4.6 Irrigated mungbeans – best practice guide

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Key points

- Water required varies from 350 to 550 mm
- Mungbeans are sensitive to waterlogging, particularly if irrigated when the soil has been allowed to crack open
- Mungbeans should be planted into a full profile - pre-irrigate if necessary to achieve this.
- Field selection and fast watering practices needed to minimise the risk of crop death through waterlogging.
- Schedule the first irrigation at 7 days prior to budding (R1)
- A second furrow irrigation is usually only needed on lower PAWC soils
- Maintain soil water above 50% PAWC during flowering, podding and seed development
- Irrigation is not necessary beyond the full seed stage (R4)
- Attention to varietal choice, planting date, row spacing, and plant population are critical to achieving a profitable mungbean crop

Plant Water Use

A mungbean crop achieving maximum production will use between 350 and 550 mm of water depending on seasonal conditions.

The amount of water required to produce a mungbean crop is not a fixed value as temperature and relative humidity during the growing period, along with wind and soil moisture, all determine the rate of evaporation from the soil and transpiration from the plant (evapotranspiration or ET_c). The DAFF Queensland free on-line tool CropWaterUse can be used to examine the seasonal variability in crop water requirement for irrigated mungbeans at your location.

Tables 4.6.1 and 4.6.2 summarise the output from CropWaterUse used to estimate the irrigation needed to grow spring and summer mungbeans at three locations Emerald (15 September and 1 January planting dates), Dalby and Narrabri (1 October and 15 December planting dates). The analysis assumes that the crop is fully-irrigated to target maximum yield. An irrigation application efficiency of 75% and a 75 mm irrigation target deficit are assumed. Results show a large variation in seasonal crop water demand, rainfall and irrigation demand between locations and season types.

Figure 4.6.1 shows the daily water use in mungbean which peaks during flowering, podding and seed development (R1 to R4).

The area of irrigated mungbean to plant is a function of mungbean price, available water and your planned irrigation strategy.

Irrigation Strategies

Full Irrigation

Mungbeans are particularly sensitive to waterlogging so good irrigation management is important. They are also a quick maturing crop which reduces their in-crop irrigation requirement. Table 4.6.3 summarises the impact of excessive and inadequate water on mungbean at different growth stages.

The appropriate irrigation strategy varies with the irrigation system used.

For furrow irrigation the key strategies are:

- Select fields with good layout and tail water drainage, enabling fast irrigation events (preferably less than 4 to 8 hours in duration)
- Use high volume beds or hills, with relatively good grades (avoid flat grades)
- Irrigate down every second or alternate furrow and adjust siphon numbers per furrow to aid fast watering

Table 4.6.1. Comparison of average water requirements for spring mungbeans planted on the 15 September at Emerald, and the 1 October at Dalby and Narrabri based on historical weather data (1957 to 2008)

	Narrabri			Dalby			Emerald		
Season Type	Dry	Ave	Wet	Dry	Ave	Wet	Dry	Ave	Wet
Crop ET_c (mm)	523	493	467	483	456	443	448	420	396
In-crop Rainfall (mm)	122	202	314	145	235	331	59	116	215
Irrigation Demand (ML/ha)	5.3	4.1	3.1	4.3	3.2	2.6	4.9	3.9	2.9
No. of Irrigations	5	4	3	4	3	2	5	4	3

Table 4.6.2. Comparison of average water requirements for summer mungbeans planted on the 15 December at Dalby and Narrabri, and the 1 January at Emerald, and based on historical weather data (1957 to 2008)

	Narrabri			Dalby			Emerald		
Season Type	Dry	Ave	Wet	Dry	Ave	Wet	Dry	Ave	Wet
Crop ET_c (mm)	524	501	470	453	435	417	412	387	363
In-crop Rainfall (mm)	116	206	366	161	244	347	131	226	350
Irrigation Demand (ML/ha)	5.3	4.3	3.2	3.7	3.2	2.6	3.6	2.8	2.2
No. of Irrigations	5	4	3	4	3	2	3	3	2

Figure 4.6.1. Average daily water use pattern for mungbean and critical growth stages

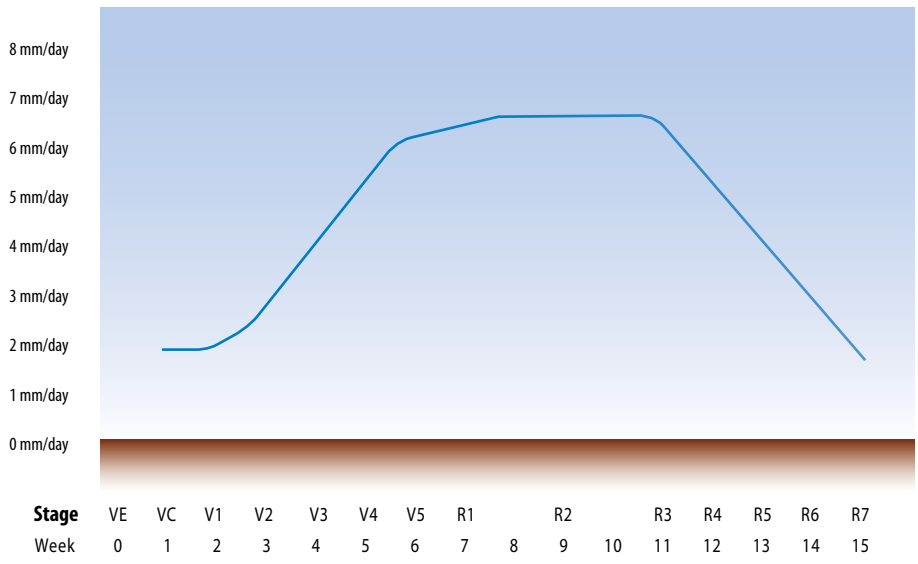

Chart for a 1 October planted crop at Dalby – water use can be as much as 10 to 20% higher under above average temperatures

- If necessary use pre-irrigation to fill the profile prior to planting.
- A single irrigation at around 7 days prior to budding (R1) and before the soil cracks open is usually all that is needed on heavy black earths.
- Irrigating too early can delay or inhibit nodulation and nitrogen fixation. This is usually at 30 to 40 days post-planting.
- Irrigation post flowering (R1) can cause flower drop and plant death through waterlogging.
- Additional irrigation after the start of flowering can cause a succession of flowering events resulting in several stages of pod development in the crop. This makes the timing of desiccation and harvest difficult.

For sprinkler irrigation, the risk of water logging is significantly less as the amount and timing of water application is better controlled.

Irrigations can be scheduled based on soil moisture monitoring using one of the commercial soil moisture monitoring tools available. This equipment can tell you the rate of crop water use and the depth of water extraction.

This can be used to make irrigation scheduling decisions (bearing in mind the importance of minimising waterlogging with this crop).

Irrigation can also be scheduled based on estimation of crop ET_c from weather data. Watersched2, a free online irrigation scheduling tool developed by DAFF Queensland is now available. This tool automatically downloads daily weather data from different locations in Queensland and New South Wales and, using farm-specific inputs, conducts a daily soil water balance and economic analysis to determine when and how much to irrigate.

Figure 4.6.2 is an example of the end of season report generated by WaterSched2 for an irrigated mungbean crop at Dalby in the 2009-10 season. This report summarises the water, crop and economic data for the crop. It provides the WUE indices for predicted and actual yield achieved. The graph at the bottom of the report shows the daily soil water depletion.

During the season, this report provides the information needed to decide on the most appropriate irrigation scheduling strategy in response to crop water requirements, likely economic returns and whole farm water availability.

Limited Water Strategies

If there is a high probability of reduced water allocation and insufficient rainfall, then the yield target may need to be revised down, and supplementary irrigation strategies adopted. Supplementary irrigated crops are 'water limited' – there is not enough water available to fully irrigate the area to be sown. Growers faced with this situation have two main choices:

1. maximise production per hectare by growing an area that can be fully irrigated from the water available
2. grow the largest possible area possible where irrigation is only applied during the most critical growth stages.

Growers wanting to maximise productivity per ML of water will need to strike a balance between these options based on their local conditions and climatic forecasts. Growing a smaller, fully irrigated area of crop may limit the potential upside but avoids the extra costs associated with growing a larger area. On the other hand, yield may be poor if a larger area is planted and seasonal conditions are not favourable.

With mungbeans the first option is preferred given its susceptibility to waterlogging. Ideally mungbeans should be irrigated when the deficit is 30 to 40% of PAWC in the root zone (before significant soil cracking is observed).

For surface irrigated mungbeans the second option is best implemented by planting on a full profile and applying a single irrigation at 7 days prior to budding (R1) and then leaving the crop as a raingrown one. For sprinkler irrigated crops, several smaller irrigations can be timed prior to budding (R1) and during the podding and seed development stages (up until R4).

Table 4.6.3. Critical water management considerations by growth stage for mungbean

Stage	Stage Length (Days)	Description	Water Management Consideration
VE	45 to 55 days	**Emergence** – cotyledons near the soil surface with the seedling showing some part of the plant above the soil surface	If needed, pre-irrigation should have been used to ensure good moisture conditions and an even crop establishment.
VC		**Cotyledon** – cotyledons separate from each other on the upper surface. Unifoliate leaves start to unroll so that the edge of the leaves are not touching each other	
V1		**First Node** – Unifoliate leaves attached to first node are fully expanded and flat	Irrigation during the vegetative stage is unnecessary if the crop was planted into a full profile. Excessive irrigation at this time will produce excessive growth and increase the risk of crop lodging. For furrow irrigation apply the first in-crop irrigation at around 30 to 40 days after planting (7 days before start of flowering)
V2		**Second Node** – 1st trifoliate leaf attached the second node is fully expanded and flat	
V3		**Third node** - 2nd trifoliate leaf at third node fully expanded and flat	
V4		**Fourth node** - 3nd trifoliate leaf at fourth node fully expanded and flat	
V(n)		**N node** – a node is counted when its trifoliate leaf is infolded and its leaflets are flat	
R1	5 to 10 days	**Start flowering** – one flower open at any node on the main stem	For furrow irrigated crops on high PAWC soils (black earths) a single in-crop irrigation should be sufficient. On lower water holding capacity soils a second irrigation during podding may be necessary. For sprinkler irrigated crops, maintain the soil above 50% PAWC during the flowering, podding and seed development stages.
R2		**Beginning pod** – one pod of 1 cm in length is found between node 4 and 6 on main stem	
R3	10 to 15 days	**Beginning seed** – one pod of 5 cm length is found on any of the top 3 nodes on main stem	
R4		**Full Seed** – one pod on any top three nodes has constriction between seed	
R5	15 to 25 days	**Beginning maturity** – one pod on the main stem turns to brown, dark brown or black in colour	Irrigation is unnecessary beyond the full seed stage.
R6		**50% black pod** - fifty percent of pods on the plant mature	
R7		**90% black pod** – ninety percent pods physiologically mature (black or yellow)	

Figure 4.6.2. WaterSched2 End of Season Field Summary report for a fully irrigated mungbean crop at Dalby in 2009-10

WaterSched2

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End of Season Summary

Field Summary

Farm:	Wallon Park	**Plant Date:**	1/10/2009
Location:	Dalby	**Season:**	2009
Field Name:	Wallon Park	**Length of Season:**	72 days / 1072 GDD
Field Size:	100 ha	**Irrigation Type:**	Surface 100%
Crop:	Early Mungbean	**Irrigation Trigger Deficit:**	75 mm

Water Summary

	mm	ML/ha
Total Irrigation:	200	2
Total Rainfall:	49	0.49
Total Losses:	55	0.55
Starting Soil Water:	190	1.9
Ending Soil Water:	71	0.71
Soil Water Change:	119	1.19
Total Water Input:	368	3.68
Net Water Supply:	312	3.12

Crop Summary

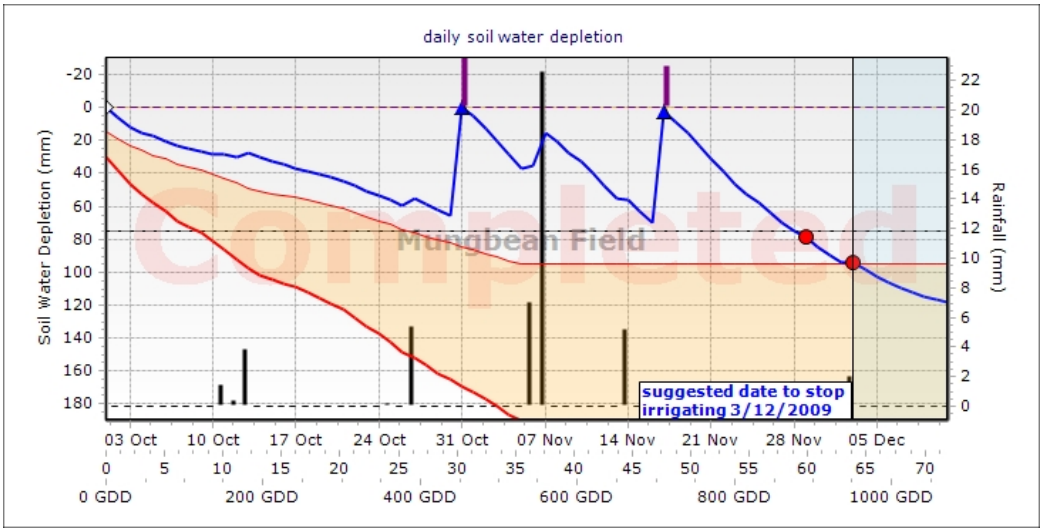
Expected Yield:	2 tonnes/ha
Predicted Yield:	2 tonnes/ha
Actual Yield:	1.8 tonnes/ha
Accumulated ETp:	314 mm
Accumulated ETc:	312 mm

Economics Summary

Price Per Unit:	$700 / tonnes
Variable Costs:	$574 / ha
Gross Margin:	$686 / ha

Water Use Efficiency

	Predicted	Actual	Gross Margin
Total Water Use Index TWUI	0.54 tonnes / ML	0.49 tonnes / ML	$187 / ML
Gross Production Water Use Index GPWUI	0.63 tonnes / ML	0.58 tonnes / ML	$221 / ML
Irrigation Water Use Index IWUI	0.99 tonnes / ML	0.9 tonnes / ML	$343 / ML
Crop Water Use Index CWUI	6.35 kg / mm	5.77 kg / mm	$2.2 / mm



Agronomy

To achieve high irrigated yields it is necessary to follow good agronomic practices. High yielding crops use water more efficiently than lower yielding crops.

Variety Choice

Choice of variety is based on yield potential and adaptation for specific locations, maturity, powdery mildew resistance, plant height and lodging potential, weather resistance and suitability for target market.

The variety Emerald can produce a high proportion of hard seed which can lead to volunteer plant problems in subsequent cotton crops.

Planting Date

The planting window for mungbeans varies across the irrigated valleys. Generally they can be planted as a spring crop or as a late (summer) crop.

Ideally they should be planted into a full profile to ensure even establishment and even maturity at harvest.

Late October/November plantings are riskier than the preferred late September/early October plantings because of the increased risk of experiencing dry, heatwave conditions at emergence and during flowering.

Row spacing

Row spacings of 18 cm to 100 cm are used. The choice is largely determined by available planting equipment, the existing field layout and tillage practices (whether zero-tilled or cultivated).

Wide row spacings offer a number of advantages which include:

- Greater ability to plant into heavy stubble
- Improved evenness of plant stands and crop maturity as row crop planters are used
- Improved harvestability as plants grow taller with a higher pod set
- Easier access for ground spraying
- Shielded sprayers can be used for weed control
- Input costs can be reduced by band-spraying

Where the yield potential is greater than 1 t/ha, narrower row spacings have a yield advantage – around 10 to 15% in favour of narrow rows as yield potential approaches 2 t/ha.

In surface irrigated fields yield potentials can be maximised by using multiple rows planted onto 2 m beds as opposed to 1 m row configurations.

Plant population

For narrower row spacings, aim for a target population of 30 to 40 plants per square metre. Populations above these increase the risk of lodging. Crystal, Satin II, White Gold, Emerald and Green Diamond are more resistant to lodging at these higher populations than other varieties.

At 1 m row spacings aim for 20 to 25 plants per square metre – higher populations will exacerbate lodging.

If planting after mid-January yield potential is reduced. This is because the crop flowers around 35 days after planting, producing short plants that fail to achieve canopy closure. In this situation increase the planting rate by 5 kg/ha.

Further Reading

Cumming, G. and Gentry, J. 2010 Certified Mungbean Agronomy Course 2010, The Australian Mungbean Association, Pulse Australia and DAFF Queensland

Gentry, J. 2009 Mungbean Management Guide, QPIF