CT for the Vegetable Industry – What will it take?

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INTRODUCTION

The Australian vegetable industry is a $1.66 billion business (farm gate, 2003/04), with value adding bringing the total to $2.36 billion. The industry is very diverse, with enterprises of every conceivable scale in every state growing a wide range of products. Although accurate statistics are difficult to obtain, it seems that the fresh market sector accounts for about 75% of the industry value. The Tasmanian situation is the reverse the national picture, being 75% processing based. The Tasmanian vegetable industry is worth $160 million (farm gate) and $360 m packed and processed. Potatoes represent just over 50% of the industry value and are the dominant crop (75%) of the processing sector. Potatoes, onions, carrots, peas, beans and broccoli represent 90% of the value of the industry. The Tasmanian industry is contract based in both the processing and fresh sectors.

A wide range of temperate vegetables are grown including potatoes, onions, carrots, brassicas, peas, beans, pumpkins and leafy vegetables. To add to the enterprise mix, many farms also grow pyrethrum, opium poppies, cereals, pastures for hay and silage and run livestock. The main vegetable growing areas have traditionally been in the north-west and north-east hinterland, but over the last decade, production has expanded in the midlands and north-east coastal belt. There are distinct differences in soil type, topography and farm size between the older and newer production areas (Table 1).

Table 1. Comparison of the main vegetable cropping regions in Tasmania

North-west/north-east	Midlands and north-east coast
Ferrosols (red clay loam on basalt)	Clay loams, sandy and duplex soils
Well drained soils	Well to poorly drained soils
Undulating to steep (10 – 20% common)	Flat to gently undulating
Water run erosion issues	Wind erosion issues
Small holdings (typically 100 – 150 ha)	Larger enterprises (typically about 200 ha)
Expensive land	Cheaper land
Big gun irrigation, pivots and linear increasing	Predominantly pivot irrigation, some big gun
About 75% of vegetable production	About 25% of vegetable production
Greater diversity of crops with some livestock	Smaller range of crops, livestock more likely

About 30% of potato production is on leased ground, a figure that is likely to increase. Contractors are used heavily in some farming operations, particularly harvest. Peas, beans, poppies, pyrethrum, cereals, carrots and onions are almost exclusively contract harvested. About 80% of potatoes are contract harvested. Although crops are planted, grown and harvested year round, vegetable production is predominantly a summer irrigation based enterprise. Planting intensifies in the Sep – Feb period, with harvest concentrated in the Jan – Jul period.

BENEFITS OF CT TO THE VEGETABLE INDUSTRY

The broad benefits of controlled traffic are well known through research and experiences in the grain industry. The benefits include improvements in soil structure and biological activity, infiltration, yield and operational efficiencies through lower fuel use, lower power requirements, spatial accuracy and timeliness. Additional advantages that are likely to be important for the vegetable industry include:

- Elimination of heavy tillage operations to improve opportunities for direct drilling and allow retention of crop residue and use of cover crops for controlling erosion and weeds
- Isolation of compaction to reduce clod load in the soil and make harvest of root, bulb and tuber crops easier and cheaper
- Direct drilling and guidance to improve opportunities for permanent or semi-permanent drip irrigation systems, with consequent benefits for water use efficiency and foliar disease management
- Potential to achieve more uniform maturity in many vegetable crops, with consequent improvements in product quality and harvest and processing efficiency
- Improved opportunities for mechanical weed control through better guidance, which may become important with the development of herbicide tolerance in weeds

Clods can be a major issue in the harvest of potatoes, carrots and onions. Clod load at harvest is influenced by soil type, soil moisture, tillage practices before and during planting, and inter-row traffic during the growing season. Clods are removed by mechanical and manual grading on the harvester, or post-harvest grading. Use of clod windrowing prior to planting of potatoes is increasing. The benefits of clod windrowing give an insight into what might occur in a controlled traffic situation. Observations some years ago indicated that clod windrowing could reduce clod load at harvest by 65%, which would equate to about a 30% reduction in harvest labour requirements. Misener and McLeod (1986) observed increases in harvest rate of 50% with the use of clod windrowing. Dickson et. al. (1992) recorded 30% more clods when harvesting conventionally grown potatoes compared to those in a 2.8 m track width controlled traffic experiment. The same research also gave an average 18% increase in marketable yield over 3 seasons, and a 40% reduction in draught requirements for post-harvest tillage.

SOME OF THE CHALLENGES IN THE VEGETABLE INDUSTRY

Machinery Configurations

Achieving commonality of wheel tracks will be a major challenge in the vegetable industry. The most common tractor track widths used in Tasmania for in-crop work are 1625 mm and 1730 mm (dictated by potato row spaces of 32″ and 34″). Other potato growing areas in Australia are based on 1730 mm. Most vegetable crops are grown in rows or beds based on one of those track widths. Some growers are moving to 1830 mm centres for primary tillage and harvest operations. Tractors of the power ranges used in the vegetable industry (80 – 140 kW) are usually able to attain track centres of 1500 – 2200 mm without exceeding manufacturers’ standard configurations. For in-crop work, tyre tread widths are 330 – 360 mm, whereas for primary tillage and harvest work the range is 460 – 600 mm. Some vegetable crops, and other non-vegetable crops in the rotation, use equipment with a range of alternative track centre widths and tyre tread widths. Crops grown on a typical Tasmanian vegetable farm, and relevant equipment track and tread width characteristics, are shown in Table 2.

Table 2. Crops and harvest equipment characteristics typical of the Tasmanian vegetable industry

Dimensions (mm)	Potatoes, carrots, onions, brassicas	Peas, beans	Cereals, pyrethrum, poppies
Tractor track width for in-crop work	1625 or 1730	Not critical, generally 1625, 1730 or 1830	Not critical, generally 1625, 1730 or 1830
Row crop tractor tyre tread width	330 – 360	na	na
Tractor track width for out of crop work	Not critical, generally 1625, 1730 or 1830	Not critical, generally 1625, 1730 or 1830	Not critical, generally 1625, 1730 or 1830
Non-row crop tractor tyre tread width	460 – 600 530 common	460 – 600 530 common	460 – 600 530 common
Harvester track width	2200 – 2640	2200 – 2600	3000 – 4000
Harvester tyre tread width	300 – 750	400 – 750	700 – 800

It is clear that changes are needed for controlled traffic to work, but the key decision is what track width to use as the base. A track width of 2.4 – 2.6 m offers some advantages. Most potato, carrot and onion harvesters have track widths of 2.2 – 2.4 m, although there are exceptions. The challenge is that most potato harvesters are single row, and potato harvester track configurations are not symmetrical, with an out-rigger wheel required for stability. While it may be physically possible to side-shift the digging front to the centre row of 3 rows over a 2.4 m span, there are issues of maintaining tracking and stability on sloping land. A change to European style twin row harvesters would be a positive move, but then we are still left with a 2.4 m track width for a 1.6 – 1.7 m harvest width. Changing the digging width to 2.4 m would be a positive move, but that is a major engineering re-design issue. There may be other options that involve pre-digging and windrowing all three rows into one and still using a single row harvester. A UK manufacturer has recently released a 3 row straddle potato harvester with a 2.7 m digging width which may have potential.

Top pull carrot harvesters are another issue. They generally harvest only one or two rows at a time and the row spacings are narrower than potatoes. Increased moves to self-propelled carrot and potato harvesters compound the problem, as a number of these are of tricycle design. One model leaves tyre tracks over 65% of the width of the machine on a single pass. Moving across the paddock two rows at a time, the entire paddock is subject to multiple wheel passes.

There is the option of a completely different track width (e.g. 2 or 2.5 m) which would then require a complete re-think of crop growing systems. There is no commonality between current tractor track widths and the track widths on any harvesters, regardless of the crop.

A consideration in most vegetable growing areas, and particularly in Tasmania, will be the overall width of tractor and machinery combinations for road travel. Many growers transport equipment on public roads. Vehicles exceeding 3.5 m total width on highways, and 3.2 m on minor roads, require at least one escort vehicle. A significant amount of travel occurs on minor roads. The road transport issue lends some support for a 2 – 2.5 m track width standard.

Soil Erosion and Drainage

Almost all vegetable cropping in Tasmania occurs on undulating land, particularly in the north-west and north-east. Slopes of 10 – 20% are common, with isolated parts of paddocks up to 35%. Even though the crop growth zones under controlled traffic would have much better infiltration, soil erosion in the traffic lanes remains a serious risk, particularly at the interface of the compacted traffic lane and the friable crop bed. A technique that is used to control erosion in fine tilth seedbeds is ripper mulching, in which straw is placed in lines ripped along the contour. This technique has been further adapted with the development of a prototype machine to apply straw down the furrow. This may have potential for reducing wheel track erosion under controlled traffic. There is also scope for the construction of up-slope cut-off drains to divert overland flow, although this could be a significant capital investment on many farms.

Many paddocks used for vegetable production in Tasmania have complex slope profiles, resulting in areas within paddocks that accumulate run-off. It may be necessary to install strategic drainage, and maybe grassed waterways, to ensure that traffic lanes remain firm and trafficable in wet conditions.

Farm and Operational Logistics

Vegetable farms in Tasmania tend to grow a more diverse range of crops and operate on smaller contracts compared to other production areas. Paddocks often have irregular shapes, with many being dissected by drainage lines or having boundaries dictated by dams, creeks or other features. Slope may be an issue, not only from an erosion perspective, but also for maintaining accuracy of traffic, particularly in wet conditions. Although GPS will obviously assist directional tracking, it is still important to maintain traction on the wheel track to keep the equipment on track.

Another issue regarding farm logistics will be the use of headlands. Headlands are usually planted across the slope and harvested first to allow room to turn harvesters at the end of the row and for parking trucks. Such an arrangement is inconsistent with the objectives of controlled traffic. It may be possible to sow headlands to grass, but land is valuable and up to 5% of a paddock area could be devoted to permanent headlands under such a strategy. The alternative would be to crop the headlands anyway, and just accept that they will not be managed under a controlled traffic system.

THE DESIRE TO CHANGE

Technical challenges to the introduction of controlled traffic in the vegetable industry are considerable, but all within the bounds of possibility if there is the will to change and the benefits are recognised as worth pursuing. The processing vegetable industry has come under significant economic pressure in recent times due to rising input costs, particularly fuel, and the availability of cheap imports of processed product. If controlled traffic can offer sufficient economic and sustainability advantages to offset some of these pressures, then there will be interest.

WHAT WILL IT TAKE?

Change will require a considerable degree of co-operation. Since most crops are grown under contract, the role of fresh vegetable packers, vegetable processors and extractives companies will be critical. Each company provides a range of services to its growers, and so is in a position of influence in relation to future directions.

The wide spread use of contractors in Tasmania, particularly for harvest operations, suggests that contractors will be central to any change process. An important part of the overall picture will be identifying the advantages for the contractor. Improved soil sustainability, yield and water use efficiency, ease of operations, direct drilling and options for permanent drip irrigation are all advantages that will accrue to the grower. Will the benefits of reduced power requirements for root harvest machinery offset the cost of machinery modifications for the contractor? And where are the benefits for contractors who harvest cereals, pyrethrum and poppies?

REFERENCES

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