Russian wheat aphid: a new pest of Australian cereal crops

Greg Baker[1], Michael Nash[1], Kym Perry[1], Garry McDonald[2], Julia Severi[2] and Paul Umina[2]

[1]South Australian Research and Development Institute, Waite Campus, Adelaide, SA

***[2]cesar**, 293 Royal Parade, Parkville, VICTORIA*

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Take home messages

- Russian wheat aphid (RWA) is a significant new pest of Australian cereal crops
- The known distribution of RWA is still limited to parts of SA and VIC. Suspect aphids found outside of these areas should be reported to biosecurity authorities in all State jurisdictions.
- RWA is a manageable pest, with a combination of effective cultural, chemical, biological and (longer-term) plant resistance controls available.

Occurrence and current distribution in Australia

Russian wheat aphid (*Diuraphis noxia*, RWA) is one the world's most economically important pests of wheat, barley and other cereal grains. It is native to southern Russia, the Middle East and Central Asia, but since the late 1970s and early 1980s, has rapidly spread to other major grain producing regions in Europe, Africa, North America and South America. Around the world, the distribution of RWA is primarily associated with cereal production regions characterized by warmer, drier climates. It is less prevalent or nonexistent in higher rainfall areas.

RWA had not previously been reported in Australia, prior to 19th May 2016 when it was identified in a wheat paddock near Tarlee in the SA Mid North region. Further surveillance has lead to the detection of the species across much of the eastern half of South Australia and western and central Victoria. At the time of publishing this article RWA had not yet been found in the States of WA, NSW, QLD or Tasmania. A map of the known distribution of RWA is being regularly updated on the Plant Health Australia website: (https://portal.biosecurityportal.org.au/rwa/Documents/Russian%20Wheat%20Aphid%20Distribution%20Map.pdf)

Landholders and agronomists in Victoria and NSW where RWA has not yet been detected are requested to check emerging cereal crops and report any suspect aphids or unusual damage to their State's Exotic Plant Pest Hotline.

Identification and lifecycle

Wingless adults grow up to about 2 mm long and have distinctively short antennae. They are light green in colour and can appear coated with a whitish wax. In addition, there are three other conspicuous features that can help distinguish RWA from other cereal aphids.

• The first is its elongated body. While the bodies of established cereal aphids are often pear or globe-shaped, RWA is longer and more spindle-shaped.

• The second feature is the apparent lack of siphuncles, which are commonly referred to as ‘exhaust pipes’. These structures are notable on most aphids, however they are very difficult to see on RWA with the naked eye.

• The third diagnostic feature is the presence of two caudae or a ‘double tail’ at the rear end of the aphid. This can be seen best when viewing the aphid from a profile perspective.

Adult RWA can be winged (alates) which are also up to 2 mm. However unlike wingless RWA, the antennae are body-length, and the body is generally darker in colour.

Figure 1: The Russian wheat aphid is elongated (left) (Source: Helen De Graff, SARDI) compared with the globular body of the oat aphid (*Rhopalosiphum padi*) (top right), and lacks the siphuncles or ‘exhaust pipe’ structure shown on the corn aphid (*Rhopalosiphum maidis*) (bottom right) (Source: **cesar**)

In its native range, the annual lifecycle of RWA includes sexual and asexual phases. However, like most other introduced aphid pests in Australia, invasive populations of RWA reproduce asexually with females giving birth to live female offspring.

In autumn, aphids may infest wheat or barley seedlings soon after emergence, usually from wingless aphids walking off nearby senescing hosts. Aphids require actively growing plants for development; populations start to increase from tillering and stem elongation. Aphids regularly move by walking among leaves, tillers and plants, so that the percentage of infested plants increases during the crop cycle. Population growth becomes most rapid from booting onwards. Early in the crop cycle, the vast majority of aphids are wingless. Later in the crop cycle as aphid population density increases, the

proportion of winged aphids increases and may reach high levels prior to ripening; at this stage, aphids emigrate in search of alternative summer hosts. Alate RWA are weak flyers, but are thought to travel on wind currents efficiently enough for some aphids to locate isolated host plants.

RWA are able to survive under a wide range of temperatures and may perform better at lower temperatures than the other cereal aphids. The optimum temperature range is considered to be around 18-21°C. RWA does not do well under higher temperatures (>25°C). Under laboratory conditions, generation time ranges from approx. 20 days at 10°C, and 9 days at 20°C.

Like other aphids, populations of RWA are strongly regulated by environmental conditions. Survival of aphids outside the shelter of leaf rolls is affected by exposure to rainfall, drying winds, and predators and parasitoids. Rainfall washes aphids from upper leaves, and heavy rainfall may cause mortality of up to half of the population. Populations are generally reduced by cold and wet conditions.

Host range and plant damage

The host range of RWA includes more than 140 species of cultivated and wild plants within the family Graminae (grasses). These include wheat, barley, triticale, rye, oats, pasture grasses and wild genera including *Poa*, *Bromus*, *Hordeum*, *Lolium*, *Phalaris* and others. Wheat and barley are most susceptible, while triticale, rye and oats are less susceptible. This wide availability of host plants partly explains why RWA had a history of successfully invading new regions. *Bromus* grasses, particularly perennial species, are important to RWA survival and population build-up. In South Africa, native grasses apparently do not host RWA.

Unlike other cereal aphids that damage plants by removing nutrients, RWA also injects salivary toxins during feeding that cause rapid, systemic phytotoxic effects on plants, resulting in acute plant symptoms and potentially significant yield losses. Even a few aphids can cause plant damage symptoms to appear as early as 7 days after infestation. These include:

- Curled, rolled or hollow tube leaves
- Discoloured leaves
- White and purple streaks on leaves
- Stunted growth or flattened appearance
- Hooked-shaped head growth from awns trapped in curling flag leaf
- Bleached heads

Figure 2: Streaking on wheat leaf (left) (Source: Michael Nash, SARDI) and flattened growth from RWA feeding (right) (Source: Kym Perry, SARDI)

Aphids feed in dense colonies, typically at the base and sheath of younger leaves and within leaves curled by their feeding. Aphids prefer the newest leaves of plants, and are often found on the last two leaves unfurled. At high densities they can be found on any foliar parts.

The salivary toxins injected by RWA during feeding damages plant chloroplasts, resulting in reduced photosynthetic ability, delayed leaf initiation and tillering, reduced numbers of fertile tillers, shoot and root biomass, grains per ear and grain weight. Yield impacts are determined by the percentage of infested tillers and plants and crop development stage. Heavy infestations during early growth can cause serious damage (under USA conditions). From early booting to soft dough stage, feeding on upper leaves, in the leaf sheath and next to the developing head, can cause direct yield losses. In wheat and barley, damaged leaf tissue does not recover. If aphids are controlled, new growth proceeds normally (new root and shoots are unaffected) and plants may recover unless excessively stressed. After soft dough stage, further impact is minimal.

Management

The GRDC FITE strategy is recommended for RWA aphid control:

Find - look for aphids and the characteristic plant symptoms on cereal crops and grasses.

Aphids may infest crops during any stage of crop development, from early establishment to maturating flag leaf. Check crops regularly following seedling emergence. RWA are often difficult to find when at low numbers so check for the characteristic and distinctive leaf streaking and rolling. Infestations often begin along crop edges, usually on the windward side or adjacent to infested grasses. RWA also commonly occurs in areas of paddocks where plants are sparse, on sandy rises or adjacent to bare ground. After initial infestation, aphids can rapidly spread across a paddock.

SARDI entomologists have observed weather conditions may affect distribution of aphids on plants. During inclement weather RWA on volunteer cereals (GS5 to GS8) were only found on lower leaves and in their leaf sheaths, but were more broadly distributed over plants during fine weather.

Identify – positively identify RWA, in consultation with a specialist where necessary.

Threshold approach – consider international thresholds for control, factoring crop growth stage and potential yield losses.

Chemical control of RWA is effective, however decisions on the need for foliar treatments are based on the proportion of seedlings or tillers infested. Threshold guidelines (ET) recommended in the USA vary somewhat between regions, but for early season growth we currently recommend an ET of 20% seedlings infested up to the start of tillering, and 10% plants infested thereafter. Local research will be required to test, and if required, to modify these thresholds for Australian crop conditions.

Due to the cryptic feeding habits of RWA, complete coverage and use of an insecticide with fumigant or systemic activity is required. An APVMA permit (PER81133) has been issued for the use of products containing 500 g/L chlorpyrifos and 500 g/kg pirimicarb to control RWA in cereals. The results of RWA spray trials with a range of products and rates conducted in SA in July will be presented at the Update. To maximize coverage, which is essential for RWA control, we advise using a high water volume (100 L/ha), a non-ionic surfactant and nozzle pressure to produce medium-sized droplets (e.g. 2.5-3.0 bar pressure for flat fan nozzles).

Enact - enact an appropriate management strategy that where possible encourages beneficial insects

RWA is attacked by a range of natural enemies in other parts of the world, many of which also attack other aphids. Of these, groups that commonly occur in Australia include the minute parasitoid wasps *Aphidius colemani*, *A. ervi*, *Diaeretiella rapae* and generalist predators including ladybird beetles (e.g. *Coccinella* spp., *Hippodamia* spp.), lacewings (*Chrysopa* spp.), damsel bug (*Nabis* sp.), hoverflies (*Syrphus* spp.), and also entomopathogenic fungi. We have already observed mummified and fungus diseased RWA. If spraying is warranted, aim to use the softer chemistry to maintain predators and beneficial populations.

We do not advocate the use of prophylactic sprays for managing invading or dispersing RWA. These sprays can create secondary pest outbreaks (such as other cereal aphids or armyworms) by removing beneficial species. Invading (winged) RWA are expected to be more prominent later in the season.

Non-chemical cultural controls options include eliminating refuge volunteer cereals and grasses in fallows and other areas during summer and autumn; later planting of winter cereals to delay and reduce early aphid infestation; agronomic practices to promote crop vigour and dense canopy growth, which inhibit RWA populations and reduces their impact on the crop.

RWA resistant wheat and barley germplasm is available overseas, and some has already been introgressed into certain Australian cereal lines. GRDC and commercial breeding companies are initiating screening and breeding programs to provide industry with resistant/tolerant cultivars in future (anticipated to take 5-6 years).

Acknowledgements

Plant Health Australia RWA national technical group.

Useful resources

Crop Aphids: The back pocket guide. GRDC (https://grdc.com.au/Resources/Bookshop/2015/02/Crop-Aphids-Back-Pocket-Guide)

GRDC Paddock Practices - Monitor RWA numbers closely over winter (https://grdc.com.au/Media-Centre/GRDC-E-Newsletters/Paddock-Practices/Monitor-RWA-numbers-closely-over-winter)

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Plant Health Australia – Threat Specific Contingency Plan (http://www.planthealthaustralia.com.au/wp-content/uploads/2013/01/Russian-wheat-aphid-CP-2012.pdf)

Contact details

Greg Baker, Michael Nash or Kym Perry
SARDI
Waite Building, Waite Rd., Urrbrae, S. AUST.
08 8303 9536
bill.kimber@sa.gov.au
@PestFactsSARDI

Paul Umina, Garry McDonald or Julia Severi
cesar
293 Royal Parade, Parkville, VICTORIA
03 9349 4723
pestfacts@cesaraustralia.com
@PestFactscesar