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Virus control in chickpea–special considerations

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KEY MESSAGES

1. Chickpea is distinct from other pulses in respect to virus diseases and how viruses spread in crops.
2. Aphicide sprays and some other control strategies that are effective in other pulses are not warranted for chickpea.
3. At present, the best control options for chickpea are the current *best agronomic practices*: retaining standing stubble, using optimal sowing rates and times, and controlling in-crop and fallow weeds.

Control of viruses in pulses

Pulse crops are susceptible to many kinds of plant viruses that can reduce yield and grain quality. Occurrences of viruses are sporadic and dependent on seasonal conditions, but severe epidemics can impact on income or even cropping options. For example, epidemics in some areas of northern New South Wales (NSW) in the early 1990s reduced growers' acceptance of chickpeas.

No pulse cultivars are immune to all viruses and there is no cure once plants become infected. However, losses can often be reduced by a combination of preventative strategies, i.e. integrated disease management (IDM). Strategies may vary with virus species, pulse species, local environment, and seasonal conditions. Benefits in terms of reduced disease need to be weighed against added costs in terms of money, labour, optimisation of yield in average seasons, and effects of farming systems and environment.

Comprehensive IDM packages have been developed for *Cucumber mosaic virus* (**CMV**) and *Bean yellow mosaic virus* in narrow-leaf lupins in Western Australia (WA). These are the result of many years of local field experimentation as well as published information. Field experiments in WA have also included CMV in chickpea and *Pea seed-borne mosaic virus* in field pea. General recommendations that do not distinguish between pulse species have also appeared in Pulse Australia Bulletins, Grains Research and Development Corporation (GRDC) Updates, and State Department publications and websites (see 'Further information', below). The general recommendations have been based mainly on the WA work and overseas experience with analogous problems.

Virus problems in chickpea are distinct in several respects from those in other pulses. This means that control strategies need to be decided on separately.

Recommendations in this article are based mainly on results for chickpea in northern New South Wales (NSW), but should assist with decisions elsewhere in Australia.

Viruses that damage chickpea

Viruses that infect chickpea naturally have been identified in northern NSW and Queensland (Qld) since the early 1990s. There are at least fourteen species of virus plus a virus-like phytoplasma—more than for other pulses. All are spread by insect vectors that have airborne life stages. The virus species can be divided into four groups in order of importance:

1) A group of viruses called **luteoviruses** that are transmitted by aphids persistently*;
2) viruses, mainly **CMV** and *Alfalfa mosaic virus* (**AMV**), transmitted by aphids non-persistently*;
3) viruses and virus-like phytoplasmas transmitted by leafhoppers persistently;
4) viruses transmitted by thrips persistently or in mechanically infective pollen carried by thrips.

*Persistent and non-persistent transmission are described below under 'Spread of viruses in chickpea'.

Luteoviruses including *Bean leafroll virus* (BLRV), *Soybean dwarf virus* (SbDV) syn. Subterranean clover redleaf virus, and *Beet western yellows virus* (BWYV)-like viruses have been very damaging in northern NSW, and at least one of them (BWYV) is reported to be an emerging problem in southern states and WA. **AMV** and **CMV** are both damaging but less so individually than luteoviruses collectively. Leafhopper and thrips-transmitted viruses have not reached damaging incidences in commercial crops, but often account for virus-like symptoms in seasons of low overall incidence and are a concern in small experimental plots. Control strategies discussed below deal with the most damaging viruses, namely luteoviruses, AMV, and CMV, but general considerations are the same for other aphid-transmitted viruses.

In northern NSW, viruses caused particularly severe and widespread damage in 1992 and 1995. Damage that was localised but still significant has occurred in most seasons since 1985.

Virus symptoms in chickpea are generally more severe than in other pulses and are commonly lethal. They appear in shoot tips initially, rather than lower leaves as in the case of root diseases. Symptoms common to all groups of viruses in chickpea include foliar yellowing of kabuli type cultivars, reddening or yellowing of desi cultivars, stunting, bunching, and premature death. Additional symptom types include phloem browning (revealed by a shallow cut at the collar) for luteoviruses, shoot tip necrosis for AMV, and bushy stunting and plant persistence for CMV, but none of these are diagnostic. Laboratory tests or field kits are required to confirm and distinguish viruses in individual plants.

Spread of viruses in chickpea

Chickpea is distinct from other pulses, particularly lentil, and narrow-leaf lupin, in that it is colonised poorly by aphids. Viruses in chickpea are spread mainly by migrant aphids that fly in from outside crops but do not stay long or reproduce. The footprint of migrant aphids is scattered infection points–either single plants or small groups where an aphid probes briefly or feeds on the intermeshed foliage of 1-3 plants (Fig. 1) before flying off or dying. Occurrence of many infection points leads to major damage (Fig. 2). In contrast, pulses that can be colonised are afflicted not only by migrants, but also by walking and flying populations of aphids generated within crops. Virus disease in colonisable pulses is often seen as diseased patches of plants or lengths of row traversed by colonising aphids, with severity greatest in the first-infected plants at the centre. Patches of more than a few diseased plants are unusual in chickpea, except around colonisable broadleaf weeds.

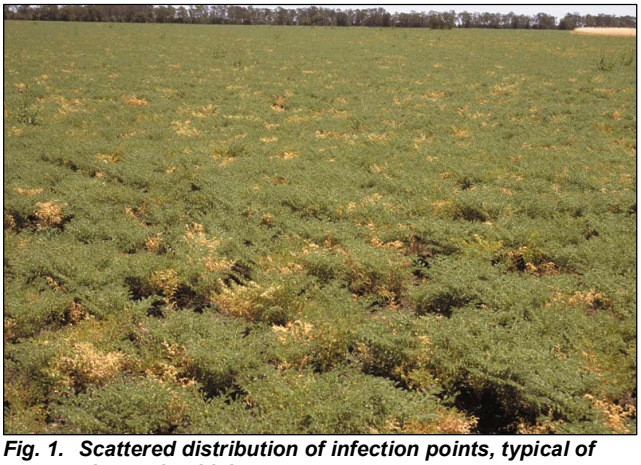

Fig. 1. Scattered distribution of infection points, typical of viruses in chickpea crops

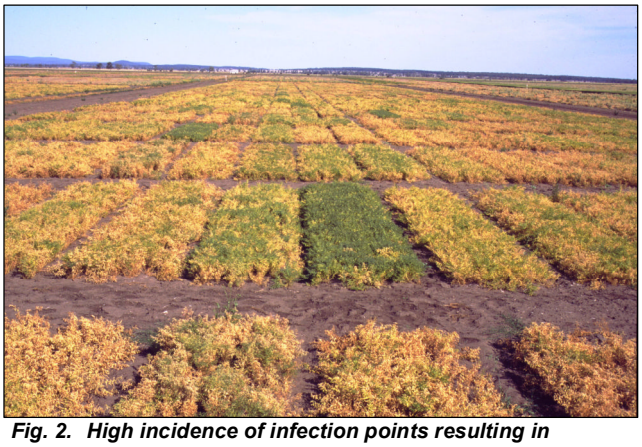

Fig. 2. High incidence of infection points resulting in premature death at Narrabri, northern NSW, in 1995

Nonpersistently transmitted viruses including **AMV** and **CMV** are acquired by migrant aphids that probe briefly or feed in chickpea crops or nearby sources. The in-crop sources include chickpea plants or broadleaf weeds that become infected early via aphids or infected seed. The nearby sources include legumes in pastures and broadleaf weeds including self-sown pulses along waterways, roads, and fences. Transmission and loss of further infectiveness occur at the first and possibly second plant probed or fed on after acquisition.

Luteoviruses, which are transmitted persistently, are likely to be acquired from distant sources or colonisable weeds inside chickpea crops. Acquisition of luteoviruses requires feeding of around 1-2 hours, followed by a non-infective latent period of 12-24 hours. Aphids stay this long in colonisable pulses but probably not in weed-free chickpea crops. Aphids that have acquired luteoviruses may transmit to a number of chickpea plants if they feed for 5-10 minutes or longer on each plant.

Control strategies for chickpea

In selecting control strategies for IDM for chickpea, farmers should aim to control luteoviruses, AMV, and CMV collectively, in preference to having a separate strategy for each virus. It is usually impractical to determine which virus is damaging a crop because extensive and preferably repeated sampling are required, and combinations and mixed infections with different viruses are common. Furthermore, current season diagnosis has not been able to predict the relative importance of individual viruses in following seasons.

Based on special considerations for chickpea described above, strategies often recommended for pulses are evaluated in Table 1. The first category, 'generally warranted', constitutes *best agronomic practices*. This is the most practical approach for chickpea. Reducing virus is an incentive to adopt these practices. The second category, 'benefits possible', should be considered based on local or regional experience. Strategies in the third category, 'not beneficial' (aphid monitoring, spraying, and sowing earlier or later than recommended), should not be recommended unless new experimental evidence becomes available to support their efficacy.

Prospects of better control

Current control options are limited by impracticality (apart from *best agronomic practices*), limited effectiveness, or both. There are three priority areas for research for improving control:

1) identifying the aphid species that spread viruses in chickpea, particularly in northern NSW and Qld which have the largest areas of chickpea;

2) using information on aphids to develop screening methods and identify new sources of resistance

3) characterising broad-spectrum virus resistance of chickpea cv. Gully and combining it with resistance to foliar diseases (ascochyta, botrytis).

Fig 2. shows the survival of cv. Gully (three green plots) under high virus disease pressure in 1995.

Table 1. Evaluation of strategies to control viruses in chickpea

Strategy	How it works	Reservations for chickpea
Generally warranted		
Retain standing stubble	Deters migrant aphids from landing	Best agronomic practice–no reservations
Optimal seeding rate and sowing time	Closes canopy early, lessens aphid attraction to plants next to bare soil	Best agronomic practice–no reservations
Control in-crop and fallow weeds	Removes in-crop and nearby sources of infection	Best agronomic practice–no reservations
Net benefits possible in some cases (considering cost, efficacy, and agronomy)		
Virus test seed, reject infected stocks	Removes in-crop source of infection by AMV and CMV	Benefit likely in WA where CMV is important, less likely elsewhere Benefit not demonstrated for AMV Plants infected through seed are overgrown due to severity in chickpea Few colonising aphids, less secondary spread than in other pulses
Reject seed from symptomatic crop	As for virus test seed above	As for virus test seed above Northern breeding program experience suggests no carry over or build up of seed-borne viruses in chickpea, even after major virus infestations
Control extraneous weeds	Removes adjacent source of aphids and virus, particularly for AMV and CMV (non-persistent)	Often impractical—requires well-managed cover with non-host (crop or pasture) Benefit limited mostly to crop margins where low-flying aphids transmit to the first plants they probe but then lose non-persistent viruses
Distance from lucerne	Perennial host that harbours legume aphids and viruses, especially AMV and the luteovirus BLRV	Benefit likely, but no experimental data on minimum distance
Narrow row space, high seeding rate	Closes canopy early, more overgrowth of infected plants	Soil moisture use, capacity of machinery to handle stubble may be overriding considerations, as well as cost of extra seed
cv. Gully	Reduced infection incidence (luteoviruses, AMV, CMV)	Resistance is partial—still damaged by heavy disease pressure Very susceptible to fungal foliar diseases, especially ascochyta blight; additional fungicide sprays needed
Not beneficial		
Monitoring and forecasting aphids	Decision support for spraying aphids	Little or no colonisation of chickpea No effective response for high numbers of migrant aphids
Aphicide sprays	Stops colonisation by aphids Stops in-crop acquisition and spread of luteoviruses after early infection	No evidence of reduced virus in field experiments No benefit in terms of direct feeding damage by colonising aphids, in contrast to narrow leaf lupins and lentils which are susceptible to feeding damage In-crop acquisition of luteoviruses unlikely providing broadleaf weeds are controlled Sometimes increases spread of non-persistent viruses by flying aphids General concerns—environment, resistance, aphid predators
Sowing early or late	Sowing early promotes canopy closure, deterring aphids Sowing late avoids autumn aphid flights that infect at an early stage	Yield penalty incurred outside of recommended sowing window for a cultivar In chickpea, early sowing increases risk of foliar disease and lodging There is only a low incidence of infection in autumn, and limited secondary spread from early-infected plants that are overgrown when aphids arrive in spring

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