Management of Pulse Crops – A Time for Change

Trevor Bray and Wayne Hawthorne, Pulse Australia.

Take Home Messages

- Retaining maximum stored soil water greatly benefited yields in 2008.
- Early sowing of pulses has once again been very successful and is now becoming a sound risk management strategy provided the right variety and management of diseases, weeds and frost issues have been taken into consideration.
- Wide rows (30cm) are becoming more beneficial especially in combination with standing cereal stubbles providing improved crop height, better harvestability and yield.
- Gross margins should also reflect the savings in nitrogen requirements over the following crop as well as across the whole rotation.

After another dry spring in south-eastern Australia, the big challenge for next year is to ensure that growers keep pulses in their rotation. Pulses must be grown for their benefit to the whole rotation but also be able to maximise yields through good management even when there is limited water available.

Utilising soil moisture: Experiences in the recent run of dry years have shown conclusively how retaining maximum stored water in the soil during summer and autumn can greatly add to seasonal water supply and subsequent yield benefit. The amount retained can vary greatly relative to the speed and efficiency of weed control to prevent soil water loss and stubble retention has also played a major role. This was most evident in southern NSW during 2008 as had occurred in the previous year in the Victorian Mallee and Wimmera where significant summer and autumn rainfall events occurred followed by less than average in crop rainfall. Pulses sown into cereal stubble retention systems faired best, particularly if inter-row sown into standing stubble with less surface loss from bare soil, but also better moisture penetration and less surface runoff into low lying areas.

Variety Selection: Varieties such Mandelup and Luxor lupins, SW Celine, Sturt and Bundi field peas and Genesis 509 chickpeas have fared well once again due to quicker maturity, but increasingly it is the way we manage pulses that is important, especially in moisture limiting situations. Growers need to ask themselves if they are growing pulses in moisture efficient ways. No longer does it pay to compromise on summer weed control. No longer can we sow into bare soil with minimal stubble, using 'narrow' rows (eg 15-18cm) and delay sowing to achieve better weed control, minimise disease risk and perhaps avoid frost. When machinery and capital are limited, there are cheap innovative ways being developed to enable adoption of new farming systems often involving minor modifications to existing equipment. GPS and auto-steer technology is now more affordable too.

Sowing time: In recent years with the exception of 2005, early sown pulses have performed better in most situations than when sowing was delayed and field observations have been supported by State Departmental time of sowing trials conducted in southern NSW on faba beans and chickpeas and similar trials on lentils and chickpeas in Victoria. This must be put into context of what "early" really means in relationship with the pulse type, variety, region and conditions. "Early" can have different connotations, and is not necessarily the same calendar date to all. There are recommended sowing windows for the various pulses in the NSW DPI Winter Crop Sowing Guide based on historical long-term trial data in various regions, and early relates to the time within that sowing window. Generally beans and lupins need to be sown first, and for some dry sowing has now become a common practice. Peas and chickpeas tend to be delayed somewhat, but less so in the drier western areas.

Row Spacing: Increased row spacing (to greater than 15-18cm) is becoming a 'hot topic'. Row spacing trials conducted in Departmental sowing time by row spacing trials has shown that 30cm spacings are suitable for most pulse types. However, row spacing must not be considered in isolation of the whole farming system. Increased row spacing must be accompanied by stubble cover to ensure there is minimal moisture loss from bare soil. Weed control must be achieved with correct paddock selection, no disturbance between rows and appropriate herbicide use. Rows wider than conventional (15-18cm) rows lead to delayed canopy closure, and

can assist or delay foliar disease control, giving more confidence in sowing beans, chickpeas and lentils earlier than previously done, and with more disease resistant varieties now available. Harvest efficiency is greater in wide row chickpeas, beans, lupins and lentils (when trellised in standing stubble) where they grow taller and more erect with greater height to the lowest pods.

Diseases: There is no doubt that the impact of disease on pulse production has decreased with the occurrence of dry spring conditions. In recent years we now have newer crop varieties with improved levels of disease resistance, understand canopy management and have a better understanding of foliar fungicides and their effective application should there be a return to a good spring. We cannot ignore diseases, but simply need to manage crops to minimise the disease risks up front. For some specific diseases we do however need to be more cautious. For example, controlling bacterial blight in peas is not possible once detected in crop, so prevention starts before seeding and crop spraying. Likewise risk of blackspot in peas can be assessed before seeding and the crop managed accordingly. Herbicide damage does leave pulses more prone to disease incidence, for example phoma and herbicide interaction in chickpeas, metribuzin and blackspot in peas.

Nitrogen fixation and benefits: One of many reasons for inclusion of pulses in a crop rotation is that of Nitrogen input (fixation minus removal), savings in N fertiliser in following year(s) and "slow release" of biological N through a year and over years. Value of pulses to a rotation is over several years, and lessens exposure to risks from high fertiliser N input in non-cereals. Gross margins and nitrogen requirements must reflect more than the one year of the pulse and this is an area where the full benefits of pulses are not being portrayed.

Need for rhizobia inoculation or benefits from it in pulses is being heavily scrutinised. We now have new products and application technologies should we need them. Past assessment of inoculation benefits was purely on pulse yield, but also needs to take into account nodulation; nitrogen fixed and flow on benefits. We also need be conscious that we are dealing with a living organism (rhizobia) when inoculating, and occasionally circumstances might lead to one product or application method proving more beneficial in one situation, but worse in another. More work is required, but we need to be aware of what can go wrong in particular cases with different methods and products. For example, freeze dried inoculant applied onto seed may not survive in dry soil conditions whereas a granular product might.

How much nitrogen: Nitrogen left after a pulse depends on the amount of Nitrogen fixed less that removed. There is usually increased available soil nitrogen after a well nodulated pulse, even if total soil nitrogen is not increased greatly or at all.

Nitrogen fixation is greatest where:

- Dry matter production is greatest (approximately 25-30 kg/ha N is for each t/ha of above ground dry matter production, but half as much again will also be in roots)
- Soil organic matter (organic C) is high
- Soil available nitrogen level is low (eg if stubble is incorporated)
- Nodulation with the correct rhizobia strain is maximised (eg by inoculating)
- Nitrogen fixation is not hampered by factors like water-logging, herbicide.

Nitrogen removal relative to that fixed is however influenced by:

- High grain yield per hectare, hence greater removal of N in grain
- A low harvest index (ie high grain yield relative to forage dry matter produced)
- If green forage is removed as hay, silage or grazing (a third of total N produced will remain underground though)
- Removing stubble after harvest (bale, graze)
- Pulse type. Nitrogen removed in grain is greatest in lupins (approx 50kg/t) compared with faba beans, peas, lentils, vetch (approx 40kg/t) or chickpeas (approx 30 kg/t)
- Presence of weeds in crop.

Tables 1 and 2 are a guide as to how much nitrogen (kg/ha) is saved in the current cereal when the previous crop was a pulse harvested for grain (Table 1), green manured or cut for hay by comparison to a pure clover pasture (Table 2). Note impacts of soil organic matter content, forage or grain yield, harvest index and forage removal.

Table 1: Nitrogen saved in current cereal* after last year's pulse grain crop (Kg N/ha).

Soil Organic Carbon (%)	Grain yield relative to crop growth (HI)	Pulse Crop Grain Yield (t/ha)		
		1.0 t/ha	2.5 t/ha	4.0 t/ha
0.6	Low	25	**55**	90
	Medium	20	35	**50**
	High	20	20	35
1.8	Low	**50**	**55**	90
	Medium	**55**	45	**50**
	High	60	40	40

* From "Nitrogen fertiliser calculator", Primary Industries SA 1994 developed by Richard Payne and Jeff Ladd.

Table 2: Nitrogen saved in current cereal* after last year's pulse when green manure or hay crop (Kg N/ha).

Soil Organic Carbon (%)	Use	Pulse Forage dry matter Yield (t/ha)		
		2 t/ha	6 t/ha	10 t/ha
0.6	Pulse Green Manure	38	105	172
	Pulse Hay	8	21	35
	100% clover pasture	25	**70**	115
1.8	Pulse Green Manure	**67**	95	172
	Pulse Hay	14	21	35
	100% clover pasture	45	**70**	115

* From "Nitrogen fertiliser calculator", Primary Industries SA 1994 developed by Richard Payne and Jeff Ladd.
Green manure = 1.5x pasture, hay = 0.3x pasture.

Nitrogen input from a pulse crop is deducted from the nitrogen input requirements of the current cereal. To put these figures in context, from the Nitrogen Calculator (Payne and Ladd 1994), nitrogen requirement for a cereal crop grown on a soil with an organic carbon level of 0.6% and grain protein content of 8-12% is estimated at 20-45kg/ha N for a 1t/ha cereal grain yield, 45-65 kg/ha for 2t/ha yield, 105-140 for 3.5t/ha yield and 160-215 kg/ha for 5t/ha grain yield respectively. At soil organic carbon level of 1.8% and grain protein content of 8-12%, nitrogen requirement is estimated at 0 kg/ha N for a 1t/ha or 2t/ha cereal grain yield, 45-80 kg/ha for 3.5t/ha yield and 100-155 for 5.0t/ha grain yield respectively.

Pulses as forage: As another way of minimising risk, pulses are also being considered as a forage option rather than just grain in situations of poor grain yield (eg poor pod set, frost, drought etc). Peas in particular and varieties such as Morgan are being considered as a better option than vetches because of greater production of biomass, especially the early dense canopy and easier harvestability of grain for retained seed. Sowing on time or early makes forage options more viable however early sowing can increase blackspot incidence in peas and affect overall forage production, so that risk must be managed accordingly. Grazing for subsequent recovery for forage is an unlikely option compared to vetch. See "Using pulses as forage crops" www.pulseaus.com.au

Herbicide impacts: Potential for damage to pulses from residual herbicides must be accounted for in 2009 after an extended dry growing period. Plant-back intervals and rainfall requirements must be known and adhered to. Herbicides used in-crop in new farming systems can lead to greater crop damage or poorer weed control if this was not considered as part of the overall system adopted. Soil throw during seeding can be important for herbicide reaction, but excessive throw into the seeding furrow may also become damaging. You must know the product and system you are dealing with.

Insect impact: Failing to monitor and spray on time for heliothis during last spring came at a high cost to yield and quality with high numbers of grubs very active in pulse crops. Increasingly growers are looking towards an Integrated Pest Management (IPM) approach to insects to improve insect management and crop pollination. Pulse crops differ in their tolerances and critical levels for pest control. We also need be aware of aphid control and how it fits with virus management. Virus management requires an integrated approach across summer weed control (green bridge) and aphid control, along with crop management to minimise aphid virus sources (seed, weeds), aphid numbers (weeds) and landing sites (avoiding bare ground). There are now better ways of monitoring aphid flights entering crops. See "Virus management in pulse crops" at www.pulseaus.com.au

Seed quality: In recent years seed quality has been overlooked, and as a result some growers have suffered establishment problems. For example, lupin 'abnormal seedling' counts were often high for 2008 sowings as a result of harvesting in "tough" conditions. Problems could have been avoided had seed been tested and seeding rates adjusted appropriately. Small seed harvested from 2008 will likely have less vigour than normal sized seed, so grading might help this year. Bacterial blight and PSBMV in field peas, CMV in lupins and lentils were present in crops last year, and pose a threat to new crops if that seed is used in 2009.

Pod Set: Achieving a satisfactory pod set was difficult with pulses in 2008 with cold and/or hot conditions impacting at critical times. Early pods were often the only pods after hot dry conditions, especially in peas and beans. Cold, frosty conditions meant that many chickpeas did not flower or set early pods and pea crops had varying levels of frost damage relative to flowering time. With faba beans, poor pod set was caused by absence of native pollinators or bees or delayed sowing followed by hot dry spring conditions that shortened flowering time. Angustifolius lupins benefited when sown early and with quicker varieties being predominantly grown in the lower rainfall western regions, while albus lupins performed well in the medium to high rainfall zones where they predominate and with the exception of some frost damage produced some excellent yields. See "Managing pulses to minimise frost damage" at www.pulseaus.com.au

Trevor Bray ph 0428 606 886 email: pulse.trevor@bigpond.com
Wayne Hawthorne ph 0429 647455 email: pulse.wayne@bigpond.com