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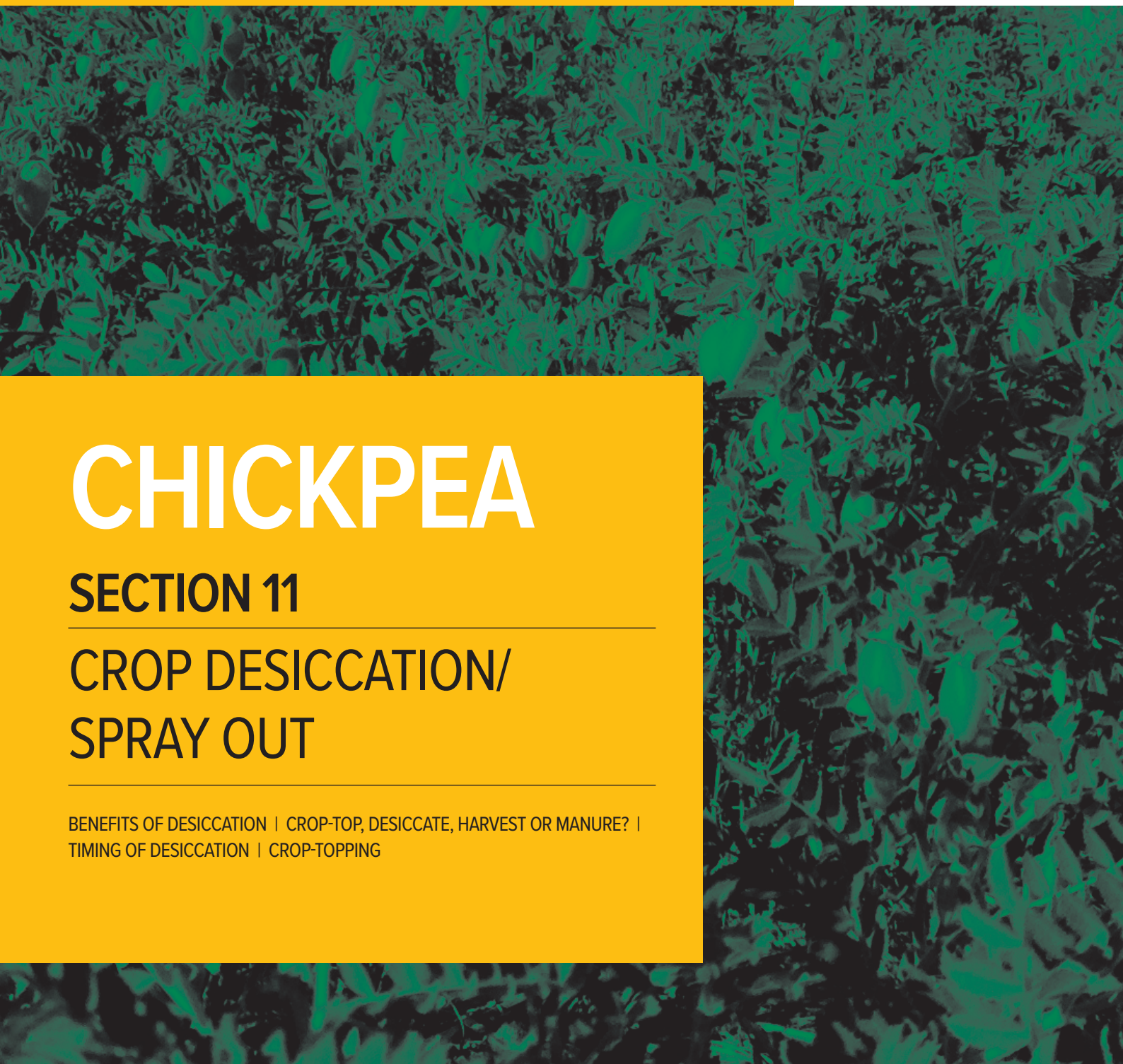

CHICKPEA

SECTION 11

CROP DESICCATION/ SPRAY OUT

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

Crop desiccation/spray out

Key messages

- Chickpeas often mature unevenly and require herbicides to ripen more evenly.
- Desiccation assists production by taking out late weeds (such as thistles) that 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 yellow in colour.
- A high water rate is advised to get coverage, if using a contact herbicide.
- After desiccation, plants become more brittle, so it's 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 seedset, 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 growing chickpeas. Desiccation enables a timely harvest to avoid weather damage. 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 similar to desiccation in timing and benefits to harvest, and 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. It also 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, stops chickpeas reshooting and reflowering after preharvest 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. Chickpeas 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
- podset has been very uneven due to agronomic factors such as low plant population, poor native budworm 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

1 DAFWA. Desi Chickpea Essentials. https://www.agric.wa.gov.au/chickpeas/desi-chickpea-essentials

2 DAFF. Chickpea – harvesting and storage. https://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/chickpeas/harvesting-and-storage

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 theheader; 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 Croptop, desiccate, harvest or manure?

All pulse growers face the decision between croptopping, 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 a traditional and widespread practice for cultivating pulses 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 N2 fixation, N-benefit and to conserve soil moisture

Method: The amount of N2 fixed is linked closely to dry matter (DM) production of the legume, therefore 'manure' the weed-free pulse close to its maximum DM.

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.

Option 2

Management: crop topping/desiccation followed by grain harvest

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

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 seedset in all weedy situations, including herbicide resistance. It uses the conventional approach of grain harvest, plus croptopping/desiccation at the critical growth stage of the weed.

3 Pulse Australia. (2007). Chickpea harvest and seed storage. www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf

Timing is critical – it depends on the pulse variety reaching physiological maturity at or before the time of croptopping/desiccation. Most pulse varieties (chickpeas, lupins and kaspa field peas) are unsuitable, as they are too late and lose too much grain yield. [4]

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 that growers and agronomists are confronted with 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 (when seeds are below 35% moisture content). The best guide at present 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 are 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. when the yellow colouring is moving from the 'beak' down through the seed; and
- the bottom 75% of pods should 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) (Figure 1).

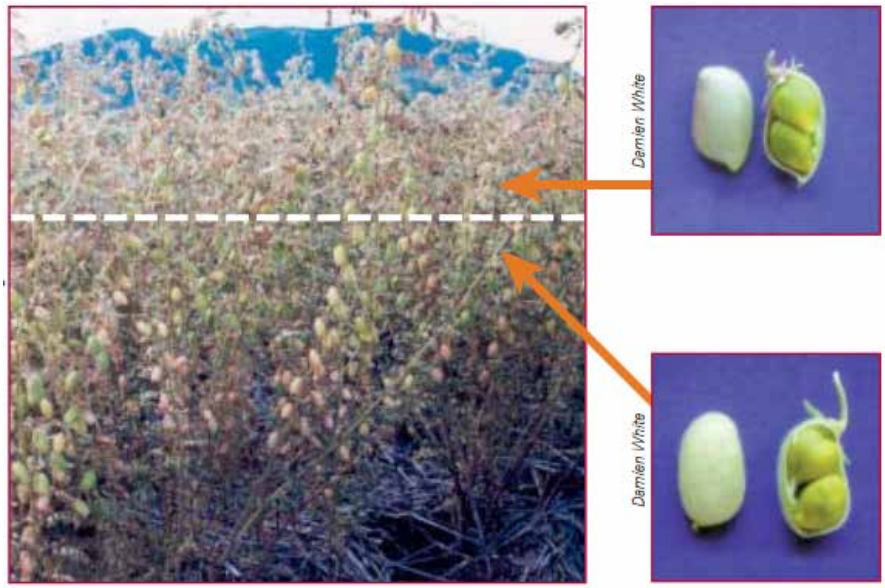

Figure 1: *Chickpea seeds mature progressively from the bottom to the top of the plant.*

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 chickpeas is when the vast majority of seeds have reached physiological maturity; i.e. 90–95%

4 Armstrong E. GRDC, (2015). Weigh up the risks, benefits of pulse harvest. Ground cover issue 115 – Profitable pulses and pastures. 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

of the crop. Inspect the seeds within the upper 20% of pods on each main fruiting branch (Figure 2).

Figure 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—normally when the pod wall begins to yellow The Western Australian recommendation for physiological maturity is 'when the pod wall begins to yellow' (Figure 3, right).

Figure 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 (Figure 4). This is usually too late for the control of ryegrass survivors. [5]

Figure 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 to 50 days depending on levels of flower abortion and the impact of moisture stress on the plant. Causes of flower abortion and poor podset 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 (podset) is ~6 days. After podset, 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.

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 due to the effects of higher temperatures and varying degrees of moisture stress on the plant. The problem faced by agronomists and growers 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—see Figure 4), the upper 30% of pods on each fruiting branch are still at 30–40% moisture content and in varying stages approaching physiological maturity. [6]

5 Pulse Australia. Australian Pulse Bulletin: Desiccation and croptopping in pulses PA 2010 #14. http://www.pulseaus.com.au/growing-pulses/publications/desiccation-and-croptopping

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

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).

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. For chickpea desiccation: Roundup PowerMAX® at 0.68 to 1.8 L/ha.
5. For additional weed and chickpea desiccation: Roundup MAX® at 0.5 to 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 lists options available to growers for desiccating chickpeas.

7 Pulse Australia. (2007). Chickpea harvest and seed storage. www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf

Table 2: *The following table details the registered herbicides for use when croptopping or desiccating pulses. It is imperative that only registered products are used at label rates. Exceeding maximum label rates will lead to the detection of chemical residues in excess of the allowable Maximum Residue Level (MRL) jeopardising market access and the future of the Australian grains industry.*

Herbicide	Example trade names	Operation	Crop	Rate	Withholding period
Diquat 200 g/L	Reglone®	Desiccation	Chickpea, faba bean, dry pea, lentil, lupin, mungbean	2 to 3 L/ha	Grazing/stockfeed (GSF): 1 day Harvest: 0 days (lupin, dry pea) 2 days (chickpea, lentil, faba bean)
Paraquat 250 g/L	Gramoxone®	Croptopping	Chickpea, faba bean, field pea, lentil, lupin, vetch	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 480 g/L	Ripper 480®	Croptopping	Faba bean, field pea	360 to 765 mL/ha	GSF: 7 days Harvest: 7 days
		Desiccation	Chickpea, faba bean, field pea, lentil, mungbean	765 mL to 2.025 L/ha	GSF: 7 days Harvest: 7 days
Glyphosate 500 g/L	Touchdown Hi Tech®	Croptopping	Faba bean, field pea	300 to 700 mL/ha	GSF: 7 days Harvest: 7 days
Glyphosate 540 g/L	Roundup PowerMAX®	Croptopping	Faba bean, field pea	320 to 680 mL/ha	GSF: 7 days Harvest: 7 days
		Desiccation	Chickpea, faba bean, field pea, lentil, mungbean	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	Chickpea	5 g + 500 mL to 1.1 L/ha	GSF: 7 days Harvest: 7 days
Saflufenacil	Sharpen	Desiccation	Field pea, faba/ broad bean, chickpea, lentil, lupin	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.

Glyphosate is not registered for seed crops and should not be used in pulses intended for seed production or sprouting.

Source: Pulse Australia

MORE INFORMATION

Paraquat for crop-topping pulses

Stay up to date with APVMA registered products.

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

The major differences between timing of desiccation and croptopping are:

- application timing is different and initiated by different criteria
- herbicides for croptopping and desiccation are not always the same
- herbicide rates for desiccation are higher than that required for croptopping
- croptopping will advance the harvest timing in some pulse crops
- neither desiccation nor croptopping 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 croptop a pulse *seed* crop.

11.4 Croptopping

Croptopping is timed to prevent weed seed-set, not by the crop growth stage. Hence, croptopping is generally not possible in chickpea, as they are too late in maturing. Croptopping chickpeas can result in discoloured cotyledons (kernel) and seed coats, leading to rejection at delivery and/or severe downgrading. Even in other 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 croptopping 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 and Genesis™ 114).
- When croptopped at the recommended stage, yields were 69–86% of the untreated control (31–14% yield loss). When croptopped 2 weeks after the optimum stage for ryegrass, yields were 92–114% of the untreated control. When croptopping was 3 weeks ahead of the recommended ryegrass stage, yields were 17–48% of the untreated control (83–52% yield loss). [9]

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 (30 Oct.)	Plus 2 weeks (12 Nov.)		Minus 3 weeks (9 Oct.)	Recommended (30 Oct.)	Plus 2 weeks (12 Nov.)
Almaz(þ)	1.18	19	83	92	27.4	91	92	91
PBA Slasher(þ)	1.96	30	70	99	15.5	87	84	100
PBA HatTrick(þ)	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(þ)	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

8 Pulse Australia. Australian Pulse Bulletin: Desiccation and croptopping in pulses PA 2010 #14. http://www.pulseaus.com.au/growing-pulses/publications/desiccation-and-croptopping

9 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