

Desiccating mungbeans – can we do better?

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Take home message

- Growers can desiccate mungbeans for harvest either chemically or mechanically by windrowing
- Timing chemical desiccation is critical to minimise glyphosate residue levels
- Windrowing may be an option in the following situations: multiple flushes of pods, hard to kill vigorous mungbean plants, pending wet weather, heavy powdery mildew infestation, accessing markets with low glyphosate maximum residue levels and growing for seed &/or sprouting.

Background

Most Australian mungbean crops are chemically desiccated prior to harvest to aid ‘dry-down’ of the crop and facilitate mechanical harvest. Approximately 90 – 95% of the crop is desiccated with glyphosate, which is recommended for application when pods are black or brown (depending on individual product labels). Timing of desiccation is critical to ensure maximum dry-down whilst minimising chemical residue in the seed. Glyphosate is translocated through the plant. The target sites of glyphosate are the active meristems/apical parts of the plant. Glyphosate firstly moves to the tips of the leaves of penetration then it is loaded into the phloem and moves upwards to new shoots and buds. It then moves to the root tips. Death ultimately results from dehydration and desiccation. Translocation to immature seeds will result in detectable levels in these seeds which may have implications for marketing.

Improved mungbean varieties have led to more vigorous plants and desiccation has become increasingly problematic. One problem faced when harvesting mungbean is moisture remaining in the stem after desiccation. This stem sap can cause seed coat staining that results in downgraded grain quality. Consequently, growers have resorted to increasing rates of herbicides.

Export markets are becoming increasingly sensitive to pesticide maximum residue limits (MRL’s) and the mungbean industry must be ready to adapt and meet market specifications if required. Furthermore, international markets are amending their MRL’s in very short time frames – often too quickly for the industry to respond. Consequently, residues of glyphosate in mungbean are already affecting the acceptance of Australian mungbean in some export markets. With over 90% of Australian mungbean exported, alternative harvest practices that do not use crop protection products were deemed a priority in the current strategic plan of the national industry body, the Australian Mungbean Association (AMA).

The Mungbean Agronomy Project (DAQ1806-003RTX) led by the Queensland Government Department of Agriculture and Fisheries and supported by the Grains Research and

Development Corporation and the Australian Mungbean Association undertook research to assess the potential of mechanical desiccation as an alternative to chemical desiccation of mungbeans. A series of large-scale commercial trials of mechanical desiccation (also known as swathing or windrowing) were implemented in 2022 following initial small plot experiments in 2021.

Windrowing is the mechanical process of swathing or cutting the crop to form the mungbean into a windrow on the ground. The windrow is harvested several days later by a header with a specialised pick-up front that lifts the crop off the ground. The 2021 trials successfully showed that mechanical desiccation of mungbean was a viable method. This report explores the results from the 2022 commercial scale trials.

What was done

2021

Four small plot trials were conducted, two at Emerald and two at Warwick, investigating rainfed and irrigated systems at each location. Eight treatments were assessed: control, mechanical desiccation at 30%, 60% and 90% physiological maturity (PM), glyphosate at the registered rate applied at 30%, 60% and 90% PM, and diquat applied at the registered rate at 90% PM. Harvest assessments were conducted at 3, 7, 10, 14 and 21 days after treatment (DAT). (For detailed information see: <https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2021/11/swathing-mungbeans-is-it-an-alternative-desiccation-method-in-mungbeans>)

2022

Fifteen trials were implemented across southern Queensland and northern New South Wales. However, only 12 had complete data sets due to rain. (For detailed information see: <https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2023/02/desiccating-mungbeans-is-windrowing-an-alternative>)

Two treatments were used in each trial: windrowing (Figure 1) and glyphosate (Figure 2) desiccation.



Figure 1. Windrowed mungbean



Figure 2. Chemically desiccated mungbean

Grain losses were measured using a variety of techniques at each stage of the treatments. Grain quality and glyphosate residue level in the seed (MRL) were also assessed.

Results

Grain quality

2021

Grain quality in 2021 commercial crops was generally low due to the high amount of late rainfall, with the quality of most crops falling into the manufacturing level. In the experiments, quality was lower for all treatments applied at both 30% and 60% PM. Mechanically desiccated mungbeans maintained a quality standard across harvest days (from day 3 to day 21). However, glyphosate treatments were downgraded if harvested too early (day 3) and too late (day 21) (data not shown).

2022

Mungbean grain quality was variable, however most trials achieved manufacturing grade and above (Figure 3, Table 1). Windrowed crops generally achieved higher quality levels (10 out of 15 had higher quality) than the chemically desiccated mungbeans including #14 where the glyphosate desiccated crop was abandoned due to excessive rainfall. These trials showed that moderate falls of rain from 25 to 50 mm on the windrowed treatments had no serious impact on mungbean quality and harvestability. Two crops had approximately 15 mm of rain (#01, #03) and in both cases the windrowed treatment had better quality mungbean than the traditional glyphosate treatment. However, an extreme weather event of over 100 mm for #02 resulted in the complete loss of the windrowed mungbean and severe quality downgrades for both treatments. In the cases of #13, #14 and #15, windrowing enabled the crop to be harvested before rain, due to quicker dry-down and no withholding period to observe, which resulted in a large quality advantage (Figure 3). Mungbeans deemed below manufacturing (BM) resulted from large amounts of rain (>100 mm) post desiccation.

Table 1. Grain quality rating scale conversion table from commercial code to number code.

	Rating scale	No. rating scale
P=Processing	P1	9
	P2	8
	P3	7
M=Manufacturing	M1	6
	M2	5
	M3	4
BM = below manufacturing	BM1	3
	BM2	2
	BM3	1

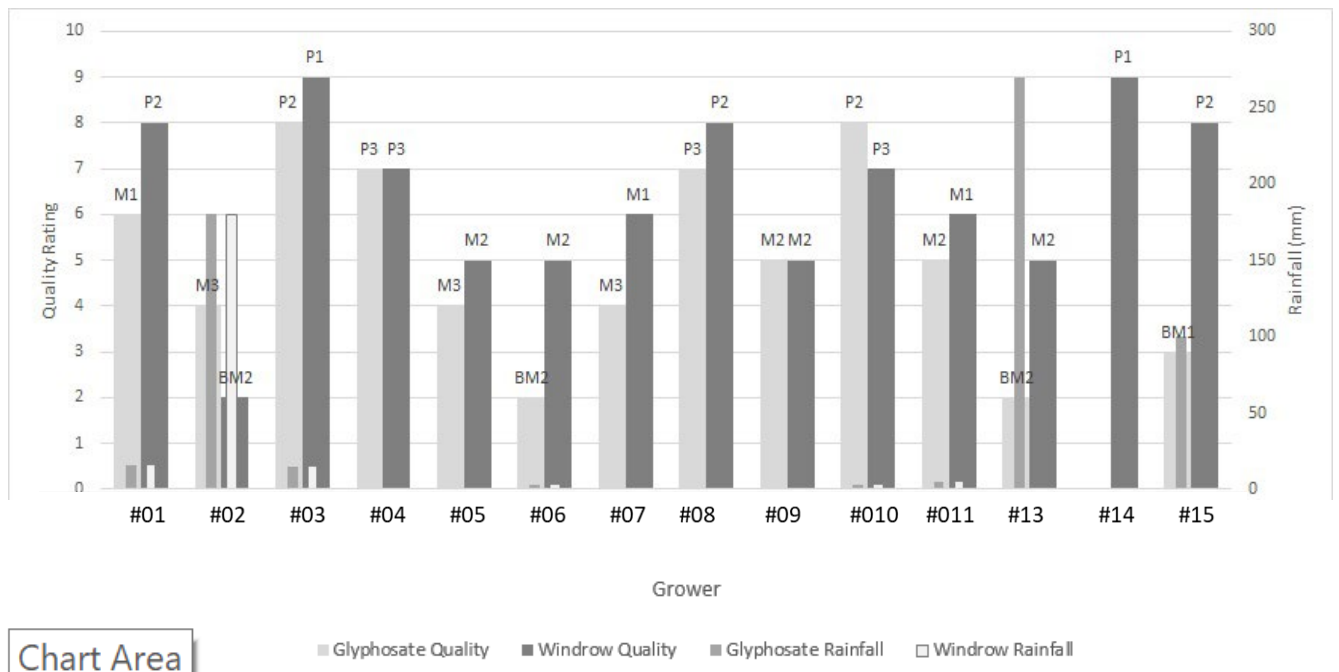


Chart Area

■ Glyphosate Quality
 ■ Windrow Quality
 ■ Glyphosate Rainfall
 ■ Windrow Rainfall

Figure 3. Grain quality for glyphosate and windrowed mungbeans and rainfall (ratings in Table 1)

*#14 glyphosate mungbeans were abandoned due to excessive rain (rainfall not recorded)

Glyphosate residue

The harvested seed in the glyphosate desiccated treatments was tested for glyphosate residue. All samples recorded glyphosate. The 2021 trial attempted to quantify the impact of ‘spraying too early’ i.e. at 30% PM and 60% PM. The data showed that the earlier mungbeans are sprayed the more residue is detected in the seed (Figure 4).

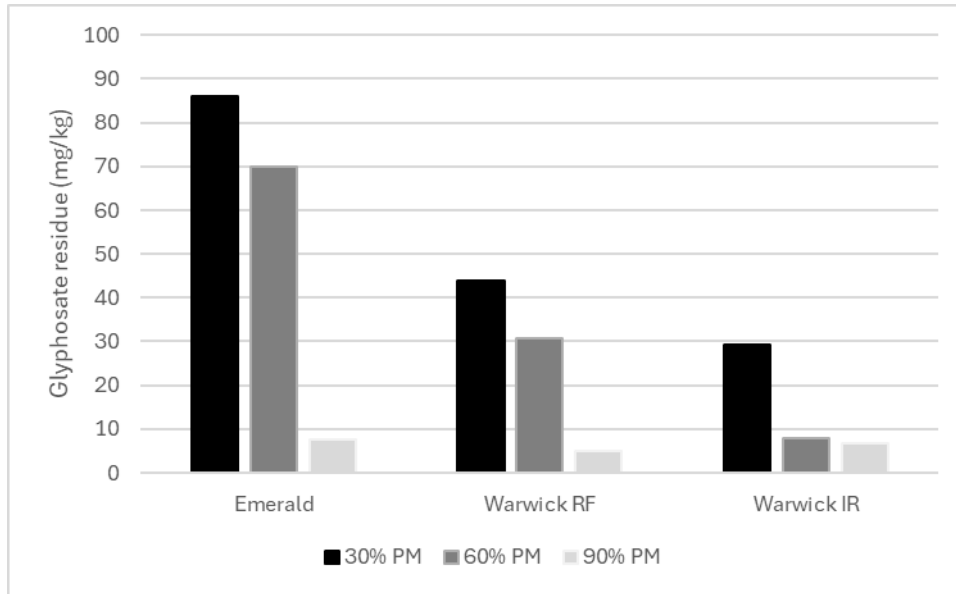


Figure 4. Glyphosate residue in seed @ 7 DAT at Emerald, and Warwick rainfed (RF) and irrigated (IR). Means with same subscript are not significantly different at the $P=0.05$ level.

In 2022, when all crops were chemically desiccated as per label (i.e. 90% PM), all samples were under the Australian maximum residue level (MRL) of 10 mg/kg (Figure 5). However, individual countries set their own MRLs. Taiwan currently has the lowest MRL of 2 mg/kg. Only two crops were over this MRL; #13 at 2.7 mg/kg and #08 at 5 mg/kg, which most likely had a higher percentage of green and immature pods at the time of glyphosate desiccation that resulted in translocation of the chemical into immature seeds.

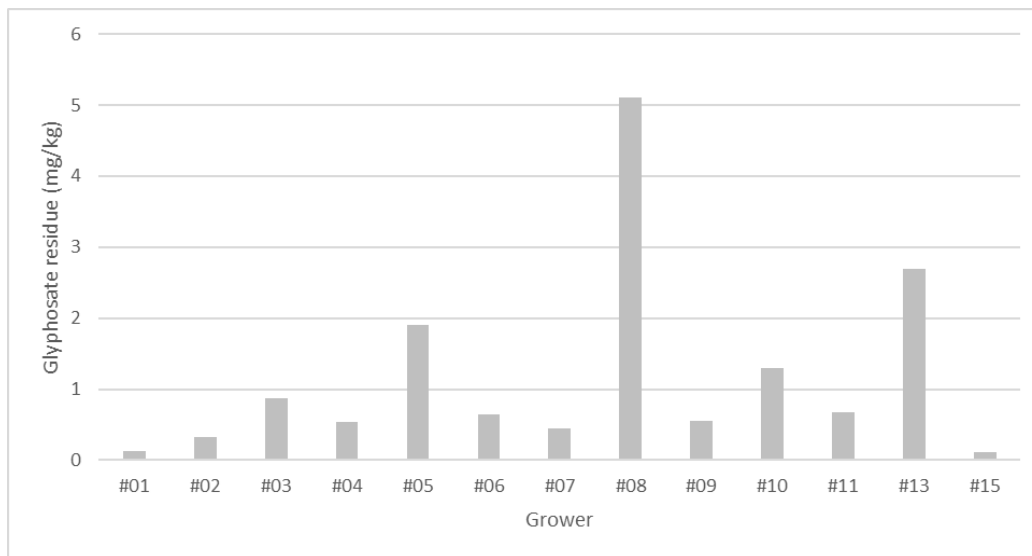


Figure 5. Glyphosate residue levels (mg/kg) of mungbean desiccated with glyphosate in 2022.

Implications to growers

Growers can choose to either chemically desiccate or mechanically desiccate (windrow) mungbean crops.

Mechanical desiccation

Mechanical desiccation may be an option in situations where:

- There are multiple flushes of pods
- Hard to kill vigorous mungbean plants are present
- Wet weather is forecast (i.e. in 7–14 days)
- Powdery mildew infestation is high and glyphosate can't be taken up by the plants
- The crop is destined for a market with low glyphosate MRLs (e.g. Taiwan)
- Crops that are targeting the seed &/or sprouting market. (Note: it is clearly stated on glyphosate label that it is NOT to be used for seed crops.)

Mechanical desiccation is not an option in situations where:

- Uneven ground is present (e.g., flood irrigated mungbean with large furrows) as this can result in very high losses.
- Very large amounts of rainfall are predicted
- Appropriate machinery is not available
- The soil is very wet (as this will result in wheel tracks and compaction).

Chemical desiccation

The key points when chemically desiccating mungbeans is the use of a robust label rate of desiccant and allowing sufficient time for the crop to dry down before commencing harvest.

Desiccating too early will result in spongy grain and seedcoat wrinkling, and therefore lower quality product. Spraying glyphosate prior to physiological maturity may result in translocation of the chemical to the seed. Ensure you discuss options with your marketer prior to desiccation and always read and follow product labels.

To minimise glyphosate seed residues:

1. Accurately assess physiological maturity
2. Do not desiccate immature crops

Timing of desiccant

Timing the application of a chemical desiccant is critical. An accurate assessment of the physiological maturity of the crop must be made. A crop must be desiccated once 90% of the pods have reached physiological maturity.

How to assess physiological maturity:

1. Assess pod colour – yellow through to black pods generally have reached maturity.
2. Assess seeds in the pod – mature seeds will fall out of the pod. Split the pod longways and tip the pod upside down. Mature seeds will fall from the pod.
3. Assess in multiple locations within the paddock

Mechanical desiccation

Mechanical desiccation (windrowing) of mungbeans is a new harvest option and has not been trialled extensively. However, initial research has shown it is a viable option.

The key points when windrowing mungbeans is timing, both the cutting and harvesting. Desiccating too early, similar to chemical desiccation, will result in seedcoat wrinkling, and

therefore lower quality product. Desiccating too late will result in larger harvest losses. Dry-down time will be faster than chemical desiccation and significant losses can be recorded if pick-up of the crop is too late.

Timing of mechanical desiccation

Timing mechanical desiccation is not as critical as it is for chemical desiccation as there is no risk of chemical translocation. The crop should be desiccated when 90% of the pods have reached physiological maturity.

Pick-up from the windrows can occur as soon as the crop is sufficiently dry to thresh; normally 5–7 days but this is weather dependant. For example, it may be as fast as 3 days after desiccation under hot, dry conditions and as long as 14 days under mild, wet conditions.

Harvest losses may be reduced by picking-up early in the morning whilst there is still moisture on the crop. If the crop is too dry harvest losses can be significant.

Once the mungbean crop has been mechanically desiccated and put into a windrow, it can tolerate small amounts of rain (i.e. up to ~50mm). However, large amounts of rain and very wet ground can result in mould and reduction in yield and quality.

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