to get through.

The crusts from tilled soils are in strong contrast to the soft furrows in the paddocks with a history of no-till. The water harvesting ability of no-till is seen best when press wheels have been used. The bottom of these furrows are nicely wet after even small rain events. (For more, see Tim Braslin's article inside.)

Left: Incredible survival from the furrows of heavy soils – note no crusting!

1. Crust from tillage provides the plants with no hope!
2. Sealed and multiple tilled soil.
3. Close up of surface.
4. These dead pastures are sadly a common sight. Is it possible that 100% cropping is too risky when crops can survive and pastures die from dry conditions?

Alan Carlton took consultant Geoff Fosbery's advice two weeks before the rain and watered a small area with the equivalent of 25 mm and this showed him that the crop had not finished its race yet.

Grazed capeweed are hard to kill!

Killing big capeweed with glyphosate in April, after they have been grazed for 2–3 months, is a big challenge. The tops may look small but they have mighty big roots. Paddocks that are intended for cropping should really be sprayed out early, before the weeds dry the soil.

At the time of spraying this capeweed was only showing about 4 cm² (50 cent piece size) of surface area and the roots were perhaps 30–40 cm long. Even 1.5 L/ha of glyphosate might struggle to kill such a weed.

Areas where autumn spraying was missed were clearly visible in the wheatbelt again this year. The below photo was taken from Luke Sprigg's farm at Bonnie Rock (Luke's story featured in the last *WANTFA Newsletter*). The photo was taken in late-June this year—when most wheatbelt crops were extremely moisture stressed. Luke did receive 100–220 mm of January and February thunderstorms rain across his farms—which is more than much of the state.

The 6 m wide strips of poor crop (see arrows) were not sprayed after the January rains in the eastern wheatbelt. However, the whole paddock was properly sprayed a month later after more rain.

By late June, the difference in drought tolerance was striking! Conserved summer moisture enabled many farmers to get crops into the soil with knife-points (and high tine breakout pressure) with a minimum of seeding rain. And the no-till furrows helped catch small amounts of rain where it was needed— in the furrows.

Stuart Bee and Terry Andreoli Scholarships

WANTFA has offered two scholarships in 2001 to Muresk Honours students. Stuart Bee is studying the effects of crop and pasture residues on plant emergence and Terry Andreoli is studying the timing and rate of Flexi-N on Stirling barley for meeting the Sochu barley market.

Stuart Bee helps remove wheat straw from the furrows of a canola crop. The crop was sown with either knife-point or triple disc openers. The left-hand plot has had the stubble burnt for a complete comparison.

Knife-points get the crop up!

In a repeat of the year 2000, knife-points and press wheels on 25 cm row spacings, with high breakout, have established crops well with a dry start. The photo below, from Boyle's at York, shows how well the system works.

The DBS runs on the right-hand-side look much healthier than the inverted T points on narrow row spacings—left of centre."

Yet again damage has occurred with trifluralin use on narrow rows. Adding to the trifluralin throw is the use of inverted T points which throw more soil than knife-points—particularly at usual farmer speeds—and we observed about 30% of failed emergence from twisted plants found underground.

Lucerne area expands into wheatbelt

Encouraging results from growing lucerne on the south coast has prompted others to try it. The ability of lucerne to survive in dry regions, use ground water and decrease recharge has given many the confidence to have a go.

Peter Capito from Bodallin (left) shows Toll Temby (WANTFA committee member) how well his lucerne has established and grown.

When rain falls in summer the lucerne grows spectacularly and provides a rich source of stock feed. No-till is the perfect method of establishing lucerne, especially with seeders that give precise seed placement.

Paired row adapter

The inventive Harringtons have done it again! Doug Harrington has developed a clever paired row system that can be attached to most standard seeders.

Doug's invention was a hit at our Annual Conference. Doug has been thinking about how to make such a system both simple and practical after hearing Dwayne Beck speak on his first visit to WA in 1996.

Last year, thousands of hectares were sown using the system with good success. The unit uses a pair of opposing offset discs and a presswheel which follow a tine fitted with a knife-point (see photo below). The discs are offset from the tine by approximately 55 mm. So, if the tines are set at 300 mm spacing, the row spacing becomes 190 mm/110 mm/190 mm. In this configuration, fertiliser can be placed behind the tine, in between the two seed rows.

Alternatively, if wide rows are required (eg. lupins), the seed can be sown behind the tine, with fertiliser banded on either side, as per Dwayne Beck's concept. The units are easily modified to suit individual seeders and conditions. Call Doug on (08) 9881 1496 to discuss this innovation.

A simple paired row system for placing high rates of fertiliser safely near the seed and away from the weeds.

Last WANTFA newsletter!

At recent WANTFA committee meetings, concerns were expressed about some farmers' interpretation of no-till farming. Buying a set of knife-points is a good start, but successful no-tilling most likely requires the adoption of the complete no-till system which also includes rotations and residue retention.

In recognition of the complex interactions of sustainable and profitable farming systems, and to increase our awareness of the importance of this systems concept, our *Newsletter* will have a name change. This change will also be reflected in our next Annual Conference (14–15 February in Perth and 12 February at Katanning).

Growing hay can be expensive!

I have had several discussions with farmers about how profitable hay growing can be. While this is no doubt true, several people have suggested including some costs of hay growing.

Hay requires the export of all top material at peak biomass. The amount of material produced is likely to range from 6–8 t/ha. Let's assume it is a 7 t/ha hay crop and a bale weighs 700 kg. Growing such a crop might cost the following:

Item	Activity	Cost/unit	Cost ($/ha)
1	Bailing @ $25/t	$25/t	$ 175.00
2	130 kg/ha of MAP	$620/t	$ 80.60
3	Cartage	$7 bale	$ 70.00
4	150 kg/ha of potash	$400/t	$ 60.00
5	130 kg/ha of urea	$395/t	$ 51.35
6	Cutting @ $40/ha	$40/ha	$ 40.00
7	Herbicides (RU, Dual, Diuron, Dicamba)	$38/ha	$ 38.00
8	Seeding	$35/ha	$ 35.00
9	Fungicides at high rate	$27/ha	$ 27.00
10	Seed at 140 kg/ha	$190/t	$ 26.60
11	Interest on est. costs (10% for 9 mths)	$22/ha	$ 22.00
12	400 kg of applied lime	$25/t	$ 10.00
13	Topdressing costs (x3)	$2/ha	$ 6.00
14	Raking	$5/ha	$ 5.00
15	Insecticides (RLEM or antifeed)	$5/ha	$ 5.00
		Total =	$ 650.55

The fertiliser applications might seem high, but they are only a little higher than replacement levels. Some highly fertile loamy soils can produce good hay for several years. However, after perhaps 10 years of constant hay cutting, even these good loams will stop performing without high fertiliser inputs. Hay seed is expensive and fungicides are needed to ensure high quality.

At these costs, good returns can be achieved, with hay in a typical year fetching $140/t. Therefore, 7 t/ha at $140/t equals $980/ha gross. Conversely, if for some reason the crop fails, or is damaged, then losses can be significant. Poor spring weather can greatly reduce hay quality and there will be no return if the crop is not taken through to completion.

Poor quality hay might be worth $70/t and if this happens one in five years then a 50% loss every 5th year roughly equals a 10% loss every year. Therefore, $980–$84/ha = $896/ha gross. If these assumptions are correct, then hay might return $896–$615 = $281/ha nett.

This brief appraisal relies on suggested budget information. It is clear that actuals over a 3-year history would be more valuable. The new haysheds being erected suggest that hay growing is making money, but do your own calculations.

How about round and round in circles?

Although this concept is different from the 'up and back' idea and the tramlines discussed by other farmers in this issue, some may find it useful (especially those who are having problems finding their way when seeding into stubble with knife-points or discs).

Farmer Barry Gray from Kukerin, (08) 9864 6066, suggests that square paddocks can be sown most efficiently when done in a spiral pattern coming out from the centre (see diagram). The idea is good for seeding, spraying, harvesting and chaser bin use.

Seeding in circles makes it easy to stay on track in thick stubbles. This approach ensures that 90% of the paddock is sown with 100% efficiency and this reduces stubble blockages if the paddock was sown as a square in the previous year. The headlands are reduced in size and are a different shape, but can still be managed more efficiently than when sown in the conventional manner.

Barry says, "Try the idea and you will be amazed how much easier the driving is on the operator. Working on a continuous curve has many benefits, like in dusty conditions—you are never travelling in the one direction for long."

In the distance about 4 m of overlap can be seen. This is common with inexperienced drivers and is quite expensive.

Big Meckering R&D Day 18th September 2001

Please mark this day in your diary! It will be an exciting event. There are many interesting trials on show. To assist in planning, we are encouraging early registration. (See enclosed application form.)

Also, note the inserted pamphlet giving comprehensive details of the site. Feel free to visit the site on your own during the year. If you would like to take a local group there before the big day, please contact Matt Beckett on 9622 3395 or matt.beckett@wantfa.com.au.

Carbon is top-dressed out at the recommended rate in a trial where phosphorus levels are also varied. Come and see for yourself how it performs! There are 20 other innovative trials also on show.

Diuron damage is higher with small rains and zero-till

Spraying Diuron before seeding wheat is now commonplace for many knife-point no-tillers. Likewise for disc zero-tillers!

However, usually when Diuron is applied IBS (Immediately Before Seeding) at low rates, little crop damage occurs—as any rain readily washes it through the profile. Not so for this zero-tiller for this year (see photo).

Diuron damage is evident on 3–5 leaf wheat plants—two very small rains, with zero-till, after seeding seems to have concentrated diuron in the furrow.

Diuron IBS is more safely used with knife-points than with discs, as a shoulder of soil is created on the edge of the furrow with knife-points. This decreases the amount of soluble herbicides moving into the furrow. Some of the herbicide might move down, in preference to sideways into the vicinity of the crop seedling.

Meckering R&D Site Sponsors

WANTFA would like to thank the following sponsors of the WANTFA Meckering R&D site 2001.

BEELINE Technologies has provided a BEELINE Navigator to guide precision sowing at Meckering. Neil McAlpine, BEELINE Regional Manager has offered WANTFA members a discount when purchasing a BEELINE system.

Elders Ltd State Technical and Professional Services Manager Bevan Addison said "Farmer driven work on such a large area is commended and supported by Elders".

CSBP futurefarm will not only assist with all trials at Meckering but also provide technical advice and laboratory testing. Their new product "Flexi-N" is the subject of several trials.

Crop Care has been an excellent supporter of WANTFA having sponsored the Annual conference since 1999. WANTFA appreciates the support provided via WA Sales Manager Gordon Cumming and National Marketing Manager Peter Nilson.

Syngenta Crop Protection Systems are new WANTFA sponsors. State Sales Manager Brian Gunn said "Research and Development is very important to Syngenta and we are very happy to be cooperating with WANTFA as it brings synergy to both Syngenta and WANTFA".

AWB Ltd is also a new sponsor. AWB Ltd is pleased to be working with WANTFA to produce more sustainable farming systems and to generate more reliable returns to WA grain growers.

Partnerships with the above companies is particularly satisfying for WANTFA as they all desire to assist farmers to implement profitable and sustainable farming systems.

Mg can sometimes be limiting

I recently spoke to an agronomist about a soil test taken from Narembeen. The farmer was puzzled as to why a paddock was not performing despite lifting the pH with 4 t/ha of lime in the last few years.

The topsoil pH was now 5.9 in $CaCl_2$ and lower at depth. A full soil test to 30 cm showed that he had only 37 mg/kg of Mg^+ in the top 15 cm and only 11 mg/kg of Mg in the next 15 cm to 30 cm depth. These levels suggest that magnesium is likely to be restricting his grain yield.

This is not a common result, but it has been observed on several farms this season where extensive soil testing has been done. Usually WA soils have an increasing amount of Mg with depth, but not always.

Ants again!

More disc zero-till farmers, such as Geoff and Lindsay White from Goomalling, have noticed strong ant activity in paddocks that have been zero-tilled for a long time.

The ants love to collect weed seeds. Geoff noticed that a large number of ryegrass plants emerge around their nests. This can make ryegrass hard to kill in these patches with selective herbicides.

Two ant nests are observed in close proximity. This paddock has had stubble retained for about 10 years.

Residue manager!

Before retiring, inventive manufacturer and WA champion of no-till, John Walker from Merredin was experimenting with a residue manager design.

It was a new concept to me—and John said it showed promise. However, sadly he was not able to take the invention to the market.

The disc travels on a 4–6 degree angle and the press wheel stops the disc from cutting into the soil. There is a great need for someone to invent a reliable residue manager for our West Australian sandy soils.

Draft Walker residue manager needs to be taken further. Thanks, John for your great contribution to no-till in WA.

Cunderdin students help at Meckering

The WA College of Agriculture, Cunderdin has been a great help at WANTFA's Meckering site this year.

In partnership with Beeline and co-ordinated through AgriTech Crop Research, these students have helped generate straight lines on most of the Meckering site this year.

Cunderdin students and supervisor learn how to use Beeline equipment.

From the President

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

This year has really tested the farming system for so many people. For those without rain, it didn't matter what type of crop planting system was used—it was still dry.

However with just a little rain, the combination of knife-points and press wheels has been fantastic. Crops have established surprisingly well, and apparently held on in most cases. Where stubble has been retained the results have been even better.

Farming systems for all seasons

This year's experiences highlight the need to develop farming systems that reliably work in all seasons. My guess is such a system will include no-till sowing and stubble retention. Problems of stubble toxicity have been solved elsewhere in the world—now WA must do the same.

Your committee have resolved to put additional effort into getting appropriate research done into the benefits that members are seeing from long-term use of no-till, and into matters restricting the successful use of no-till farming in WA. We believe that the weight of membership in this active association is best used in influencing existing institutions (who are already spending our money) to do the work that is needed. CSIRO, UWA, Ag Dept have large infrastructure in place to which we can add a strong innovative farmer link, exposing those institutions to the issues confronting farmers. Such partnerships have the potential to be of great benefit to both farmers and researchers.

Work happening at Meckering will continue with Matt Beckett taking a bigger role, freeing Bill Crabtree up to spend more time working with members in the paddocks. This will also enable Bill to produce more of our excellent Newsletters, with these arriving in your mailbox prior to the critical decision-making times in the farming year. Matt is also going to run the demonstration work with the WANTFA precision planter around the wheatbelt this spring. This should give us a much better knowledge of the growth possibilities and water use patterns of sorghum and sunflowers in a wide range of locations.

Warm season crops

Some people are questioning the amount of work going into warm season crops. Experience elsewhere in the world has shown that a crop system with only a small number of crop types invariably fails, and our observation of the explosion of ryegrass in a wheat:lupin rotation is a typical symptom of this. By incorporating a crop that is planted and harvested at different times of the year the system can be made much more robust. The short-term cash benefits may not be high, but the long-term contribution to weed and disease management should be significant. Effects on soil health, and hence productivity, and the water use to prevent salinity and waterlogging have also been observed. We wish to quantify these benefits, and help make them available to our members.

Roundup Ready

The issue of Roundup Ready crops has been a hot topic of discussion. There is potential for as much benefit as harm with this technology, given our dependence on glyphosate as a knockdown prior to planting. Anything that increases the risk of weeds developing glyphosate resistance needs careful handling, and it may be appropriate to discourage the use of such technology until alternative knockdown products are available. Rogue plants growing on roadsides would not be controlled with the present glyphosate spraying, so this would need altering at the same time. This is an area where we are in need of further information so that we can make an informed decision, and no doubt it will come up for discussion at our next Conference in February.

Glyphosate resistance is here!

Richard McKenna, Mullewa Committee member, (08) 9961 5218, fax 01

The development of glyphosate resistance in ryegrass on a farm in the northern wheatbelt, whilst not entirely unexpected, is a cause for concern to many WA no-till farmers, myself included.

It had been reported in the Eastern States several years previously but I had hoped that we in the west might have been able to delay its development for longer than we did. The fact that the glyphosate resistant population was discovered in my area prompted me to investigate more.

Gene frequency

The gene conferring resistance to glyphosate is thought to occur at a rate of 1 in 10 million plants (see Lorraine-Colwill et al, Theoretical Applied Genetics 2001, pages 545–50). At a plant density of 100/m2 this would equate to one glyphosate resistant plant every 10 ha. Similarly, at a density of 1,000/m2 this would equate to a resistant plant every hectare. Modeling carried out by WAHRI (WA Herbicide Resistance Initiative) researchers suggests that 15 applications of glyphosate may result in the development of a resistant population.

Farm history

I have contacted the farmers who either owned or leased the farm from the mid-1970s to attempt to get an idea of how much glyphosate had been used prior to the discovery of resistance. Ryegrass was not noticed on the property until the late 1970s or early 1980s. However, its establishment was rapid, as it is well suited to the low-lying, lighter textured soils on the property. Crop establishment in the years up to 1990 was carried out using traditional methods (ploughing and sowing with full-cut) hence knockdown herbicides were not used until 1990–91 when SpraySeed and full cut tillage was adopted.

The paddock where the resistant population was discovered was not in crop in 1992 or 1993. It is likely that it was spraytopped with glyphosate in spring 1993 and wheat was sown in 1994.

This crop was established using John Deere's Biomax opener after applying 800–1000 mL/ha of Touchdown® (glyphosate). In 1995, the paddock was left out of crop once more, with glyphosate being applied for seed set control during the spring. Wheat was sown in 1996 and 1997 with the Biomax opener after Touchdown® application.

Lupins were grown in 1998, presumably dry sown, in which case no glyphosate would have been applied. Excellent grass weed control using a grass selective was reported. In the following year (1999) the paddock was deep-ripped and then harrowed (which controlled a germination of ryegrass) in preparation for a wheat crop. However, the extremely wet May in 1999 prevented sowing. Consequently, the paddock was spray-topped in spring with glyphosate, and burnt in autumn 2000 to further reduce seed numbers.

By this point in time, I estimate 6 applications of glyphosate were used on the paddock—perhaps 7 if the lupin crop in 1998 was not dry sown. The discovery of ryegrass seedlings in the 2000 wheat crop that survived a robust rate of Roundup Xtra® led to resistance testing. UWA researchers, principally Dr Paul Neve, have now confirmed the resistance status of this population in the glasshouse (see table).

	Survival 21 days after spraying (%)	
Dose of Roundup Xtra (L/ha)	Susceptible population	Mullewa population
0	97.7	97.9
0.5	71.7	95.8
1.0	16.6	86.7
2.0	2.5	65.4
4.0	0.0	29.4
8.0	0.0	4.8

letters

9 July 2001
The Editor
WANTFA Newsletter

Dear Sir

As the person who convened the formation of WANTFA in 1992, and who has attended every WANTFA Committee meeting ever held, bar one, I am disappointed that WANTFA appears to have achieved little or nothing on glyphosate resistance.

It is problematic in my view whether no-till sowing, and therefore sustainable grain-growing on sandy and sloping loamy soils, can long survive glyphosate-resistance.

Six years ago glyphosate-resistant ryegrass first developed in Australia. Four years ago, World Weed Science Society President, Professor Jonnie Gressel told a WANTFA meeting that preventative action is a lot easier than trying to cope with glyphosate resistance, if it is allowed to occur. Yet WANTFA still has done practically nothing!

Some people seem to know better—that an equally effective new knockdown will turn up. It may well, but it's not here now, like glyphosate-resistant ryegrass! And guess what a replacement would be priced at, like Roundup was!

Would you stake sustainable grain-growing on it?

I had been asked by WANTFA President Neil Young to spearhead herbicide resistance activities on the Committee. I have now told the Committee I can no longer do so because, having laboured long and hard on glyphosate resistance, little if anything appears to have been achieved.

Rather, I believe it is in everybody's interest to slow the rate of development of glyphosate resistance as much as possible.

Alerting other landholders including Government authorities such as Main Roads and Westrail, as well as Shire Councils, hobby farmers and our neighbours to the potentially deadly danger of glyphosate-resistant ryegrass to commercial grain-growing now (before firebreak-spraying time) would be timely, in my view.

Kevin Bligh
Honorary Life Member and Committee member

What implications for us?

It makes me wonder that if resistance to glyphosate occurred after only 6–7 applications then how many other paddocks in the wheatbelt have had similar or greater exposure to glyphosate? I would suspect there would be hundreds or thousands such paddocks. The current owners reported that the paddock had very high ryegrass numbers prior to the lupin crop in 1998, and that they had reduced this population considerably. Higher plant populations would lead to an increased frequency of the naturally occurring resistance gene, and high plant numbers should accelerate the onset of resistance.

Double knock use is paramount!

Dr Paul Neve (WAHRI) said, "The development of this resistant population has shown that despite glyphosate being a low risk herbicide for resistance development, resistance can and has occurred! The major message is not to rely solely on glyphosate for knockdown weed control. This is even more important in no-tillage systems. I am working on computer models which simulates the evolution of glyphosate and paraquat resistance under a range of farming systems. These results show how powerful the 'double knockdown' is for reducing the probability of glyphosate resistance evolution. The double knock is glyphosate followed by a second knock of SpraySeed—at full label rates!"

Paul continued... "In years where a double knock is not possible, alternation of knockdown chemistries should be considered. Using glyphosate before cropping and in pasture for spraytopping, and its potential future use 'in crop' (with Roundup Ready) further increases the risks of resistance development."

Conclusions

It is possible that there are more glyphosate resistant ryegrass populations in the wheatbelt, either undiscovered or undisclosed. WAHRI and the Dept of Agriculture are happy to test any further suspect populations. The challenge for all of us is to stop the development of more populations, and to identify, and if possible, eliminate any populations that exist. On behalf of the WANTFA committee, I urge you to use the techniques outlined above to achieve this, not only in the cropping phase, but also in pasture.

Acknowledgements

This population was found as a result of collaborative work with Dr. Abul Hashem of Agwest. Dr. Paul Neve (WAHRI) and Bill Crabtree (WANTFA) have provided technical data and assistance. The current and previous farmers of the property involved have been very obliging with their time and records. Thank you to them all!

Why paired rows?

Mike Collins, Dept of Agriculture, Northam

There are good reasons to increase row spacings, despite that fact that there are also good reasons to keep them narrow.

For wheat, wide rows tend to decrease yield and give less competitiveness with weeds. However, the benefits of wide rows or paired rows include:

1. Improved stubble handling at seeding.
2. Lower machinery costs (both capital and operating), due to fewer seeding units.
3. Improved placement of fertiliser with paired rows.

Paired rows enable safe separation of seed and fertiliser. The seed is placed either side of a fertiliser row. Such a separation is useful in very dry seeding conditions where fertiliser salts cannot interfere with crop emergence. This placement also encourages the crop more than the weeds so is likely to be more effective, as there will be more competition from the crop than when fertiliser is on one side of single rows.

Mike shows lupins compared on normal row spacings versus those sown on the skip row configuration (left) at the Northam Dept of Agriculture in July 2001. Doug Harrington's paired row openers were used.

Inter-row weed spraying would also benefit from wider paired rows. A lower proportion of the total area 'in-row' would need selective weed control methods. Such methods may be difficult, expensive or give greater pressure towards herbicide resistance (depending on in-pair spacing). This configuration would halve the number of inter-row spray shields, reducing both costs and the weight carried by the boom.

Possible grain yield response

Paired rows may also provide a yield benefit. The lupin row crop trial of 1998 showed little disadvantage from late weed control but this was not the case in 2000. Last year, a 'critical period' trial at Southern Brook showed a yield decline from the first weeding in early July onwards. Obviously there was competition from ryegrass for moisture throughout the whole season.

The main row crop trial at Wongan Hills on 56 cm row spacings showed good in-row weed control when 1.5 kg/ha of Kerb was banded over the row at seeding time with a double knock between the rows. As strange as it seems, the best yield was from where there was no in-row weed control. These lupins produced less biomass (see table below).

Treatment	Yield (t/ha)	Biomass (t/ha)	Grain weight (g/1000)
Kerb in-row	0.69	4.24	146.3
No in-row control	1.02	2.78	145.3
Conventional simazine	0.42	4.00	142.5
Control – none	0.61	2.78	132.5
LSD 5%	0.35	1.80	7.1

This result has stimulated the thought that 'skip rows' or 'paired rows' may give the possibility of moisture conservation. This may only work in certain seasons, such as a cool wet July followed by a warm dry August.

Skip rows

The concept of 'skip' rows has been imported from Queensland and northern NSW where summer crops are grown on stored soil moisture. The idea is that when roots from the close spaced rows meet, growth is checked, conserving moisture for grain production. After this, the plants find that the skip row zone contains moisture which can finish the crop. The concept is being tested this year.

Trifluralin applied to seed in autumn and buried

Mike Collins and Julie Roche, Dept of Agriculture, Northam (08) 9690 2114

For many years people have been talking about how trifluralin should work on the seed coat.

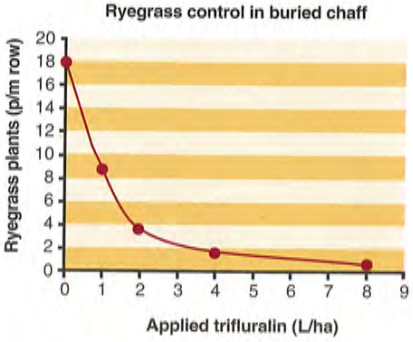
Some laboratory study results were presented at the WANTFA Conference this year with mixed results. We conducted some field work and found that, if a row of seed is buried immediately after application, it does work! See the photos and graph right.

Julie Roche placing wheat chaff full of ryegrass in the furrow.

Above: Mike sprays the chaff with trifluralin with only one nozzle active. Immediately afterwards the chaff was buried with soil.

Left: This July 2001 photo shows the non-treated ryegrass strips—with healthy ryegrass germinating in the lupins.

The planted strip of ryegrass that was treated cannot be seen—see results in graph.



Drought tolerance of wheat seedlings

Andrew Heinrich, Quality Agronomics,
Ongerup (08) 9828 2241 fax 42

In the early 90's, I conducted a trial to assess the drought tolerance of wheat seedlings while I was a Research Officer with the Department of Agriculture at Northam. The purpose of the trial was to assess the drought tolerance of wheat seedlings when sown early in the season on limited rainfall and followed by an extended period of drought.

Irrigation trial

Wheat was hand sown 2 cm deep into red brown clay loam and irrigated with 3 treatments to represent opening rainfall events of 15 mm, 25 mm and 40 mm. The wheat was sown on March 29. The irrigation treatments were applied as 10 mm before seeding and the balance applied immediately post seeding. The plots were covered with a plastic tunnel house to prevent natural rainfall supplementing the irrigation treatments.

Conditions were harsh under the tunnel house during the trial. Seven days exceeded 40°C and another 5 days exceeded 35°C. The tunnel house was removed 5 weeks after sowing when plant growth had ceased.

All seeds germinated, but failed to emerge in the 15 mm irrigation treatment. About 80 plants/m2 were established in the 25 and 40 mm irrigation treatments. The seedlings that emerged produced on average 2–3 leaves for the 2 treatments, then ceased to produce any more after about 4 weeks of drought. Leaves were senescing and plant density was reduced by up to 40%.

Incredible drought tolerance

At the designated completion of the trial the tunnel house was removed in early May. 10 mm of rainfall fell on May 10 and the "dead" plants revived. The apparently "dead" seedlings were not "dead"; they had simply died back from severe drought but remained viable under the soil surface. After the rain, plant density returned to 90% of the maximum achieved.

Seedings looked dead before the rain, now 10 days later they are away again.

Amazingly, the seeds that had germinated under the 15 mm irrigation treatment and lay dormant for 6 weeks, emerged after the 10 mm of rainfall that fell after the tunnel house had been removed. Plant density achieved under these conditions was equal to that achieved by the seedlings that emerged immediately after sowing.

All treatments commenced producing leaves at a similar rate to each other after the rain and proceeded to produce grain by the end of the season. Hand harvested yield estimates from all plots were about 4 t/ha.

This trial clearly demonstrates the drought tolerance of wheat seeds and seedlings. Given the season that we have experienced so far, I strongly recommended that reseeding "failed crops" be contemplated very carefully. At least allow a few days after rain before reseeding to ensure that the seed already sown, has really failed and will not establish. There is no point in re-sowing a crop when there is already one waiting for rain to get going. Wheat seedlings are very tough. They will survive!

Once rain is received, drought affected seedlings will grow as normal wheat seedlings and go on to produce a grain yield that the season will allow. Please don't despair if you think your crop is dead.

If you have crops that have not emerged, there are a couple of things that you can do to reduce the stress you may be feeling. Grab the fire fighting unit and go and water a couple of spots in the paddock, you will soon see if the crop will come up. Alternatively, you can dig up some of the topsoil with seed in it, put it in a pot, and water it at home. Any viable seed will quickly show their hand and you can make an informed decision as to the necessity of re-seeding.

Soils are alive!

Matt Braimbridge[ab], Peter Fisher[b], Jennifer Bignell[b], Jessica Sheppard[c], Rod Bowey[c], Greg Hamilton[c]

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[b] Department of Agriculture, Katanning.
[c] Department of Agriculture.

No-till for grey clay soils

The adoption of no-till and zero tillage sowing systems for hardsetting grey clay soils has increased rapidly over the last 10 years. The GRDC funded 'Grey Clay Project' compared no-till and full-cut sowing systems over 4 years through measurements of crop establishment, production and the physical status of the soil. Work is currently being conducted by members of the Soil Biology group at the University of Western Australia to determine the effect of tillage practices and other factors on the biology of grey clay soils.

The Grey Clay Project

In 1995, a GRDC funded project was initiated by the Dept of Agriculture in Katanning to identify and investigate factors influencing production and sustainability on grey clay soils. These soils are estimated to occupy around 15% of the Great Southern. They are hardsetting, poorly structured and very dense, usually with a shallow topsoil overlying a sodic subsoil.

A survey of 166 grey clay farmers investigating current farming practices and research priorities was conducted in 1995, with the results incorporated into treatments in a large scale farming systems trial at Wemyss Estate, Mindarabin.

The survey results indicated that, in 1995, approximately 25% of farmers surveyed were using no-till systems on their grey clay soils, with the remainder citing a lack of information on the suitability of no-till systems for such soils as a major problem. A follow-up survey of the same farmers in 2001 indicated that over 70% were now using no-till or zero-tillage systems on their grey clays.

To investigate the effects of no-till versus full-cut tillage, the crop rotation and pasture/crop rotation treatments at the Mindarabin trial site were sown with Keech knife-points and full-cut 175 mm points. ARP presswheels and Agmaster rotary harrows were compared as the seed covering devices with each tillage system (see photos below).

From 1996 to 1999, the trial was sown with the tillage/seed covering device comparison. Measurements of crop emergence, weed numbers, sowing depth, dry matter production and yield were taken under the different systems. Measurements of topsoil bulk density and unsaturated hydraulic conductivity were also conducted.

Crop Establishment

The ability of crops to establish well with early vigour is especially important on these soils, which are prone to surface crusting and waterlogging. Results and field observations indicate that the soil moisture at the time of seeding and the soil conditions preceding crop emergence have a dramatic effect on crop establishment.

The early application of no-till at the Farming Systems trial resulted in lower establishment in comparison to the direct drill, full-cut tillage. However, in 1999, this trend was reversed with the no-till treatments providing significantly better establishment than the direct dill. The use of presswheels as a seed covering device generally produced better establishment than harrows.

The no-till system consistently provided a more consistent seed depth, especially in combination with the presswheels as a seed covering device.

Keech no-till points and full-cut points.

Our regular Soil Biology segment continues...

Table 1: *Effect of tillage and seed covering device on crop establishment*

Rotation	Year	Crop	Relative Establishment*		
			Direct Drill, Presswheels	No-till, Harrows	No-till, Presswheels
Crop Rotation	1997	Wheat	+3%	-17%	-6%
Crop Rotation	1998	Canola	+3%	-27%	-17%
Crop Rotation	1999	Wheat	+5%	+18%	+13%
1:1 Crop/Grazing Rotation	1997	Wheat	-13%	-23%	-7%
1:1 Crop/Grazing Rotation	1999	Wheat	+12%	+24%	+30%

** Values expressed relative to Direct Drill, Harrows treatment in each year.*

Weed numbers

Reduced tillage through the no-till system consistently reduced weed numbers, particularly in combination with the use of presswheels. This is a direct result of reduced seed bank disturbance under the no-till and presswheel combination.

Table 2: *Effect of tillage and seed covering device on weed numbers*

Rotation	Year	Crop	Relative Establishment*		
			Direct Drill, Presswheels	No-till, Harrows	No-till, Presswheels
Crop Rotation	1997	Wheat	-13%	-30%	-74%
Crop Rotation	1998	Canola	+25%	-50%	-50%
Crop Rotation	1999	Wheat	-36%	-18%	-32%
1:1 Crop/Grazing Rotation	1997	Wheat	-16%	-64%	-72%
1:1 Crop/Grazing Rotation	1999	Wheat	-14%	-76%	-92%

** Values expressed relative to Direct Drill, Harrows treatment in each year.*

Crop Yields

The use of no-till on the crop rotation treatment has resulted in a small but increasing trend toward greater crop yield over the four years of comparison. No-till on the crop/pasture rotation has resulted in slight reductions in yield.

Table 3: *Effect of tillage on crop yields*

Rotation and Tillage	Yield Relative to Crop Rotation, Direct Drill			
	1996 Faba Bean	1997 Wheat	1998 Canola	1999 Wheat
Crop Rotation, No-till	-45%	-2%	+1%	+2%
1:1 Crop/Grazing Rotation, Direct Drill	Pasture	-1%	Pasture	+2%
1:1 Crop/Grazing Rotation, No-till	Pasture	-4%	Pasture	-3%

Physical soil characteristics

The effect of reduced tillage on the physical status of the soil has been mixed, with only small changes in bulk density being measured between the two tillage practices. The largest differences in topsoil bulk density were seen between the continuous cropping and grazed treatments where sheep compaction has significantly increased the bulk density.

The unsaturated hydraulic conductivity of the topsoil, measured using disc permeameters, has indicated that the lack of inter-row cultivation with the no-till system resulted in a broad scale reduction in the hydraulic conductivity of the topsoil. This reduction, however, was not as dramatic as that on the grazed pastures, where topsoil compaction by sheep significantly reduced the rate of water infiltration into the soil.

Table 4: *Effect of Tillage on topsoil bulk density*

Rotation and Tillage	Topsoil bulk density relative to Crop Rotation, Direct Drill		
	1997 Wheat	1998 Canola	1999 Wheat
Crop Rotation, No-till	+1%	-3%	+3%
1:1 Crop/Grazing Rotation, Direct Drill	+12%*	+5%	+15%*
1:1 Crop/Grazing Rotation, No-till	+10%*	+8%	+18%*

** Grazed in previous year*

Table 5: *Effect of tillage and sheep compaction on unsaturated hydraulic conductivity*

Tillage Treatment	Relative Unsaturated Hydraulic Conductivity*	
	1997	1999
No-till	-17%	-41%
Grazing	-55%	-61%

**Values expressed relative to Direct Drill treatment in each year.*

The Grey Clay Project has recently received an extension, with the continuation of the farming systems trial and establishment of a number of smaller scale satellite sites for 2001. New research includes the incorporation of 'subsoil loosening' into treatments at the farming systems trial and the addition of lime to examine any possible effects on soil structure and resulting crop yields. An economic analysis of the various farming systems under investigation is also planned for the near future.

For further information please contact: Matt Braimbridge, Centre for Land Rehabilitation, UWA (08) 9380 2598 or Jessica Sheppard and Rod Bowey, Department of Agriculture, Katanning on (08) 9821 3333.

ARP Presswheels and Agmaster rotary harrows.

Tread lightly—claying operations caused compaction

Jeremy Lemon, Dept of Agriculture, Esperance (08) 9083 1111

Crop yields on the Esperance deep sands have declined over 10 years of continuous cropping and, sadly, claying has not fully "revived" the performance of these soils. My recent exploration suggests that ripping compacted layers and tramline farming need investigating to sustain cropping on these soils.

Many sandplain farmers in the Esperance region have noticed crop yields declining since they started continuous cropping on sands deeper than about 0.5 m. The same decline has not been noticed on shallower soils, where gravel and clay start at about 0.3 m. There have been several theories put forward to try and explain this phenomenon including: nutrient depletion, declining organic matter, increased non-wetting, and the nebulous statement 'flogged out soil'.

A number of farmers have tackled non-wetting with claying, using various rates of application. These clayed paddocks have improved with better crop emergence and weed control. But they continue to perform poorly compared to their original levels of production when serious cropping began 10–15 years ago. This poor performance has been most noticeable with the dry finish to the 2000 growing season.

Farmers have noticed that lupins perform well after claying compared to canola and cereals. This suggests that nitrogen nutrition could be an issue on freshly clayed country.

Dry 2000 amplified compaction issue

The spring of 2000 at Gibson was exceptionally dry with 14 mm and 15 mm in the months of September and October. Cereal and canola crops were noticeably droughted on clayed areas when compared to adjacent unclayed areas in the same paddock. Cereals and canola in some clayed paddocks have been appalling, with canola yields as low as 700 kg/ha and barley yielding less than 1 t/ha. These observations have led one group of Gibson farmers to investigate more closely the reasons for this poor performance.

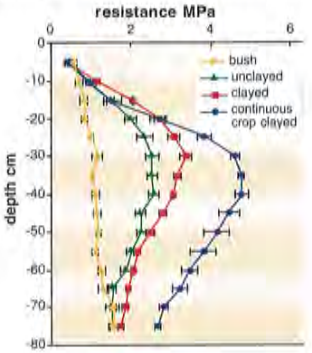
On a field walk in October, several crops, clayed and unclayed were inspected. Holes were dug by hand to observe the root distribution of the crops. The roots appeared to be growing quite happily in the clayed zone as well as in the layer just below the clayed zone to a depth of 25–30 cm. The zone below 30 cm appeared to have adequate soil moisture, yet the crop was severely drought affected. This can be explained by the layer at 25–30 cm being severely compacted—making a barrier to root growth.

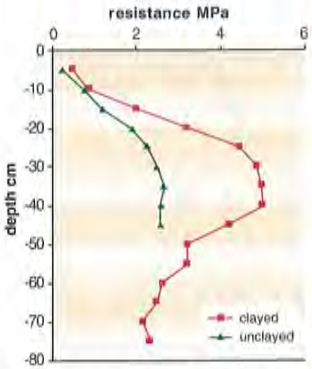
We used a Penetrometer to test soil penetration resistance. These measurements have revealed that many clayed sites have soil strength exceeding 4 MPa at 35 cm and some are above 5 MPa. Figures of 2.5 MPa or less are considered most desirable for crop growth. Clayed areas are 1–2 MPa stronger at 35 cm compared to adjacent unclayed sites in the same paddocks.

A lot of the claying in the Esperance area has been done in the summers of 1998–99 and 1999–2000, both of which were very wet with the soils being moist during the claying operations. Claying involves 1.8 to 2.4 hectares of ground being covered with rubber tyres for each hectare of ground clayed. The moist soil and repeated traffic have been responsible for compacting deeper sands.

Below are graphs of clayed and unclayed comparisons of soil penetration resistance with depth measured near the Esperance airport. The top graph compares clayed and unclayed within 10 m with a bush site and clayed with 15 years of continuous crop site for comparison. The graph below compares sites within 10 m. The unclayed site has gravel at 50 cm.

Some of the observations can be explained in terms of compaction. Lupins are less susceptible to compaction than canola and cereals. Nitrogen nutrition will be poorer on





compacted soils because the roots are unable to penetrate to a depth where a lot of the N moves with soil water. Normal spring rainfall on the Esperance sandplain is sufficient to sustain crops even with a shallow root system, but in a dry finish, the deeper moisture is inaccessible.

Claying alone is not the cause

Claying cannot be blamed for all the soil compaction that is observed. Paddocks with a longer cropping history appear to have stronger soil at depth than mainly pasture paddocks. Increasing crop intensity and larger machinery both contribute to compaction.

Ripping has been tried in the Esperance region in the past but has not become a widespread practice with only moderate and short-lived results experienced in the past. This was done when there was not a lot of cropping history on the deeper sands but it is time to reassess deep ripping responses. After the cost of ripping, you are unlikely to want to re-compact the soil deliberately so the next step in trying to develop sustainable cropping on these soils is to move into controlled traffic or tramline farming.

The morals of this story...

Today's solution creates tomorrow's problem. Unfortunately, this seems to be true for a lot research. It is difficult to foresee all the consequences of new technology. Perhaps, when trying something new, go lightly at first. Try a pilot area to experience all the implications before making a complete change.

National Heritage Trust warm season crop demonstrations

Matt Beckett, WANTFA Scientific Officer (08) 9690 2157

Narrow rows gave the best grain sorghum response and January is not too late to sow sorghum, but one 30 mm thunderstorm is not adequate.

Overview

Grain sorghum and corn, sown in late January 2001 at Dowerin produced the most biomass when sown on narrow row spacings. The 0.5 m solid row spacing producing significantly higher dry matter and grain yields (where measured) than the 1 m solid, 1 m skip and 1 m double skip rows. The fertiliser was separated by 5 cm to the side and 3 cm below the seed. However, fertiliser toxicity probably still occurred and increasingly so with the wide and skip row demonstrations.

At Morawa, sorghum produced grain and matured by early May, even when sown in late January. One thunderstorm of 30 mm in January was not enough to produce good sorghum grain yields at Dowerin.

An extensive warm season crop demonstration was planned for 2000. However, the extraordinarily dry spring of 2000 and the arrival of WANTFA's precision seeder in September meant that the soil had dried too much to get seeder penetration in spring. A scaled-down program was sown in January 2001 after 30 mm of rain (Dowerin).

Nine demonstrations involving three different warm season species were carried out at Ashley Jones' property near Dowerin. Grain sorghum and forage sorghum demonstrations were also sown on the Chisholm's family farm near Morawa early this year. All of the demonstrations were sown with WANTFA's John Deere Max-Emerge precision seeder. This is an 8 row, triple disc unit on fixed one-metre row spacings, and has the ability to place the seeds accurately spaced within the rows.

Methods

The Dowerin demonstrations sown were as follows:

- grain sorghum and corn—row spacing/configuration x plant seeding density
- grain sorghum and corn—N requirement
- grain sorghum and corn—row spacing/configuration by TOS
- grain sorghum—variety x TOS
- sunflower—variety x TOS
- non-replicated, warm season species/varieties demonstration plots with: Jumbo forage sorghum, Betta Graze sorghum, safflower, French White millet, Shiroale millet and Dolicus lab lab.

The TOS treatments were 20th Oct 2000, 9th Jan 2001, and 23rd Jan 2001 with the soil moisture at sowing being: dry, moist—but rapidly drying, and moist respectively. The monthly rainfall totals for Dowerin and Morawa were as follows:

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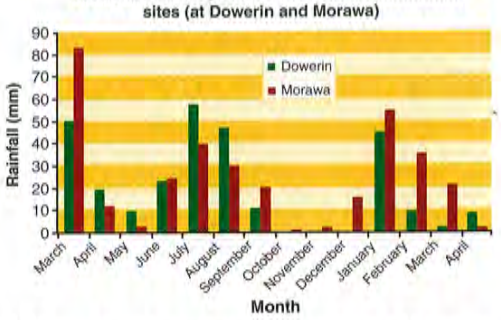


At Morawa these demonstrations were sown on 30th January 2001 into soil that was wet at 2 cm. The grain sorghum had 3 row spacing treatments (solid 1 m, 1 m skip and 1m double skip) by 3 fertiliser treatments (none, DAP only [22 kgN/ha + 24 kgP/ha] and DAP plus Flexi-N [72 kgN/ha + 24 kgP/ha]) by 3 replicates (100 m long plots). The demonstration areas of forage sorghum were non-replicated and were sown with 4 different fertiliser treatments. The row spacing or configurations used at Dowerin were 0.5 m solid, 1 m solid, and 1 m skip rows (equivalent to 1 m spacing with every third disc/tine removed).

Results

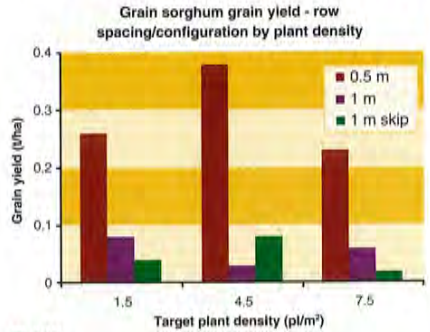
Dowerin

The grain sorghum and corn both produced significantly higher dry matter on the narrowest row spacing (0.5 m solid row). The grain sorghum also had significantly higher grain yields and a higher number of emerging plants from this configuration.

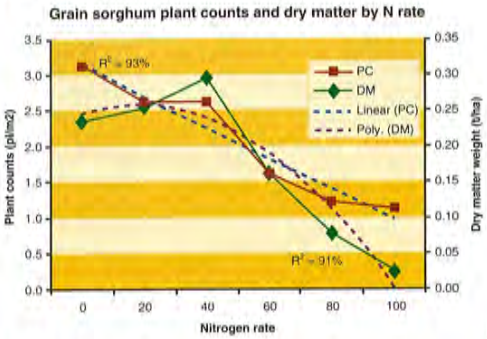
The grain sorghum on a 0.5 m solid row spacing had an average grain yield of 290 kg/ha compared with 60 and 50 kg/ha for the 1 m solid and 1 m skip rows respectively (5% LSD = 150 kg/ha). The same 0.5 m row spacing with the corn produced 920 kg/ha of dry matter, significantly higher than the 560 and 370 kg/ha for the 1 m solid and 1 m skip rows respectively (5% LSD = 230 kg/ha). See the graphs below.

The highest grain sorghum grain yield was obtained from a target plant density of 4.5 plants/m², with the highest corn dry matter being achieved from a target plant density of 2.5 plants/m² (both not significant).

The grain sorghum—N requirement demonstration, had decreasing plant numbers from the addition of any nitrogen.



Plant numbers decreased linearly by 14% for every 20 kgN/ha applied (R2 = 93%, 5% LSD = 0.002). The highest dry matter weight of 290 kg/ha was produced from the 40 kgN/ha treatment, however statistically, the optimum rate of N addition in this demonstration was 19.4 kgN/ha (R2 = 91%, p-value = 0.028).



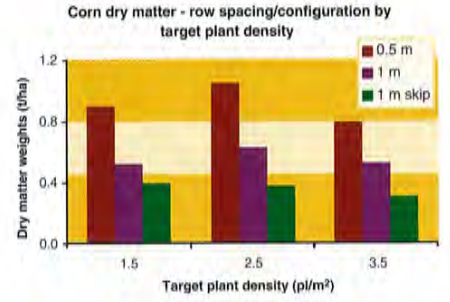
Morawa

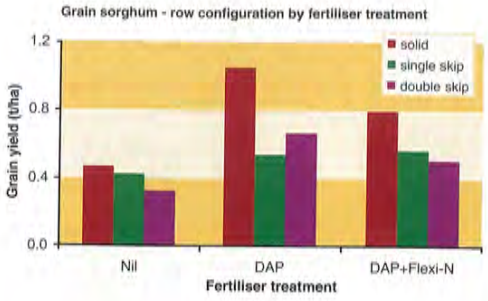
The grain sorghum at Morawa also gave higher grain yields from the solid row configuration, above the single and double skip row configurations, producing 780, 510, and 500 kg/ha respectively (5% LSD = 140 kg/ha, p-value = 0.001). The solid row spacing also had significantly greater plant establishment with an average of 2.6 plants/m² compared with 2.0 and 1.9 plants/m² for the single and double skip rows respectively.

On average, the highest grain yields were obtained from the DAP-only fertiliser which out-performed both the nil treatment, and the DAP and Flexi-N mix treatments (5% LSD of 140 kg/ha and p-value <0.001). Visual ratings from Angie Roe (Farm Focus Consultants, Northam) also statistically confirmed this.

The forage sorghum samples collected at Morawa indicated the average dry matter production to be about 4.2 t/ha (although it looked as though it would be a lot higher). The highest production of 5.5 t/ha occurred from the 120 kg/ha of DAP/urea blend treatment (64 kgN/ha + 24 kgP/ha). See graph: *Grain sorghum row configuration by fertiliser treatment*, next page.

Fertiliser	N kg/ha	P kg/ha	Dry Matter t/ha
120 kg/ha of DAP/urea blend	64	24	5.5
120 kg/ha of DAP + 120 L/ha of Flexi-N	72	24	4.8
120 kg/ha of DAP	22	24	3.7
120 kg/ha of urea + trace of DAP	57	2.4	2.7





Discussion and Conclusions

Decreased plant establishment was observed with the wider and skip row configurations in all of the row spacings at both Dowerin and Morawa. Fertiliser toxicity seemed likely to be responsible for this because, using the same rate of fertiliser per hectare with wide row spacing resulted in a higher concentration near the seed than what you would get with narrower rows. The dry conditions are likely to have made the seedlings even more susceptible to toxicity. Likewise, reduced plant establishment from the grain sorghum N requirement demonstration, which was sown with a 1 m skip row configuration, seemed to reflect some level of fertiliser toxicity even at the lowest rates of N (20 kgN/ha).

In all row configuration demonstrations the wider rows produced less dry matter (and grain yield where measured). Dr. Bill Bowden from AGWEST, Northam, dug up some plants and investigated their root systems at the Dowerin site. He hypothesised that the wider row spacing allowed the plant roots to explore the larger inter-row area for moisture and nutrients, but as a result they were less able to 'chase' the water down the soil profile as it dried rapidly. Whereas, with the narrower rows, the increased competition for water and nutrients at the surface, which the plants used, encouraged their roots to go deeper. In those conditions, they were able to access the moisture for longer.

In theory and in practice in NSW wide rows reduce the risk of moisture stress. Wide rows also allow inter-row weed spraying and relay cropping (seeding a different crop species between the rows of a crop that has not yet been harvested). Appropriate fertiliser rates with warm season crops sown on wide rows needs to be investigated further in a more "typical" season.

Visually, the forage sorghum grown at Morawa was quite amazing, growing nine feet tall in as many weeks. This very rapid growth could probably be attributed to the loamy soil, thick wheat stubble (which retains soil moisture), and mostly, the 142 mm of rain received between 17th January and the end of February. This demonstrates that with good summer rain, forage sorghum can be sown very late and yet still perform well in 28-degree latitudes of WA.

This work has demonstrated that warm season crops can be grown successfully in WA conditions and has provided an insight into their basic agronomic requirements. Further investigations in a more "typical" season are required to determine how to manage warm season crops within a rotation so that they can be economically viable to the farmer.

Derek Chisholm standing beside the forage sorghum demonstration grown on his property at Morawa.

Matured grain sorghum on 1 m skip row spacing at Morawa.

Grain sorghum row spacing by fertiliser requirement demonstration at Morawa.

Poor performing corn from the corn N requirement demonstration at Dowerin.

Peter Bartlett (left) and WANTFA committee member Toll Temby inspect the starting gap at the beginning of a run. Note how consistent Peter's driving has been further along the row.

Below (top to bottom):

- Solenoids that activate the seed and fertiliser to the two wheel run lines.
- Side-marker arm.
- Side-marker arm folded and seeder used.
- Control box showing that every second run the switch will toggle.

Sidearm marking, and up and back, saved 5%

Peter Bartlett, Bodallin, (08) 9047 5062

While spraying in-crop chemicals last year, I noticed seeder overlap of up to four feet. This was with a 29-tine seeder and I calculated that we had up to 14% overlap error during sowing. We therefore decided to purchase a side arm marker and a control system worth $14,000 for this season. Our intentions were to increase the accuracy of inputs and decrease wastage by marking and using tramlines for future sprayings. We are pleased with the marker arm results and think that we may move to controlled traffic in the near future.

Our current cropping program consists of 900 ha wheat, 200 ha of lupins, 100 ha of Sona chickpeas, 80 ha of oats and 60 ha of serradella. We use a Flexicoil 820 bar with 29 ConservaPak openers. We tow a 9000 L Horwood Bagshaw air cart (three bin) and use a 20.5 meter Jenell spray unit that will be reduced in size to 18.7 m to match two runs of the seeder.

The combined marker unit is made up of two parts. The first is two Haaukaas side marker arms and a Marker Master controller, costing $9,500. The second part consists of four solenoids (costing $4,500), which are connected to the top of the seed and fertiliser heads and a micro switch. The solenoids toggle the seed and fertiliser flow when activated automatically or manually.

Marker arms, controller and solenoids

The controller makes using the side arm markers very straightforward. For example, you retract the arm currently in use, lift the machine, turn 180 degrees, extend the opposite arm to mark the next run and then lower the machine.

It takes one set of remotes, from the hydraulic supply, to power the unit consisting of three solenoids and a flow control valve. From inside the cab, the touch pad on the controller allows you to manually extend or retract either marker arm. Once the marker distance has been set, and the cutting angle of the discs is established, then an accurate line can be left. This makes driving a lot more relaxing. A 10 mm rod is mounted on front of the tractor and provides a line with the marker arm furrow and this greatly helps you to drive in a straight line.

The Marker Master controller can be set from the cab to the cycle required. Most operators use three seeder runs to one boom run, this makes the first seeding run simple. However, we used two seeder runs to every one spray run and this requires only half of the seeder being used on the first run—in order to get the tracks in the right spot. The micro switch that toggles the solenoids is located on the depth control slide (see photo below). For our system, we signal the controller to shut down the solenoids on every second run, leaving two un-sown rows that guide the spray and spreading operations.

Sub 10-cm accuracy is easy

With concentration, it was easy to achieve accuracy within 100 mm or less. We currently work 75% up and back, and 25% on the contour. Now that the tramlines have appeared in the newly emerging crops, it is a lot easier to follow them, in most spraying conditions, without having to use foam markers. We did have some early problems with night driving. It was difficult to sight the line on newly emerged crops—usually on hard surfaces and in short stubble.

The night driving problem was overcome by switching off all lights except the front ones. The lines left by the disc were now more pronounced. Lowering the light levels reduced the amount of reflection, within the cab and also lowered the level of eyestrain—often associated with long tractor hours. Less lights is obviously only appropriate in paddocks with no obstacles.

Paddocks shrink!

Previously calculated paddock sizes have reduced, one paddock being 10 ha less. Over the whole program, I saved 65 ha by not overlapping, resulting in a considerable amount of fertiliser and seed being left over. I believe we will recoup the expense of the package within two years—at 5% cost savings per year.

Installation and changes

The unit performed reliably, except in very stony ground where any excessive chatter on the depth control slide changed to the next cycle. Locating the micro switch closer to the hydraulic ram will solve this problem.

Fitting the sidearm markers took two days. This was because I wasn't aware that if you have 650 lb trip housings, the arm wouldn't clear the trip if located in the manufacturer's position. We overcame this by mounting the arm on the edge of the wing and joining the stand-offs with equal sized RHS. There are low profile trip housings available.

Pick the gap between seeder runs—in the centre.

Solenoids turn the seed off in these two rows.

Future modifications will include hydraulic rams that will lift the two openers clear of the soil to leave it untilled when on the tramline cycle, reducing any unnecessary weeds. The tramline unit was imported and kindly lent by Neil Harris of Agrivise. ■

The three important components.

Magnetic trip which toggles the solenoids for seeds in the wheel tracks.

Peter's marker controls are conveniently located near tractor controllers.

DBS furrows help in the dry

Tim Braslin, WANTFA Committee (08) 9822 1518 p/f

I manage the cropping business for NC Flugge and Co. at Badgebup, East of Katanning. We farm 6,100 ha over 4 locations. We crop 4,300 ha and have a self-replacing merino flock on the remainder.

Tim Braslin

We have numerous soil types, including tight grey clays, red self-mulching soils, gravels and some parts of the farm that are almost beach sand. The average rainfall is supposed to be 375 mm but we do wonder about this.

DBS has been reliable

We establish our crops with a 13 m John Ryan DBS on 25 cm spacings. The DBS is actually the 8th one built by John and providing that we have a reasonable harvest it will have the new model parallelogram fitted for seeding 2002.

We find that the DBS's ability to sow the seed accurately to the depth you require then press the seed into a moist seedbed, regardless of the operator's competence, make it a vital part of our cropping operation. No matter how tight the soil is, if there is reasonable moisture, the DBS will sow into that moisture and the press wheel will ensure the quickest possible germination.

Since seeding, the ability of the DBS furrows to harvest water into the slot has been quite remarkable. Even the smallest rainfall event of 2 mm seems to concentrate water into the slot giving maximum moisture to the plant—enabling it to survive through to the next shower of rain. The system goes close to drought- or dry year- proofing our seeding program. The deep, under seed cultivation, is important for root development and seems to help our crops hang on longer than full-cut systems.

Canola grows well in the furrows which catch the water after a long dry spell.

Wheat and fertiliser are located in the wet furrow.

While we are positive towards the DBS seeder, we do not believe that it is the full answer. The ability to seed into 3 t/ha plus wheat stubble is questionable and we will investigate the options of adding coulters or residue managers. Perhaps the ideal machine would be the DBS with the stubble handling ability of disc seeders. Perhaps a fourth row for the DBS tines would even help.

Paired row experiment

This seeding, we wanted to take the pressure off the DBS, so we looked for another cost-effective knife-point seeder that used press wheels and was independent of the operator's ability. We converted a scarifier to Doug Harrington's paired row system. A few problems occurred that were easily rectified and, in general, it has the potential to be a good system. Hopefully Doug will be able to improve the design more, enabling better stubble handling. We will wait until harvest before we make too many comments. However, so far we are quite impressed with the results.

Wheat grows well in the paired rows.

Farming challenges

With our farming operation, a few challenges that we are facing are:

- integrating a sheep and cropping enterprise successfully
- ensuring the longevity of the chemicals that we currently use
- creating a profitable/sustainable rotation
- using all of the available rainfall
- using both soil and applied nutrients.

The challenge of mixing sheep and crops

Sheep and Cropping are hard to manage side by side. To use less chemicals requires us to be more aggressive in the pasture phase—which effects carrying capacity, especially early in the season. Sheep are good at overgrazing lighter patches in paddocks—causing wind erosion and resulting in poor crop performance in these areas.

To make the two enterprises complement each other we will need to look at better pasture species, feedlots, strategic grazing and develop more of a trading policy than a breeding and sentimental approach. In the last two years, we have found that crops sown into pasture paddocks will wilt before crops sown into stubbles. This observation is more noticeable in continuously cropped paddocks that have not been grazed.

Rotating chemicals and crops

Without the chemicals that we currently use we would not be able to farm using such different rotations and it would make continuously cropping very challenging. Well-planned chemical use will be crucial to reducing the spread of resistance and allowing us to keep using these chemicals in future years. We keep our water rates above 60 L/ha, which is a struggle for the boomspray.

In the past, rotations have relied on pasture or lupins to provide the break crop in the rotation. Weeds can be quite expensive to control in lupins and the nutrient removal is higher than with other crops. Canola is playing an important role in weed control and the gross margin seems better than lupins. Canola seems to grow better in our cold climate than lupins. The area of peas that we sow is also increasing and, if they keep performing, they could prove very important. With no-till we are also testing how far we can take a rotation of canola/wheat/barley/wheat on our heavier soils.

Maximising water use

Growing a clean healthy winter crop will help maximise water use efficiency, although we may have to look at other options. Warm season crops are interesting and, if effective rainfall use requires warm season crops, then they might be an option. These crops have the potential to provide summer feed or extra grain income. At the same time, they use otherwise mostly wasted water from historically wet areas and possibly reduce some recharge of the watertable.

Burning and waves

In 1998—99, we burned concentrated header rows of canola and lupins to kill weed seeds. Heavier stubbles were raked and burned, or raked and baled, in an attempt to make seeding easier. However, all we accomplished was waves and ill thrift in most of the crop. This is helping us to appreciate the importance of stubbles and the nutrients they hold.

Wheat on wheat is no longer an option for us. The hot burn required for disease management creates a soil erosion risk, and there is a question mark on which nutrients are lost—both in the burn and from subsequent winds. We are also finding improved responses from applying trace elements and are looking at ways to maximise P uptake with the aid of liquid P (foliar at present) and trace element sprays. Phosphorus is one of the most important tools for establishing a healthy crop.

Flexibility and reality

The future requires us to be able to have the flexibility to sow on small rainfall events and provide a crop, and a rotation, which has high yield potential with a low cost structure (lower risk).

Do sheep have a place? We must answer this question in the next few years. All the fancy no-till cropping feel good jargon is great but we must, and I believe we do, have profitable enterprises. Farming is expensive—particularly cropping. We feel that no-till is an important part of reaching a sustainable and profitable cropping system.

There is still some resistance to no-till—particularly by some professionals. These people seem to be negative towards no-till and are happy to say, "I told you so" when people half-heartedly try to adopt no-till and it fails. Should we go back to farming in the way of the 1970's?

Any farmer that I know, who has gone into no-till with an open mind and given it plenty of thought, seems to do well.

A good no-till strategy is to combine sound soil conservation techniques, buying or modifying machinery and sound agronomy to obtain profitability. The best way of describing this is under the banner of no-till. I don't think that no-till is the answer to everyone's problems but I do believe that people should be able to give it a go with an open mind without detractors pressuring them to get it wrong.

A late no-till adopter!

Richard Humphry, Moora-Milling
(08) 96 549031 fax 02

Richard (right) is thankful for the help neighbouring farmers gave when he was planning the switch to no-till. With Richard is friend Tony White. All the best with the English wedding Tony (to Julie)!

Thanks for the help!

Three people have lent me a great deal of help and encouragement in switching over to no-till. These are firstly Mike and John McLean (my neighbours) who allowed me to copy their no-till setup and ideas. Secondly, Tony White of Miling (WANTFA committee member), who put up with me badgering him over a 5-year period about no-till!

Eventually Tony decided that the only way to shut me up was to help me escort my newly purchased chisel plough home from Koorda! Thanks, Tony!

Why the switch to no-till

The 2000 growing season had a very dry May. I watched "no-tillers" in my district successfully keep seeding and get a germination—which was far superior to what I achieved with my direct drill combine. The difference at harvest was clear with no-tillers, like Tony, getting 2.5 t/ha of barley, while mine yielded only 1.5 t/ha— both sown at the same time.

"The writing was on the wall"—if I was going to prosper, then I needed to be in no-till. All of the top producers in my area had switched to no-till in the last 5 years and I was getting left behind.

A second reason for making the change was that I have been very keen on growing forage sorghum since my first try in 1999. I could see that a no-till setup was needed to establish this, and, handle the sorghum trash in establishing the following wheat crop.

Machinery set-up

For about $20,000 (plus employed labour), I have set up Frigstaad chisel plough with a 3 ton Shearer air seeder box. The bar is 6 m wide and the openers are on 25 cm spacing. Using an old chisel plough is a cheap way of getting into a high breakout tine. This is not news to many no-tillers because second hand chisel ploughs are now quite scarce!

Obviously Horsepower is a major ingredient, and the old rule of 8–10 hp per tine is well worth sticking to in heavy clay soils. Fortunately, I already had a JD 8440 4WD tractor (200 hp).

Main benefits of no-till

1. Better establishment.
The increase in plants per square metre (from better seed depth control), plus water harvesting, have been crucial in giving me the best chance of a profitable crop in 2001.

2. Wider and safer use of chemical groups.
Safer use of Treflan and particularly Diuron have greatly improved my early weed control.

3. Trafficability.
Although this is not an issue in 2001, the improved access after seeding will be of enormous benefit in an area that, for about 75% of years, has a period of winter waterlogging (you know, slush and mud!).

4. Efficiency.
There are the normal benefits of a wider machine and a bigger box. In fact, on a per-hectare basis, the 25% fuel saving I achieved using an air seeder (6 m air seeder versus the 4.8 m combine) is enough money to service the debt on the $20,000 I borrowed to set the machine up!

Another major efficiency gain is not changing combine points, which saves us about 1.5 hours a day in hard conditions.

5. Stubble handling.
In the past there has very little flexibility for stubble retention with a combine, but where we have retained stubble this year it has greatly assisted in crop and new pasture survival.

Richard made a seeder for no-till at a minimum cost. Note the black polypipes from seed bin to distributors.

Below: Richard assembled a parallelogram opener with spring release. Although light-weight, the openers did a great job.

Another benefit of no-till is urea topdressed after seeding falls neatly, perhaps 80%, into the furrows—where it is needed and where more moisture is.

Conclusion

As a small producer, I have always invested cautiously in cropping plant. However, there are many short-term profitable gains from switching to no-till, apart from benefits that might come 3–5 years down the track. My only regret is that I didn't do it sooner.

My advice for others who have not yet taken the plunge is to seek sound advice. I spoke to several no-tillers in my area who had made a success of it. Also, I have gone to the expense of employing an agronomist to help me with the knockdown system and nutrition issues. This extra advice from an unbiased source has been a good investment.

For me, the biggest immediate challenge with no-till is crop nutrition. Weed control appears to be well understood, and there are plenty of options. There seems to be a lot less understood about the interaction between reduced tillage and nutrition, particularly, trace elements.

One fear I had of no-till was that I would rip up huge rocks everywhere. I have been pleasantly surprised that the rocks have not been an unmanageable problem with 500–600 lb breakout. Perhaps 1000 lb breakout tines would be more of a problem.

Nice looking furrows catch the water.

Our experience with Beeline in 2001

Kellie Shields, Wongan Hills 0427 550 549

In March 2001, a FarmMate Steering Assist Beeline was installed in our Caterpillar 95E. Installation was fast and simple, it took four hours and required no modifications.

We found the Beeline unit extremely user friendly, requiring only a five minute beginner's lesson. It is easily switched on and off to avoid obstacles or turn at the end of a run and has an easy-to-view screen in all light conditions. It even allows you the odd coffee break, standing on the step of the tractor, enjoying a warm winter's day—as the Beeline does the work for you!

The Beeline System was used for pre-seeding spreading, and we were impressed at the straight lines and even spacing it left in the paddocks. The guesswork was removed and it was no longer necessary to use a blob dobber—which can sometimes be troublesome. We were also able to spread into the evenings enabling us to complete our program faster.

During seeding the Beeline unit was used to work the paddocks up and back. The seeding benefits included:

- greatly reduced overlap (especially with inexperienced employees)
- decrease in driver fatigue
- greater capacity for operator to notice problems
- the ability to undertake other activities when required, like making notes about the paddock or exploring the monitor
- less wear and tear on machinery—due to less turning while in the ground
- no headlands to complete the paddock, instead two laps were done last and the paddocks were left extremely tidy
- no guesswork of where previous workings were, especially during dusty or foggy periods.

The benefits gained in our spraying program include:

- less wear and tear on machinery
- much quicker spraying time to complete the paddock
- less overlap
- reduced spray misses—especially on the corners
- much easier to follow straight workings as you are driving, particularly at night, enabling optimisation of night spraying.

Kellie (left) and Mike Shields have found steering assist to be a great experience.

Above: The controller sits clearly visible up front.

Left: Seeding with the Beeline (sub metre) unit is quite neat.

We believe that we will also receive similar benefits at harvest.

Occasional Loss of GPS

The occasional loss of GPS coverage was the biggest problem we had with the FarmMate. It was necessary during these times to steer manually. Readjustment with the satellites also occurred periodically and, at times, caused the Beeline to jump across a certain amount causing a strip with extra overlap or a miss. Despite this adjustment the Beeline maintained incredibly straight lines—they were just slightly off the ideal track. We found this problem was minimised with an overlap setting of 20 cm for our 16 m seeding bar.

The opportunity to upgrade to a more accurate system in the future is available and we look forward to doing so at some point in time. This would require basestations to be installed and the sub-metre accuracy would be reduced to 2 cm. The $35,000 purchase price of the sub-metre accuracy Beeline is an excellent way to enter into a precision guidance system.

Overall, we were very happy with our Beeline system and look forward to it playing a big part in the future of precision farming in WA. The system invites innovative positioning of crops, fertilisers and herbicides—which opens many agronomic possibilities.

Seeding, without the assist with satellite connections which were down for a while, is not quite as straight as with the Beeline.