Developing Raised Beds in SW Victoria

Colin Hacking

THE POTENTIAL

The "cool climate high rainfall" zone of Southern Victoria has an extremely large potential for sustainable and profitable crop production. In most areas this potential is far from being realised. It is estimated there is conservatively 500,000 hectares of traditional grazing land that could convert to cropping or a mixed farming operation in southern Victoria alone.

BACKGROUND

Historically, the area has relied heavily upon wool production as its major source of primary production income. It can also be argued that wool production has served the area well with very good returns being possible prior to the dramatic downturn in prices in the mid 90's. Despite the downturn in the price for wool, many farmers still have wool production as their major enterprise, although this has changed for some producers over the last few years with cropping becoming a more significant part of their operations.

Why is crop production a very low priority for some farmers? The reasons are many, however factors including waterlogged soils, poor soil structure, too many weeds, inadequate nutrition and poor management are the main ones. In many cases, crops have been grown to supplement the livestock enterprises and have been used as a means to "clean up a paddock" to prepare for the sowing of a new pasture. Crops have often been viewed as an opportunity enterprise when conditions were seemingly right. When crops failed because of climatic conditions beyond the control of the grower, such as too much winter rainfall, then this has generally been accepted as something that could not be avoided.

THE CHALLENGE

Southern Farming Systems began in 1995 to objectively look at the cropping and livestock enterprises in the high rainfall zone and realised that there needed to be a change made to the traditional farming system, to enable farmers to capture the opportunities that the area presented. One of the major driving forces was that of profitability, as it was identified that unless something was done to dramatically change the economic situation of farmers in the region, that many of them could not survive the projected long term wool downturn. The farming community was also very aware that any new system needed to be sustainable in terms of responsible land use.

A detailed analysis and consultation process was undertaken to identify the strengths, weaknesses, opportunities and threats for the region. It was identified quite early in the investigation, that one of the region's strengths was the excellent rainfall, which in most years was well distributed and was quite reliable for winter cropping. In fact, the growing conditions for crops were recognised as being far superior to those experienced in the Mallee and in many areas of the Wimmera. It was also recognised that whilst the rainfall was a significant strength to the region, it also presented significant weaknesses with regard to winter waterlogging of the region's predominantly heavy basalt soils. This was mainly a result of the significant water-holding capacity of the soils and the low ambient temperatures resulting in low crop evapotranspiration.

Strengths and Opportunities

One of the real strengths of the "high rainfall cool climate" zone of Southern Victoria is its potential for crop production, particularly that of oilseeds. The long and cool growing season means that canola is particularly well suited, with oil quantity and quality generally being very high because of the extended cool finish to the season. Other oilseeds such as linseed are also well adapted to the region and offer a greater rotation flexibility. The opportunity exists to establish South West Victoria as the premier oilseed producing region of the State.

The area is also very well suited to the production of high quality malting barley. The cool finish and extended growing season is conducive to large grain size and good malting characteristics. A large plant situated in Geelong has the capacity to service significant tonnages out of the region.

Another clearly identified strength is the ability to grow the winter feed wheat varieties becoming available. The long growing season suits the genotypes well and perhaps gives the opportunity to undertake a grazing if sown early enough. The vernalisation requirement of these cultivars would also mean that the risk of frost damage at flowering, is significantly reduced. The opportunity is there to significantly increase the feed grain production out of South West Victoria to service the needs of the expanding feed grain dependent intensive livestock market. This potential is being recognized by many private seed companies, with investment in breeding of better adapted feed wheat varieties for this region being undertaken.

With improved agronomy techniques, many producers are looking to grow high quality wheat crops. There has been considerable investment by CSIRO and others to produce better adapted milling wheat lines for the high rainfall zone.

Another major strength for the area is the ability to grow a range of plant species and the opportunities to establish flexible rotation systems. There is the ability to grow crops and pastures for nearly 12 months of the year in many areas. This significantly reduces the likely threats associated with market collapse of individual enterprises.

Threats and Weaknesses

The major weakness or limiting factor identified is winter waterlogging of the region's soils, although in the last 10 years there has been a period of significantly lower winter rainfall. The ability of plants to extract nutrients is reduced in a waterlogged soil due to the anaerobic soil conditions. Weed problems such as toad rush can also be attributed largely to the wet soil problem over winter, along with associated soil structural problems

Another significant problem identified is the declining soil structure in cropped soils and the ability to only grow profitable crops after a prolonged pasture phase in the dispersive heavier soil types. This declining soil structure is amplifying the negative affects of winter waterlogging and makes cropping extremely difficult. It is also significantly restricting the paddock options available to growers.

Another threat is that as cropping intensifies the risk of developing herbicide resistant weeds and other long term cropping issues also becomes greater.

As a result of the analysis the major opportunity to come to light was to change the way that we managed our soils so that we could capitalize on the climatic strengths that the region possessed. If we could reduce our winter waterlogging problem, then significant gains could be made in plant yields. Given the opportunities emerging in the oilseed and feed grain areas, attention was turned to trying to significantly increase crop yields.

THE VISION

Southern Farming Systems back in 1995 set the target for wheat yields to increase from 2.1 Tonnes per hectare to 5.5 Tonnes per hectare as a regional average by the year 2005. It was also envisaged that 7.5 Tonnes per hectare for wheat should be a reasonable target yield for the top 10% of growers. These targets have largely been achieved by growers implementing the raised bed system.

THE SYSTEM

Southern Farming Systems is embarking on a new system of growing crops, on raised beds using controlled traffic technology. Actually the system has been around for years, particularly in the irrigation areas in NSW and QLD and also in the vegetable growing industry. What we are really doing is applying irrigation technology in reverse. Instead of using raised beds to apply water down the furrows, we are using them to get rid of the excess water during the winter. The adoption of controlled traffic technology, a major feature of raised bed farming, is an integral system component in order to improve soil structure in the long term.

Why has it taken so long to wake up to trying this new approach? Well once again we have been blinded to this opportunity for many years, because we have grown to accept that our crops get water-logged over winter and that there is nothing we can do about it. We have had to unlock our minds to the new opportunity. We have in fact, had to look at converting a weakness into a real opportunity.

The system of raised bed farming simply means that furrows are formed approximately 2 metres apart and crops are grown between the furrows or on the “beds”. The beds are raised approximately 20 centimetres to get the crop out of the waterlogged soil. All traffic such as planting and spraying is confined to the furrows to avoid compaction. Harvesting is the only operation to take place on the beds, although over time this too will change.

Excess water is drained off the paddock over the winter and spring months and in many cases is collected to be re-used on high return crops over the summer.

THE RESULTS

The results so far have been very encouraging with significant increases in crop yield, across a range of soil types and crop types. These results have been achieved largely in broadacre farmer demonstrations and not in replicated trials.

In a series of farmer case studies, despite relatively dry conditions over the last 10 years, the average net financial benefit to farmers using the raised bed system compared to flat land cropping was approximately $78,000 per annum. This takes account of the extra yield and costs of the raised bed system (including machinery) compared to a flat paddock situation (Blackburn & Assoc 2005).

Farmers are also reporting that there also appears to be a significant improvement in soil structure in a very short period of time. Studies conducted by Southern Farming Systems in 1997 also indicated that in just two years, soil structure in the raised bed treatment compared to the control at its Gnarwarre (Geelong) site improved dramatically. Table 1 clearly shows this. Further investigation by Dr Renick Peries (Soil Scientist DPI Geelong) substantiates this finding.

Table 1

Test	**20 metre wide raised beds**	**Underground drainage**	**Control – spoon drained**	**1.5 metre narrow raised beds**
PH (Water)	5.7	5.7	5.8	5.4
Aluminium	10	11	<10	<10
Electrical Conductivity (Water)	0.18	0.16	0.17	0.34
Total Soluble Salts	.06	.05	.05	.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 (2 hrs)	Nil	Nil	Slight	Nil
Dry aggregate dispersion (20 hrs)	Nil	Nil	Moderate	Nil
Remoulded aggregate (2 hrs)	Strong	Strong	Strong	Nil
Remoulded aggregate (20 hrs)	Strong	Strong	Complete	Nil
Oxidisable Organic Carbon	1.6	1.9	2.1	1.9
Organic matter	3.1	3.6	4.0	3.6

DISCUSSION

In terms of dispersion and slaking, the narrow raised beds were given a completely clear bill of health. The soil was in excellent physical condition, whereas the other treatments show some signs of slaking and dispersion. This corresponds very well with the "eyeball analysis and feel tests" conducted. Right throughout the summer period, the narrow raised beds maintained excellent structure whereas the other treatments set quite hard.

It appears from the results in Table 1, that waterlogging may have a greater damaging effect on soil structure than cultivation. The controlled traffic is also contributing to this improvement in soil structure. These results are extremely encouraging and back up what we are seeing in many farmer paddocks across SW Victoria.

If we can improve the soil "health", then we are well underway to developing a much more sustainable farming system.

ADOPTION OF THE NEW SYSTEM

There are many factors to consider before setting up a raised bed cropping systems, including :

1. Movement of water off the paddock. Care must be taken that water coming off the paddock does not contain pesticides or nutrients. It is envisaged that given soil structure is improving along with significantly greater plant growth, "drainage water" may in fact decrease over time compared to a traditional flat land system.

2. The timing and rates of nutrient application need to be re-assessed, given that we are looking at a totally new system. Since we should be able to traffic the country at most times over winter, then we can be far more strategic in our timing of nutrient application.

3. The water that is coming off the raised bed country should be contained on the farm to be re-used on possibly high return summer crops. Downstream effects of water flow needs to be reduced to a minimum.

4. Drainage needs to be thought about carefully. There were instances in 2001 where trafficability in bedded country was restricted due to the inability to effectively drain the paddocks.

5. Erosion problems and washouts in 2001 were evident in some situations at the tail drain area. More consideration needs to be given to the design of the collector drains relative to the slope and length of run. The beds and furrows have proven to be very robust with insignificant erosion occurring in the wet year of 2001.

FURTHER POTENTIAL

The system certainly does uncover the possibility of more crops and pasture species being adapted to the high rainfall cool climate zone. Where we can overcome waterlogging, crops along with Lucerne can be grown on our heavier basalt soils. The gross margins from prime lambs grazing Lucerne on raised beds have been shown to be comparable to the best cropping gross margins in 2003 and 2004 (Grain & Graze Project South West Victoria).

The use of raised beds has meant that producers are far more willing to apply the inputs such as fertilizers to their crops, than in a situation where crops can fail due to waterlogging in a flat paddock situation. This “risk management” tool has been recognized as one of the major benefits to the use of raised beds.

There is the possibility that the system may have some application in saline country. Given that we can keep the plants out of the salty water in the beds, then we should be able to establish the seedlings in a relatively salt free environment. By the time the plant roots reach the soil containing higher salt loads, plant tolerance will have increased.

The investigation so far certainly indicates that increasing the cropped area of a farming system with the use of raised bed technology is a viable option for farmers in the high rainfall, cool climate zone of South West Victoria. It certainly is not suggesting that cropping should replace the grazing enterprises, however if carried out in such a way as to reduce the possible risks, then it offers greater flexibility for the producer in the region.

9. Relevance to Controlled Traffic

Raised bed cropping involves controlled traffic. Confining the wheels of tractors and implements to the furrows means that there is no compaction of the area where the crop is grown. Hence many of the benefits associated with raised beds are the result of the controlled traffic aspect.

There are many paddocks that are unsuited to raised beds because of rocks, gradient and other factors. In this situation controlled traffic alone without raised beds is a real option.

Many producers find it difficult to take the step into the raised bed system. They simply don’t like furrows in their paddocks. For these producers the controlled traffic system being implemented on flat ground offers a real opportunity.

ACKNOWLEDGEMENTS

I would like to pay special tribute to the efforts of Bruce Wightman (agronomist DPI Geelong) who was largely responsible for the drive behind the raised bed system. Bruce was also supported by Chris Bluett (DPI Ballarat). The co-operation of the farming community was also extremely important in the

early days of developing the system and there were several producers such as Bruce Wilson, David Langley, Rowan Peel, Andrew Morrison and others who made a considerable contribution of time.

I would also like to thank the many Agribusiness Companies who supported the raised bed project. This included National Australia Bank, J.B. Scott Pty Ltd (Andrew Cleary), Watson Machinery (Rex Watson) and many others.

The linkage of raised beds with the controlled traffic system is obvious. The work being undertaken by Andrew Whitlock (DPI Ballarat) and Dave Stephens in association with Southern Farming Systems in developing a Controlled Traffic Precision Farming Systems Site, will further develop the controlled traffic programme in SW Victoria.