Russian wheat aphid action threshold calculator: instructions for use

GRDC Investment UOA1805-018RTX

What has been developed?

A dataset compiled during the investment UOA1805-018RTX '*Russian wheat aphid risk assessment and regional thresholds*' has supported development of an action threshold for control of Russian wheat aphid (RWA). The calculator indicates if the economic injury level is likely to be exceeded between GS30 (start of stem elongation) and GS50 (start of head emergence) and, therefore, if control should be actioned.

The basis of this threshold

Market prices, management costs, and time between crop inspection and pest control should all factor into deciding the need for taking action control a pest population.

The 'Economic Injury Level' (EIL) is reached when the cost of pest control equals the value of yield loss resulting from feeding damage. If pest densities surpass this level, losses will be greater than the cost of control. In this case, aphid control action is the most economically viable option. If the relationship between pest population density and damage potential is understood it is possible to predict if a pest population is likely to exceed the Economic Injury Level and if action is required (an action threshold).

Due to the delay between crop inspection and pest control, a predictive action threshold is preferred in Integrated Pest Management, as it will factor in the rate of change in aphid pressure during the intervening period.

Most action threshold rules in the grains industry have been set based on field observations and estimation, rather than by collecting data experimentally to test relationships between damage, pest numbers and impact. Recent research into the Russian wheat aphid has used an experimental approach to collect this type of data.

It is important to emphasise that observations during this research investigation have shown that in low green bridge risk years (dry, hot summer and autumn), infestations reaching economically damaging levels are unlikely. To collect data that would support development of an action threshold trial sites were set up across regions affected by RWA and using several host types and varieties. This allowed the research team to collect a dataset across the area where RWA is currently known to occur, which would lead to regionally relevant management recommendations.

This data was based on three RWA susceptible crops: barley, wheat, durum wheat. Data was collected during the winter cereal growing season across two years – 2018 and 2019.

The trial work allowed the research team to:

1. Identify the best in-field indicator for aphid pressure and predicted yield loss;
2. Quantify the relationship between this indicator and yield loss; and
3. Quantify aphid growth rates.

Key findings that have been used to form the basis of the Australian intervention rule of RWA are below.

- The best metric for predicting yield loss is percentage of tillers with RWA.
- On average, **for each percent of tillers with RWA there is 0.28 % yield loss**.
- On average, the RWA population is expected to double every 35 days (see table 1).

The maximum percentage of tillers with RWA is usually reached between GS40 (start of booting) – GS50. This is the case for all cereals susceptible to RWA. Predation and parasitism would also be expected to play a role in controlling the aphid population growth rate.

Experimental data was not sufficient to develop an action threshold for infestations detected <GS30.
Growers may choose to control infestations at an earlier growth stage, however the cost-benefit cannot be estimated based on current knowledge.

A control decision should be made based on RWA population densities between GS30 and GS50. Monitoring at GS30 will allow prediction of the aphid density at GS50, and therefore if action is need during that time period.

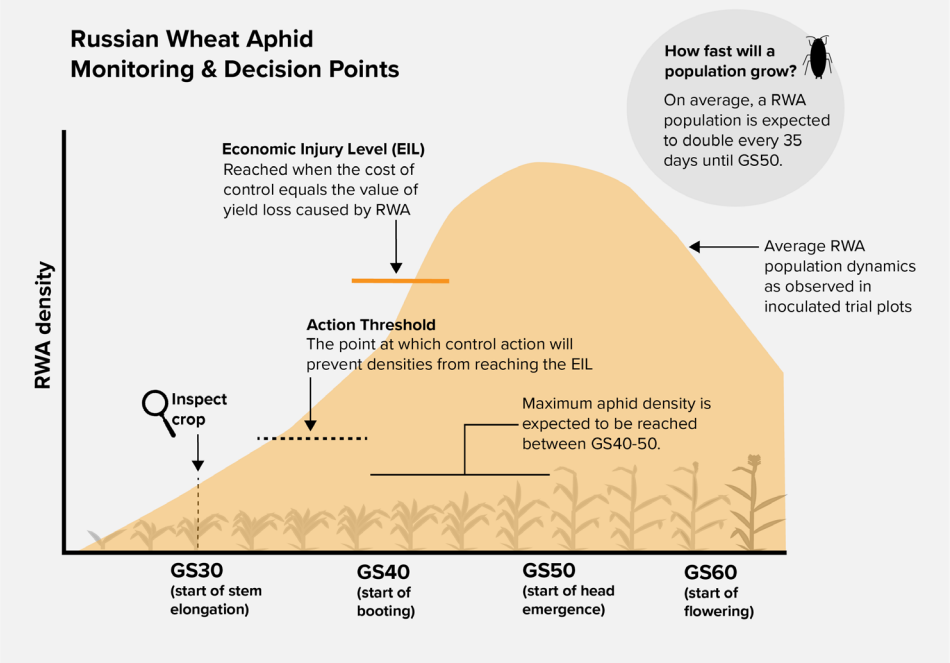


Fig 1. Schematic indicating important considerations when using action threshold advice for RWA

Determining the action threshold

The action threshold developed for RWA is 'dynamic'. This means that yield potential, market value of the crop, and cost of control are factored into each season's calculation.

At GS30 determine the RWA Action Threshold using the online RWA GS30 Threshold Calculator.

You will need to have estimations for cost of control ($/Ha), cereal market price ($/t), yield potential (t/ha), and days until GS50 (start of head emergence).

Cost of control includes cost of the product as well as cost of application.

This calculator will indicate the action threshold at which control should be taken in order to prevent an increasing RWA population from reaching the economic injury level.

Monitoring at GS30 (start of stem elongation)

1. At GS30 count the number of tillers in 50 cm row lengths (choose at least 5 areas of the paddock) (e.g. 433 tillers counted).
2. In the same row lengths count the number of tillers with symptoms (e.g. 43 tillers with symptoms). At this stage you will have 10% (0.1) tillers with symptoms (43/433).
3. In or around each of the five areas check 20 tillers with symptoms for the presence of RWA*, total 100 tillers to be checked. (e.g. results = 54 tillers with symptoms and RWA). At this stage you have 54% (0.54) tillers with symptoms and RWA.
4. Multiply the percentage of tillers with symptoms with the percentage of symptomatic tillers that are hosting aphids. This will result in the percentage of tillers with RWA.

E.g. 0.1 x 0.54 = 0.054 = 5.4% of tillers with RWA in the paddock at the time of observation.

**Check at the base of rolled tillers to confirm presence of aphids (RWA is found almost exclusively on tillers with symptoms).*

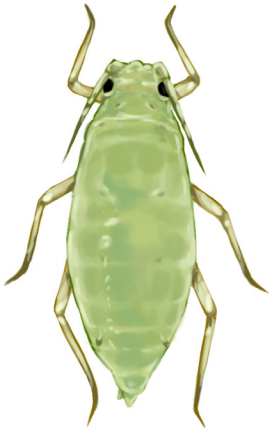
You can use the online calculator or a doubling rate of 35 days to predict if aphid density will reach the economic injury level by GS50.

Table 1. Expected increase in RWA density after monitoring at the start of stem elongation (GS30)

Day	% Tillers with RWA
0	"x"
20	1.5X
35	2X
46	2.5X
55	3X

Table 2. Reference table for estimating time between GS30 and GS50

GC30-50	Grain growing region
35-45 days	Mallee, Central NSW, Upper EP
45-60 days	Yorke, Mid North, Wimmera, Southern Victoria
60-80 days	Tasmania



Leaf streaking and rolling is a symptom of RWA feeding (left). RWA have spindle shaped bodies and can be up to 2mm in length (right). Photo credit: Dr Maarten van Helden, SARDI. Graphic: Dr Elia Pirtle, **cesar**.

Further information

The research has shown that the plant growth stage at which RWA establishes has a strong effect on yield loss potential. If establishment occurs after GS30 there is low aphid growth potential. Even when aphid establishment occurs at early growth stages, large yield losses can be mitigated through monitoring and timely control.

The dataset used for determining intervention rule was not sufficient to confirm that infestations eliminated before stem elongation (<GS30) do not cause any yield loss, but overseas research suggests plants can compensate quite well for early attacks.

Wetter and cooler summers or early breaks will increase the risk of early season infestation by RWA in mainland grain growing areas.

This action threshold can be applied to winter and spring cereal varieties.

*This research initiative is a GRDC investment that seeks to deliver information on Russian Wheat Aphid management for grain growers. This project is being undertaken by the South Australian Research & Development Institute (SARDI) and **cesar**.*