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GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

CHICKPEA

SECTION 11

CROP DESICCATION/ SPRAY OUT

BENEFITS OF DESICCATION | CROP-TOP, DESICCATE, HARVEST OR MANURE? | TIMING OF DESICCATION | CROP-TOPPING

FAQ

Crop desiccation/spray out

Key messages

- Chickpea often matures unevenly and require herbicides to ripen more evenly.
- Desiccation assists production by: taking out late weeds such as thistles which can stain the seed, allowing for earlier harvesting which lessens the weather risk at harvest and browning out green stems which can gum up knives in headers.
- The correct timing for desiccation is when 80–85% of the seeds in the pod have turned yellow and are firm and the remaining 15–20% have yellow 'beaks' on the seed or are starting to turn colour.
- A high water rate is advised to get coverage if using a contact herbicide.
- After desiccation, plants become more brittle, so it is advised not to delay harvesting.

11.1.1 Benefits of desiccation

Desiccation is the strategic termination of crop growth using herbicides. Desiccation is an established technique to improve the rotational fit, benefits and profitability of pulse crops. Desiccation provides important benefits such as reducing weed seed-set, allowing faster harvest and improving grain quality, all leading to improved profitability in pulses.

Desiccation prepares the pulse crop for harvesting by removing moisture from plants and late maturing areas of the paddock. Desiccation is an aid to a timely harvest, particularly where uneven ripening occurs across a paddock, and is now a common practice in lentil and chickpea. Desiccation enables a timely harvest to avoid weather damage.

Crop topping is a form of desiccation, but timing, products and rates differ from desiccation. Desiccation is based on the crop stage close to maturity. The timing of crop topping is based on the stage of development of weed seeds. Different chemicals and rates are used. See Sections 11.3.1 and 11.4.

Application timing is based on the crop when the grain is 75–90% mature, to avoid reducing the quality of the harvested grain. Windrowing can be considered similar to desiccation in timing and benefits to harvest. Windrowing may be considered as an alternative to desiccation. The timing of windrowing is similar to desiccation. [1]

Desiccating a crop overcomes problems with green weeds at harvest and improves harvest efficiency by eliminating many of the problems associated with green stems and gum build-up, such as uneven feeding and drum chokes. Minimising these problems enables drum speeds to be reduced in many cases, with a reduction in cracked or damaged grain. It allows harvesting of a crop that will not naturally shut down due to high soil moisture, and stops chickpeas reshooting and reflowering after pre-harvest rain, and makes crops with uneven maturity more uniform, allowing earlier harvesting. [2]

While desiccation is often not necessary under very hot conditions where the crop is under terminal moisture stress, it can be a very useful harvest management tool in situations where:

- There has been rain during grainfill and the crop is uneven in maturity. Chickpea are very indeterminate and will continue to flower and set up pods late in the season. Crop maturity tends to be very uneven and slow in situations of reasonable moisture supply.

1 Pulse Australia (2015) Desiccation and crop-topping in pulses. Pulse Australia, Australian Pulse Bulletin, http://www.pulseaus.com.au/growing-pulses/publications/desiccation-and-croptopping

2 QLD DAFF (2012) Chickpea—harvesting and storage. https://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/chickpeas/harvesting-and-storage

- Pod-set has been very uneven due to agronomic factors such as low plant population, poor *Helicoverpa* management, uneven plant establishment in some deep-sown crops, wheel tracks through crops etc.
- There is a problem with actively growing weeds in the crop.

In these situations, desiccation is a valuable management tool for maximising yield and quality through early harvesting. It also improves harvest efficiency by eliminating many of the problems associated with putting green, sappy plant material through the header, i.e. uneven intake and drum chokes. Minimising these problems enables drum speeds to be reduced, with less likelihood of cracking grain. [3]

11.2 Crop-top, desiccate, harvest or manure?

All pulse growers face the decision between crop-topping, desiccation, harvesting or manuring, and their decision is dictated by weed pressures, weed type and the nitrogen demands of the rotation.

11.2.1 When weeds are not the priority

Option 1

Management: natural maturation and grain harvest.

Goal: to maximise grain yield and profit while at the same time providing rotational benefits.

Method: This is the most traditional and widespread practice for cultivating pulses in NSW and is based on well-developed agronomy and crop management strategies from sowing through to harvest. This option assumes weeds are fully managed by conventional rotation and herbicides.

Option 2

Management: brown manuring.

Goal: to maximise N_2 fixation, N-benefit and to conserve soil moisture.

Method: The amount of N_2 fixed is linked closely to dry matter (DM) production of the legume, therefore 'manure' the weed-free pulse close to its maximum DM. For a typical Morgan PSE 23 (long-season) field pea crop sown at Wagga Wagga, NSW, in late May, this would mean desiccating around the end of October.

11.2.2 When weeds are the priority, particularly if herbicide resistance exists

Option 1

Management: brown manuring.

Goal: total control of weeds including herbicide resistance, and to fix some N and conserve soil moisture.

Method: It is imperative to desiccate the crop at or before the milky dough stage of the targeted weed. This often coincides with the flat pod stage of the pulse and inevitably falls well short of the crop's peak DM. At this stage the crop is growing at its maximum rate (about 80–100 kg DM/ha/day), so the amount of N fixed will be proportionally reduced according to its growth stage at desiccation. This cost is non-negotiable and essential to ensure complete weed control.

3 B O'Mara, S Belfield, G Cumming (2007) Chickpea harvest and seed storage. Pulse Australia, www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf

Option 2

Management: crop-topping/desiccation followed by grain harvest, although this may not be an option available to chickpea because of later crop maturity compared with the weed seeds.

Goal: to maximise grain yield and profit while at the same time providing rotational benefits of preventing weed seed set.

Method: This is the 'have your cake and eat it' scenario. It is a good option for cleaning up scattered weeds and to eliminate weed seed-set in all weedy situations including herbicide resistance. It uses the conventional approach of grain harvest, plus crop-topping/desiccation at the critical growth stage of the weed.

Timing is critical—it depends on the pulse variety reaching physiological maturity at or before the time of crop-topping/desiccation. Most pulse varieties (chickpeas, albus lupin and possibly kaspa field peas) are unsuitable as they are too late and lose too much grain yield. [4] GenesisTM079 is the earliest of the chickpeas, and only infrequently does it mature sufficiently to crop top.

11.3 Timing of desiccation

Chickpea are an indeterminate plant with flowering commencing in the lower canopy, and gradually progressing up the branches (towards the top of the plant) over a 20–30-day period. The problem growers and agronomists are confronted with in the paddock, is how to maximise yield and quality through the optimal timing of the desiccant spray. This can be difficult when you have various stages of seed maturity present on individual plants as well as variability across the paddock.

The optimal stage to desiccate the crop is when the majority (90–95%) of seeds have reached physiological maturity (seeds are below 35% moisture content). The best guide at the present time is to base this on a visual inspection of seeds by cracking open pods on each main fruiting branch. Maximum harvest yield is normally reached when 75% of seeds on each main fruiting branch have turned totally yellow and in various stages of drying down (turning yellow to brown).

Desiccation should occur when:

- Pods in the top 25% of the canopy are mainly in the final stages of grainfill, i.e. where the yellow colouring is moving from the 'beak' down through the seed (Photo 1).
- The bottom 75% of pods have all reached, or dried down below, this stage of maturity. (Seeds have turned totally yellow, and the pod has been bleached to a very light green-yellow colour) (Photo 1).

4 E Armstrong (2015) Weigh up the risks, benefits of pulse harvest. GRDC Ground Cover Issue 115, Profitable pulses and pastures 02 March 2015, https://grdc.com.au/Media-Centre/Ground-Cover-Supplements/Ground-Cover-Issue-115-Profitable-pulses-and-pastures/Weigh-up-the-risks-benefits-of-pulse-harvest

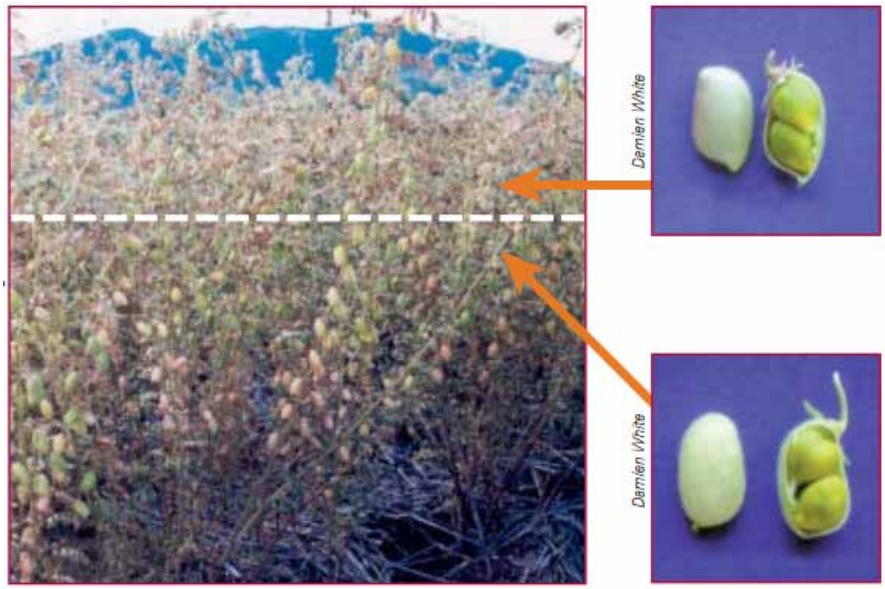

Photo 1: *Chickpea seeds mature progressively from the bottom to the top of the plant.*

Source: Pulse Australia

Monitoring for desiccation timing

Careful monitoring is needed to determine the correct timing for desiccation in both chickpea species. Yield reductions of 10–20% can occur if applied too early. Quality can also be adversely affected. The optimal stage to desiccate chickpea is when the vast majority of seeds have reached physiological maturity i.e. 90–95% of the crop. Inspect the seeds within the upper 20% of pods on each main fruiting branch (Photo 2).

Photo 2: *Correct desiccation timing based on inspection of uppermost pods of each fruiting branch.*

Photo: G Cumming, Pulse Australia

Seeds are considered to be physiologically mature when the green seed colour begins to lighten. The Western Australian recommendation of physiological maturity is 'when the pod wall begins to yellow' (Photo 3, right).

Photo 3: *LEFT: Pods in the top 25% of the canopy should mainly be in the final stages of grainfill, where the yellow colouring is moving from the 'beak' down through the seed. RIGHT: The bottom 75% of pods should have reach maturity. Seeds have turned yellow and the pod has been bleached to a very light green-yellow.*

Photos: G Cumming, Pulse Australia

To avoid the need to inspect seeds, desiccate when 80–85% of pods within the crop have turned yellow-brown (Photo 4). This is usually too late for the control of ryegrass survivors. [5]

Photo 4: *Full maturity, known as 'rattle pod', where the seed has detached from the pod wall and will rattle when shaken.*

Photo: G Cumming, Pulse Australia

Seed and pod development

Chickpea plants are indeterminate and the period of flowering can extend from 20–50 days depending on levels of flower abortion and the impact of moisture stress on the plant. Causes of flower abortion and poor pod-set have been discussed previously and they include:

- low mean daily temperature (below 15°C)
- frost
- Botrytis grey mould
- extended periods of overcast weather.

Flowering commences on the main stem and basal branches, and proceeds upward at intervals of ~2 days between successive nodes on each fruiting branch.

Under favourable conditions, the time taken from flowering to the visual appearance of the pod (pod-set) is ~6 days. After pod-set, the pod wall grows rapidly for the next 10–15 days to assume full pod size. The seeds start to develop at about the same time as the growth of the pod wall ceases.

5 Pulse Australia (2015) Desiccation and crop-topping in pulses. Pulse Australia, Australian Pulse Bulletin, http://www.pulseaus.com.au/growing-pulses/publications/desiccation-and-croptopping

Seed growth occurs over the next 20 days. Pod and seed maturation is also very staggered along each fruiting branch, although it is generally more compressed and of shorter duration than flowering owing to the effects of higher temperatures and varying degrees of moisture stress on the plant. The problem faced by agronomists in a commercial paddock situation is how to optimise the timing of the desiccant spray when there are various stages of seed maturity present on individual plants, as well as variation across the paddock. This can be compounded by variation in soil type or paddock micro-relief adding to the problem of uneven crop maturity. Some agronomists use a rule of thumb that when 90% of the field is 90% mature they will advise growers to spray it out. Alternatively, when larger areas are involved, they may split soil types and test them separately for desiccation timing. Often, inspection of commercial crops nearing desiccation reveals that while the lower 30% of pods have dried to below 15% seed moisture (seeds detached from pod and rattle when shaken), the upper 30% of pods on each fruiting branch are still at 30–40% moisture content and in varying stages approaching physiological maturity. [6]

Effect of desiccants on immature seeds

Desiccants should not be applied too early as they can affect green seeds. The result can be a reduction in grain size and yield, an increase in immature seeds, an increase in greenish discolouration of the seed coat and a reduction in seed viability (Table 1). Glyphosate does impact on the normal seedling count in germination tests.. Do not use it in crops destined for sowing seed.

Table 1: *Effects of desiccation timing on seed viability.*

Trial and treatment	Crop stage	% normal seed	% abnormal seed	% dead seed
None	Mature pods	87	9	4
Roundup®	Mature pods	84	14	2
Ally® & Roundup®	Mature pods	85	13	2
Ally® & Roundup®	Mature pods	76	20	4
Ally® & Roundup®	70% green pods	15	63	22
Ally® & Roundup®	All green pods	22	60	18

Source: Qld DPI (1999)

11.3.1 Products for the desiccation of chickpea

1. Reglone® is registered at 2–3 L/ha
2. Reglone® provides quick leaf drydown but the chickpea plant and weeds can quickly regrow if moisture is available
3. Roundup PowerMAX® is the only glyphosate registered for chickpea desiccation
4. a) For chickpea desiccation: Roundup PowerMAX® at 0.68–1.8 L/ha
5. b) For additional weed and chickpea desiccation: Roundup MAX® at 0.5–1.1 L/ha plus Ally® at 5 g/ha
6. Roundup PowerMAX® and Roundup PowerMAX®/Ally® will kill the plants reducing the likelihood of regrowth [7]

Table 2: *Chemicals registered for desiccation in chickpeas.*

6 Pulse Australia (2013) Northern chickpea best management practices training course manual—2013. Pulse Australia Limited.

7 B O'Mara, S Belfield, G Cumming (2007) Chickpea harvest and seed storage. Pulse Australia, www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf

Herbicide	Example trade names	Operation	Rate	Withholding period
Diquat 200g/L	Reglone®	Desiccation	2 to 3 L/ha	Grazing/stockfeed (GSF): 1 day Harvest: 0 days (lupin, dry pea) 2 days (chickpea, lentil, faba bean)
Paraquat 250g/L	Gramoxone®	Croptopping	400 to 800 mL/ha	GSF: 1 day (7 days for horses) Stock must be removed from treated areas 3 days before slaughter Harvest: 7 days
Glyphosate 480g/L	Ripper 480®	Desiccation	765 mL to 2.025 L/ha	GSF: 7 days Harvest: 7 days
Glyphosate 540g/L	Roundup PowerMAX®	Desiccation	680 mL/ha to 1.8 L/ha	GSF: 7 days Harvest: 7 days
Metsulfuron + Glyphosate 540 g/L	Ally® + Roundup PowerMAX®	Desiccation + knockdown weed control	5 g + 500 mL to 1.1 L/ha	GSF: 7 days Harvest: 7 days
Saflufenacil	Sharpen®	Desiccation	34 g/ha plus recommended label rate of glyphosate or paraquat herbicide plus 1 % Hasten or high quality MSO	GSF: 7 days Harvest: 7 days

GSF - Withholding period for grazing or cutting for stock food

Note: Observe the Harvest Withholding Period and GSF for each crop.

Source: Pulse Australia

Paraquat is registered for crop-topping; however, may not be effective on grass seed-set as chickpeas mature quite late relative to grasses.

The major differences between timing of desiccation and crop-topping are:

- application timing is different and initiated by different criteria
- herbicides for crop-topping and desiccation are not always the same
- herbicide rates for desiccation are higher than that required for crop-topping
- crop-topping will advance the harvest timing in some pulse crops
- neither desiccation nor crop-topping can be used effectively in all pulses
- both will cause reduced grain quality and yield if applied at the wrong maturity stage of the crop. [8]

NOTE: Desiccation can affect seed viability if applied incorrectly. To avoid damaging seed viability, it is advisable not to desiccate or crop-top a pulse seed crop.

11.4 Crop-topping

Crop-topping is timed to prevent weed seed-set, not by the crop growth stage. Hence, crop-topping is generally not possible in chickpea, as they are too late in maturing. Crop-topping chickpeas can result in discoloured cotyledons (kernel) and seed coats, leading to rejection at delivery and/or severe downgrading. Even in other

8 Pulse Australia (2015) Desiccation and crop-topping in pulses. Pulse Australia, Australian Pulse Bulletin, http://www.pulseaus.com.au/growing-pulses/publications/desiccation-and-croptopping

pulses, growers need to be aware of grain quality defects if crop-topping is done earlier than the crop desiccation or windrowing stage.

Genesis™ 079 is the earliest maturing chickpea variety, but in most cases, it will not mature early enough to enable efficient crop-topping without grain quality impacts. Evidence of the lack of suitability of crop-topping in chickpea is provided in Table 3, from a South Australian Research and Development Institute crop-topping trial at Melton, South Australia, in 2009. Visual grain quality data are not presented, but in this trial:

- Many responses to crop-topping treatments may have been masked by rapid senescence from a rapid, early seasonal finish (e.g. Almaz$^{\Phi}$ and Genesis™ 114).
- When crop-topped at the recommended stage, yields were 69–86% of the untreated control (31–14% yield loss). When crop-topped 2 weeks after the optimum stage for ryegrass, yields were 92–114% of the untreated control. When crop-topping was 3 weeks ahead of the recommended ryegrass stage, yields were 17–48% of the untreated control (83–52% yield loss).

Table 3: *Impact of crop-topping timing on chickpea varieties of differing maturity compared with an untreated control at Melton, South Australia, 2009 Pink shading denotes significant difference from the control treatment.*

	Control yield (t/ha)	Yield (% of control) for each timing			Control grain weight (g/100 seeds)	Grain weight (% of control) for each timing		
		Minus 3 weeks (9 Oct.)	Recommended ryegrass control stage (30 Oct.)	Plus 2 weeks (12 Nov.)		Minus 3 weeks (9 Oct.)	Recommended ryegrass control stage (30 Oct.)	Plus 2 weeks (12 Nov.)
Almaz$^{\Phi}$	1.18	19	83	92	27.4	91	92	91
PBA Slasher$^{\Phi}$	1.96	30	70	99	15.5	87	84	100
PBA HatTrick$^{\Phi}$	1.37	36	69	85	18.1	77	81	93
Genesis™ 079	2.09	25	80	107	18.0	95	104	104
Genesis™ 090	1.43	25	84	97	22.1	79	93	93
Genesis™ 114	0.90	17	86	114	22.1	96	102	104
Genesis™ 509	1.96	32	71	96	13.6	129	101	94
Howzat$^{\Phi}$	1.70	21	72	94	16.6	87	87	117
Sonali	2.13	40	77	104	14.5	96	80	101
Mean (t/ha)	1.90	0.6	1.5	1.90	18.6	16.3	15.9	18.2
Mean (g/100)					18.6	16.3	15.9	18.2

Source: M Lines and L McMurray (SARDI), Southern Pulse Agronomy Research trials