Section IV: Cereal Crop Pests

RUSSIAN WHEAT APHID INFESTATIONS AT SOFT DOUGH STAGE REDUCE YIELD OF SPRING BARLEY

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The objectives of these studies were two-fold: to quantify the relationship between Russian wheat aphid intensity and yield loss in spring planted barley and to compute economic injury levels.

Methods

Two artificial infestation experiments were conducted within small field plots of 'Steptoe' barley by encaging and infesting individual barley plants with 1st and 2nd stage RWA nymphs from greenhouse colonies. Cages used during Experiment I consisted of vented acrylic cylinders; these were replaced during Experiment II with organdy mesh cylinders.

Treatments were as follows:

TREATMENTS	EXPERIMENT I	EXPERIMENT II
crop growth stage at infestation	2-tiller	soft dough
RWA density per plant	0,1,2,3,4,5,8, 11,14,17,20	0,10,30,50,70,90, 110,130,150,170,200

There were 20 replicates of each density treatment. One-fourth of the replicates (5 cages per treatment) were destructively censused 7-days after infestation to determine cohort establishment losses (i.e., handling mortality and "transplant shock"). Russian wheat aphids in another subset of 5 cages per treatment were destructively censused on day 14 post-infestation. Aphids in the remaining 10 replicates were eliminated with foliar application of dimethoate insecticide on day 14; yield data were measured from these plants at harvest.

Relationships between RWA intensity and crop yield were determined by regression between mean RWA-days per plant and mean plant yield. The former was computed as

$$[(RWA_7 + RWA_{14})/2] * 7$$

where RWA_7 and RWA_{14} are mean Russian wheat aphid density at the 7 and 14-day (mean density per 5 cages each date) and 7 is the interval in days between each census. Yield data were standardized in terms of uninfested plants.

Results

1. Vented acrylic cages used during Experiment I caused severe plant injury by excessive heating under our field conditions; yield data are of dubious quality and no conclusions can be made from Experiment I.

2. Mean establishment losses of RWA cohorts transplanted from the greenhouse to field cages was 27% and 33% for Treatments I and II, respectively, as measured at the 7-day census. Data suggest that failure of cohorts to survive transplanting to field cages is independent of both crop growth stage and infestation density.

3. The relationship between relative plant yield and cumulative RWA-days during the 14-days following the soft dough stage was best described by the statistical model

$$\text{relative yield} = 1.00951\ (\pm\ 0.00591) - 0.00003\ (\pm\ 0.00005) * \text{RWA-days}$$
$$(n=11,\ P=0.0003,\ r^2=0.778)$$

where values in parentheses following intercept and slope terms are standard errors for those values. The slope coefficient designates that there was a yield loss of 0.003% for every RWA-day incurred by plants during the 14 days after the soft dough stage.

4. Preliminary economic injury levels can be computed as

$$EIL = C / Y_p * 0.00003 * V$$

Here EIL is RWA-days per plant at soft dough, C is cost of aphid control ($/acre), Y_p is crop yield potential in the absence of Russian wheat aphid (bu/acre) and V is crop market value ($/bu). Given a yield potential of 60 bu/acre, control costs of $6.50/acre and crop value of $3.00/bu, then the economic injury level for Russian wheat aphid at the soft dough stage is 1204 RWA-days. This EIL corresponds to 86 RWA feeding per plant for 14 days after soft dough. EILs can be computed for any other appropriate combination of values for C, V and Y_p.

Conclusions

The practical significance of these results is they contradict the "common wisdom" which states insecticide application after the soft dough stage never has economic benefit. However, because the magnitude of loss is quite small (0.0003% per RWA-day), RWA infestations in the field likely do not reach the levels necessary to cause economic losses.