CONTROLLED TRAFFIC DRAINAGE PROJECT

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BACKGROUND

Poor soil structure combined with high winter rainfall throughout much of south western Victoria produces conditions almost every year which results in waterlogged crops.

Farmers cropping well drained soils are obtaining cereal yields over 5t/ha and canola yields over 3t/ha. For example, the introduction of the premium malting barley Franklin has given many farmers a new target in expected yield - some farmers are consistently producing yields over 7t/ha.

The new canola varieties including Dunkeld and the Triazine resistant types have taken the risk out of growing this excellent break crop.

The release of the red wheat varieties with their early sowing capability has given farmers the means to take advantage of an early break and fully utilise the long growing seasons.

Crop nutrition has also gone ahead in leaps and bounds in recent years. Soil testing, tissue testing, sap testing and nitrogen test strips have all led to a much improved management of crop nutrition.

Although these breeding and agronomic advantages have produced wonderful benefits, they have predominantly been on well drained soils. ***Waterlogging remains the biggest constraint to crop expansion and improved yields over a large part of the south west.***

There is a limited number of well drained paddocks in south west Victoria. With the average cost of producing a cereal crop over $185/ha and canola at over $250/ha, farmers have naturally been reluctant to expand their cropping programs - except on good country programs or expanding their current program.

The ***key*** to further crop expansion and improved yields with ***reduced risk*** is the development of cheap and effective drainage techniques suitable for south west Victoria.

In 1996 our drainage project consisted of four treatments. These included wide (20m) raised beds, an underground system including plastic pipes and moles, a control and narrow (1.5m) raised beds. The results of this project which was sown to canola were as follows:

	20m Beds	***Underground***	***Control***	***1.5m Beds***
Hand Harvest	3.74t/ha	3.71t/ha	not harvested	3.35t/ha
Machine Harvest	3.3t/ha	3.33t/ha	2.20t/ha	3.55t/ha
Average	3.52t/ha	3.52t/ha	(2.20t/ha)	3.45t/ha
Oil Content	42.4%	44.3%	(N/A)	41.7%

The excellent results from this project encouraged us to expand this work further in 1997. The above demonstration was sown to Franklin Barley and six commercial satellite sites concentrating on narrow raised

beds were established (plan 1997 Field Day Notes). The 1997 results from the drainage demonstration are as follows:

1997 Results (Drainage Demonstration Site sown to Franklin Barley)

	20m Beds	*Underground*	*Control*	*1.5m Beds*
Grain Yield (t/ha)	6.55	6.90	5.7	6.3
Classification	Feed	Feed	Malt 5	Malt 2

Soil Analysis 1997/98 (State Chemistry Laboratory)

Test	Wide Beds	Underground	Control	Narrow Raised Beds
pH (Water) 5.7	5.7	5.7	5.8	5.4
Aluminium (KCL)	10	11	<10	<10
Electrical Conductivity (Water)	0.18	0.16	0.17	0.34
Total Soluble Salt	0.06	0.05	0.05	0.10
Olsen Phosphorus	10	11	11	12
Potassium 260	290	310	220	
Sulphur 40	29	51	160	
Dry Aggregate Slaking	Partial	Partial	Partial	Water Stable
Dry Aggregate Dispersion (2hrs)	Nil	Nil	Slight	Nil
Dry Aggregate Dispersion (20hrs)	Nil	Nil	Moderate	Nil
Remoulded Aggregate (2hrs)	Strong	Strong	Strong	Nil
Dispersion (20hrs)	Strong	Strong	Complete	Nil
Oxidizable Organic Carbon	1.6	1.9	2.1	1.9
Organic Matter	3.1	3.6	4.0	3.6

DISCUSSION

These results must be interpreted with caution. Our drainage demonstration is not a replicated scientific trial. We do not have initial soil tests from each treatment - we certainly didn't anticipate the success of the project and the public interest.

However the results do help confirm some of the dramatic effects we have seen in the paddock.

We cultivated extensively in the narrow raised beds and placed the top soil (plus a small amount of clay subsoil) in aerated piles in rows. This created excellent drainage where any excess water only had to find its way a maximum of 0.5m to the furrow. We applied a high rate of gypsum, which as discussed before, ends up a higher rate on the beds because we didn't apply it to the furrows. The canola crop grown in 1996 averaged about 3.5t/ha over the whole drainage site. If it is calculated on a per-square-metre basis, **the raised beds themselves** yielded around 5t/ha. The Franklin Barley crop yielded between 6-7t/ha over the whole site but once again if it is calculated over a per-square-metre basis, the **raised beds themselves** yielded close to 9.5t/ha.

The only vehicles travelling on the beds have been a windrower (once) and a harvesting machine (twice). These machines were operating when the beds were dry and although some compaction occurred, it is not serious but certainly significant. Therefore controlled traffic has been maintained in the narrow beds whenever possible and the sooner it is full controlled traffic, the better.

No animals have grazed the site and no other vehicle traffic has driven on the beds, but vehicles have travelled over the other treatments (sprayer, tractors, combines, windrowers, harvesters).

Soil pH. The narrow beds have a lower pH than the other treatments. This is probably a reflection of the gypsum application and the urea applied to the bed tops.

Electrical Conductivity and Total Soluble Salts. The soil chemists tell me the higher level on the narrow beds is almost certainly a reflection of the higher rate of gypsum and urea applied on a per-square-metre basis. These are not sodium salts so not of concern.

Sulphur. Probably a reflection on the higher initial dose via the gypsum to the top of the beds.

Dispersion / Slaking. This is the area of most excitement. The narrow raised beds have been given a perfectly clean bill of health for these physical tests. The soil is in excellent physical condition, where the other treatments show slaking and varying degrees of dispersion.

Organic Matter. Our chemists tell me it takes tonnes and tonnes of organic matter to measure a difference. With a soil weight of around 1400t/ha in the top 10cm it is easy to understand it will take a huge amount of organic matter to measure a percentage difference. The chemists tell me you need over 250t/ha of organic matter to measure an appreciable difference. I think we'll forget measuring this so-called variable.

Ballarat University were also employed to carry out soil physical tests. They selected three sites at random in the control area and in three of the beds. At each site three areas 75mm high and 75mm diameter were taken.

Results Summary

- Bulk density significantly lower and total porosity significantly higher in narrow raised beds compared to control.
- Total porosity in raised beds is approximately 10% greater than in control.
- Air filled porosity in the raised beds is approximately 15% greater than in the control.
- Gravimetric moisture content higher in raised beds than in control.
- Volumetric moisture content is equivalent in raised beds and control.

DISCUSSION

The higher porosity of the bed soil is due to the increased depth of aggregates generated by self-mulching of the surface soil and to absence of traffic: it will result in a higher infiltration capacity than in the control. More frequent wetting-drying cycles are expected in the beds than in the control and this in itself will generate a deeper surface mulch of aggregates. Penetrometer resistance in the beds was low from the surface to a depth of 450mm, whilst in the control, although there were moist conditions below 60mm, the surface was extremely hard and resisted penetration. The overall higher gravimetric moisture content of the soil in the beds confers softer soil conditions than in the control and offers better opportunities for tillage and sowing. The higher moisture content of the beds can also be taken as an indication that more of the summer rainfall has been retained on the beds than on the control. On the control, summer rainfall will not have penetrated the topsoil so readily and may have been lost as evaporation, flow into subsoil cracks, or as surface run-off.

Raised Bed Satellite Sites 1997

Approximately 300 hectares on eight commercial farmers' properties were installed in 1997. Only two sites were marginally waterlogged and estimated yield increases of 55% - 100% were achieved on these sites - when compared to adjacent paddocks with similar inputs. The other sites were not wet and yields on beds were equal or slightly superior to the flat comparison.

1998 Crop:	Declic Winter Wheat
Sowing Rate:	100kg/ha
Fertiliser:	266kg/ha 5:20:0:10
Sowing Date:	23rd April
Slug Baited:	Mesurol, 24th April
Urea Sprea:	100kg/ha early June
Post Emergent Weed Control:	TOPIK (Canary Grass and Ryegrass)