Section V.
Cereal Crops Pests

EFFECT OF TILLAGE, CULTIVAR AND CROPPING SYSTEM ON APHID POPULATIONS IN SMALL GRAINS OF CENTRAL WASHINGTON

L.R. Elberson[1], Steve Clement[1] and Frank Young[2]
[1]USDA-ARS, Western Regional Plant Introduction Station and
[2]Land Management and Water Conservation Research Unit
Washington State University
Pullman, Washington 99164-6402
509/335-3609
elberson@mail.wsu.edu

Spring-planted wheat and barley support larger numbers of cereal aphids than fall-planted grains in Washington and Idaho (Elberson & Johnson 1995, Feng et al. 1991, Feng et al. 1992). A requirement to significantly reduce PM-10 emissions in the 7-15 inch rainfall zone of central Washington may result in a significant shift from fall to spring cropping systems under no-till cultivation. Consequently, we are researching the potential increase of aphid problems with these management practices.

Research Objectives

Our main objective is to quantify and contrast cereal aphid populations in large replicated on-farm plots at a Ralston, Washington site over 5 years, thereby providing the first baseline information on the frequency and occurrence of economic aphid populations in this agronomic zone. The primary aphid species that colonize Washington wheat and barley are the English grain aphid (EGA), rose-grass aphid (RGA), greenbug (GB), bird cherry-oat aphid (BCOA), corn leaf aphid (CLA), and the Russian wheat aphid (RWA) (Clement et al. 1990). In addition, aphid populations will be related to action thresholds and the need for insecticide sprays to control economic populations. Our secondary objective is to identify and estimate the number of natural enemies present in the Ralston plots and to evaluate their role in controlling economically damaging populations of grain aphids.

Methods

Survey sites consist of 4 cropping systems:
System 1. Winter wheat - fallow - winter wheat - fallow (soft white, Lewjain)
System 2. Spring wheat - fallow - spring wheat - fallow (soft white, Alpowa)
System 3. Spring wheat - spring wheat - spring wheat - spring wheat (hard red, Butte 86)
System 4. Spring wheat - spring barley - spring wheat - spring barley (Butte 86 & Baroness)

Each cropping system is practiced in 2 plots and each plot is replicated in 4 subplots (8.4 m x 139.4 m).

Field preparation in 1996 included standard cultivation (C) and no-tillage (NT). All plots were planted into no-till cultivation in 1997.

Plots were surveyed on 4 dates (1 and 30 May, 13 June, 2 July) in 1996 and 5 dates in 1997 (6 and 19 May, 10 and 26 June, 10 July). Following methods of Elberson & Johnson (1995), 10 sampling locations per plot were selected by walking a zigzag pattern, stopping every 12-14 m. At each stop 10 tillers were randomly selected within 0.4 m^2 and all aphids were identified and counted.

After a preliminary assessment of natural enemies on 2 July of 1996 showed promise of natural enemy impact, 1997 sampling was expanded to include estimation of aphid predators and parasites. Parasitoid mummies on 100 tillers per subplot were counted and transported to a lab for rearing and identification. Predators within each sampling area (0.4 m^2) were counted and identified as to life stage and species if adult. The survey of predators was not limited to selected tillers due to the mobility of adults.

Crop growth stage was determined using the decimal code devised by Zadoks et al. (1974).

Results

The majority of aphids recorded were RWA and EGA, with other species infrequently observed. RWA populations in 1996, first detected on 30 May, were approaching or had exceeded an economic threshold of 10% infested tillers (Pacific Northwest Insect Control Handbook) by 13 June in `Butte 86' spring wheat under conventional tillage, requiring an application of Lorsban (recommended rate) in these plots on 19 June (Fig. 1). EGA populations were first detected 1 May and increased rapidly after mid-June (Fig. 3). However, by the next sampling date (2 July) the grain had reached a growth stage (soft dough development, Zadoks growth stage 85) tolerant of higher populations and at which insecticide applications are not recommended (Bishop et al. 1986).

RWA populations in 1997 were substantially less than the previous year (Fig. 2). EGA populations in 1997 exceeded counts of 1996 in some plots (Fig. 4), however numbers did not reach economic thresholds until the soft dough development stage as in the previous year.

Aphid predators were first recorded on 10 June in 1997 and parasitoids on 26 June with highest numbers occurring on the last sampling date (Figs. 5-6). Predators and parasitoids were present in all subplots.

Discussion

In 1996, spring wheat supported more RWA and EGA than winter wheat and, in general, conventional tilled plots supported more aphids than no-tilled plots (Figs. 1-2). RWA populations exceeded the economic threshold in `Butte 86' spring wheat under conventional tillage. The RWA populations observed on `Butte 86' under no tillage and 'Alpowa' spring wheat and `Lewjain' winter wheat under conventional tillage remained below levels requiring insecticide applications. EGA populations in spring wheat of 1997 were comparable to those of 1996 (Figs. 3-4. Winter wheat of 1997 supported significantly more EGA than in 1996. During both years EGA densities peaked during grain development.

Parasitoids were identified as *Aphidius avenaphis* (Fitch). Predators were identified in the field as *Hippodamia* spp. and *Coccinella septempunctata*. *A. avenaphis* and *Hippodamia* spp. are endemic species and *C. septempunctata* was introduced as part of the biological control program for RWA. Although numbers of beneficials were relatively low over the entire growing season, counts coincided with EGA population growth and may be an important factor in controlling this aphid species.

References

Bishop, G.W., H.W. Homan and R. Johnston. 1986. Development and control of the English grain aphid on wheat. University of Idaho Cooperative Extension Service Current Information Series No. 778.

Clement, S.L., R.C. Johnson, and K.S. Pike. 1990. Field populations of the Russian wheat aphid (Homoptera: Aphididae) and other cereal aphids on cool-season perennial grass accessions. Journal of Economic Entomology 83:846-849.

Elberson, L.R. and J.B. Johnson. 1995. Population trends and comparison of sampling methods for *Diuraphis noxia* and other cereal aphids (Homoptera: Aphididae) in northern Idaho. Environmental Entomology 24:538-549.

Feng, M.G., J.B. Johnson, and S.E. Halbert. 1991. Natural control of cereal aphids (Homoptera: Aphididae) by entomopathogenic fungi (Zygomycetes: Entomophthorales) and parasitoids (Hymenoptera: Braconidae and Encyrtidae) on irrigated spring wheat in southwestern Idaho. Environmental Entomology 20:1699-1710.

Feng, M.G., J.B. Johnson, R.M. Nowierski, and S.E. Halbert. 1992. Population trends and biological aspects of cereal aphids (Homoptera: Aphididae), and their natural mortality factors on winter wheat in southwestern Idaho. Pan-Pacific Entomologist 68:248-260.

Zadoks, J.C., T.T. Chang, and C.F. Konzak. 1974. A decimal code for the growth stages of cereals. Weed Res. 14: 415-421.

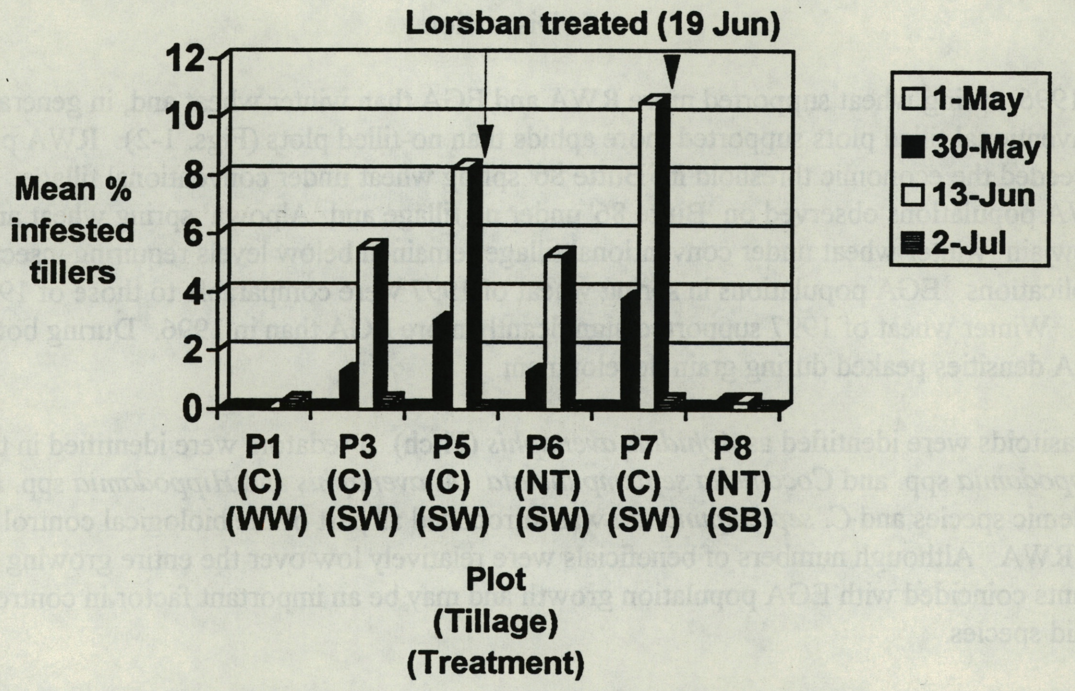

Figure 1. Russian wheat aphid infestations in Ralston plots, 1996.

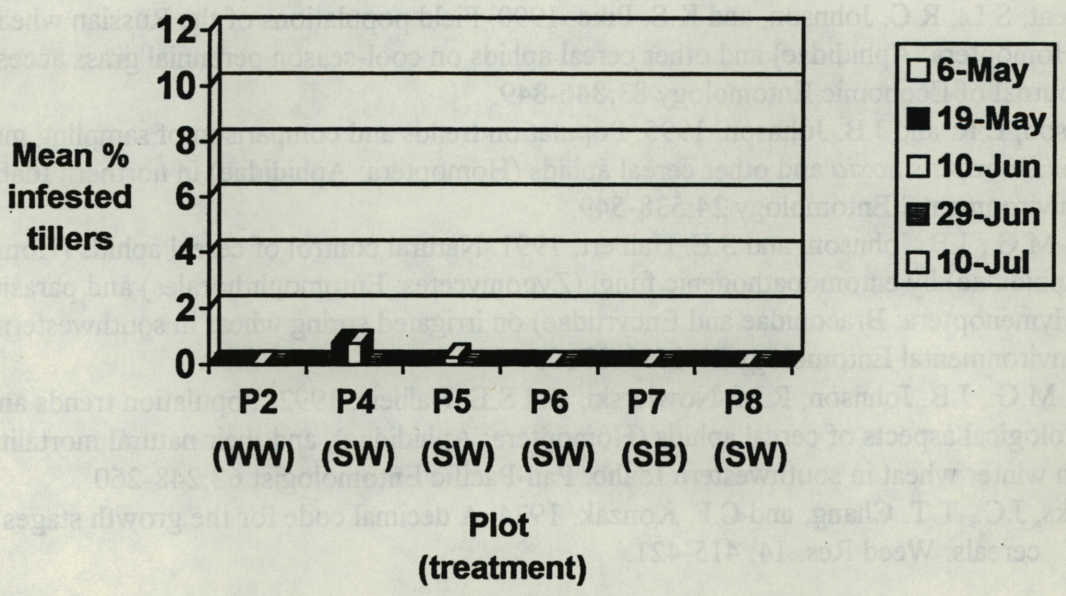

Figure 2. Russian wheat aphid infestations in Ralston no-till plots, 1997.

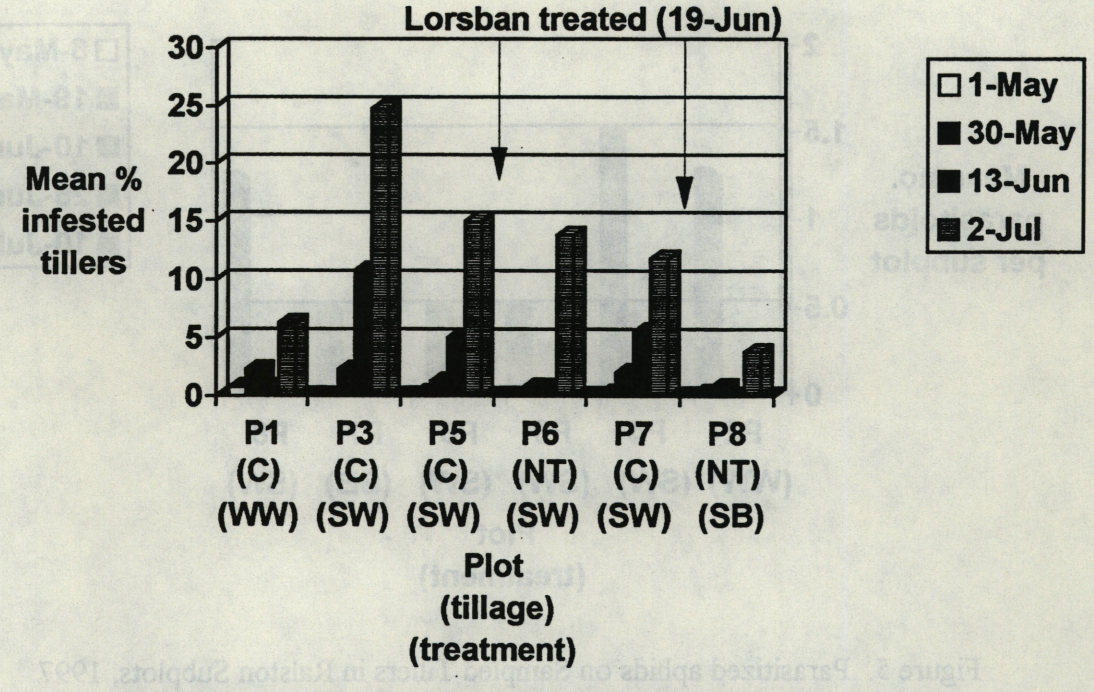

Figure 3. English grain aphid infestations in Ralston Plots, 1996

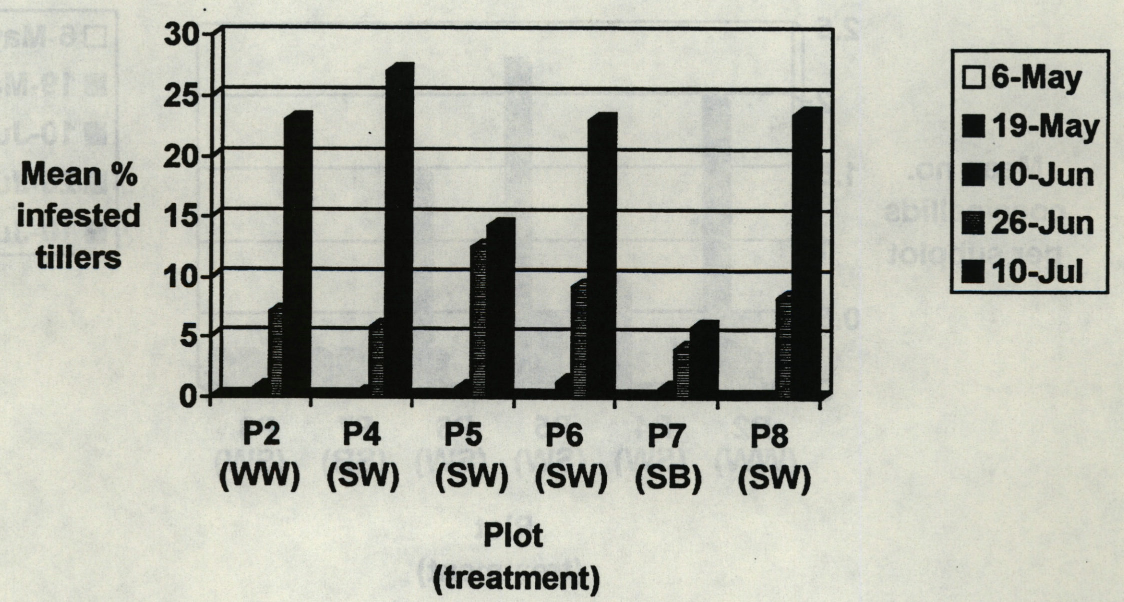

Figure 4. English grain aphid infestations in Ralston Plots, 1997

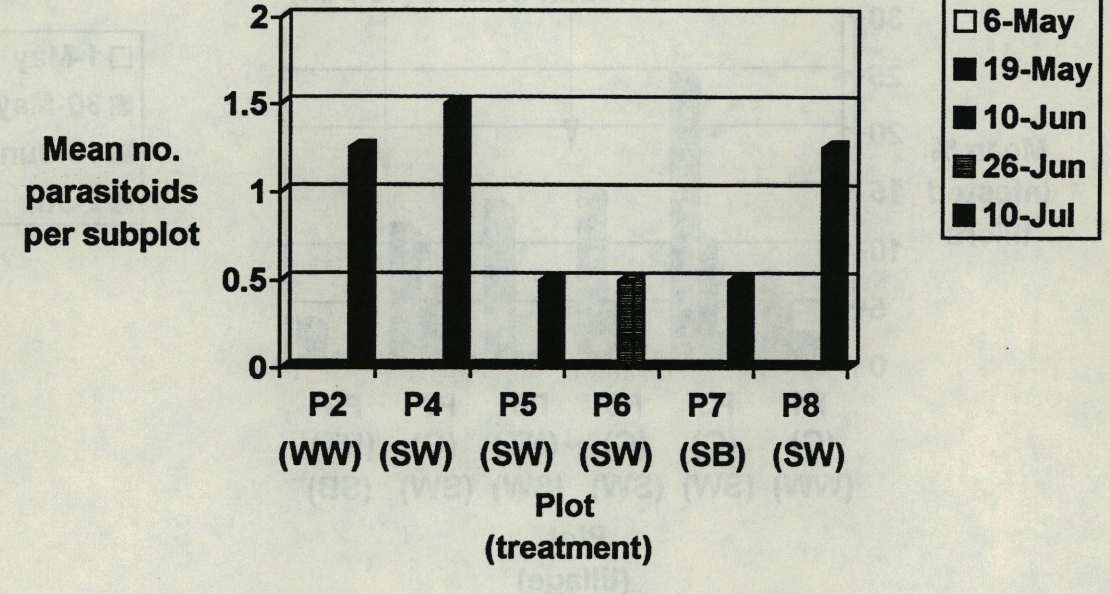

Figure 5. Parasitized aphids on Sampled Tillers in Ralston Subplots, 1997

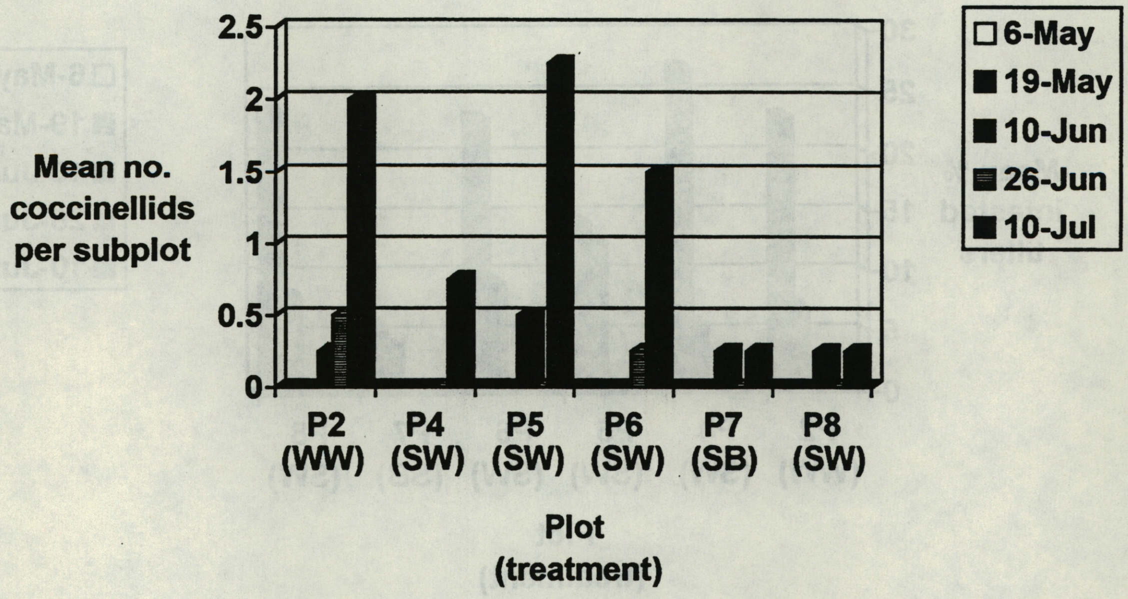

Figure 6. Coccinellid Predators in Ralston Subplot Sampling Locations, 1997