Critical period of moisture vulnerability in mungbeans

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AT A GLANCE…

- Mungbeans are most vulnerable to drought stress during the pod filling phase. It is critical to ensure adequate moisture is available or has been applied by irrigation during this period.
- Drought stress during pod filling reduces the number of grains per pod and the overall number of pods per plant.
- Trials showed that yield decreased in response to drought stress by 10–33 per cent during vegetative growth, 5–27 per cent during flowering and 53–75 per cent from early-pod fill compared with well-watered. Yield response to drought differed between varieties.
- Mungbeans compensate for lower pod number by increasing carbon allocation to remaining pods – increasing individual grain weight and partially offsetting yield losses for stress occurring during flowering.
- Optimising sowing time or irrigation timing to avoid drought stress during pod-fill will improve grain yield stability.

ONE of the major challenges facing the mungbean industry has been meeting current and projected demand for the crop when yields can be unpredictable and fluctuate considerably from season to season. Abiotic stress – mostly high temperatures and drought stress – limit mungbean growth and production potential, particularly when stress occurs during flowering and pod filling.

Mungbeans in the Northern grains region are traditionally planted from September through to November for a spring planting, or from December to January for a late summer plant, exposing them to periods of heat and moisture stress.

Mungbeans are typically grown under rainfed situations due to their short duration and lower water use compared with other summer crops. Dry conditions through the crop cycle are common meaning crops are often planted on low stored soil moisture (less than 90 mm plant available water) with little in-crop rain, resulting in terminal drought stress or drought stress during the later stages of reproductive growth.

Lysimeter pot set-up for the mungbeans experiment.

Crop response to water deficits are largely based on the stage of development when drought stress occurs. Drought stress is multi-dimensional and can impact the morphological and physiological processes that drive crop growth, productivity and grain quality.

While mungbeans are tolerant of drought conditions compared with other crops, the timing of water deficits can still have a significant impact on crop productivity.

Robertson (1934) defined the critical period for yield determination as the physiological stage in which abiotic stressors have the largest impact on yield determination.

The reproductive phase of most legumes, including mungbeans is considered the critical period for yield determination. But, the impact of abiotic stress, particularly water deficits, during this period in comparison with other development stages is largely unknown.

In February 2020 we established a pot trial in the UQ Gatton Campus lysimeter facility to investigate the critical period for moisture stress vulnerability and the impact of drought stress at different phenological stages on the final grain yield of mungbeans.

The outcome of this experiment was a deeper understanding of how mungbeans respond to drought stress and how we can improve our agronomic management to maximise grain yields.

What we found

- Mungbeans are tolerant of mild to moderate drought stress during the vegetative and early reproductive stages without major yield penalties.
- Drought stress during the vegetative phase can limit leaf development and biomass production which limits grain yield later in the season. But, yield is largely determined by terminal drought stress or drought stress in the later reproductive stages of development, i.e. during pod-fill.
- While the total number of harvestable pods is reduced when plants are under drought stress, drought stress during pod fill can increase individual or 100 grain weight through efficient remobilisation of assimilate reserves to partially compensate for lower pod number. But the total grain yield shortfall is still substantial.

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