Alternate Hosts of the Russian Wheat Aphid (Homoptera: Aphididae) in Northeastern Colorado

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ABSTRACT A 2-yr survey of 25 grass species in northeastern Colorado showed that crested wheatgrass, *Agropyron cristatum* (L.) Gaertn., and Canada wildrye, *Elymus canadensis* (L.), were dominant hosts of the Russian wheat aphid, *Diuraphis noxia* (Mordvilko). These two grasses served as hosts between the time winter wheat was harvested and planted. Russian wheat aphids showed greater life stage diversity when collected from Canada wildrye compared with any other grass species. Several additional perennial and annual grasses were able to support Russian wheat aphids but less consistently and in lower numbers. Russian wheat aphids were found on a wide range of grass species early in the summer. Thereafter, numbers of Russian wheat aphid hosts decreased as the summer progressed. Total numbers of Russian wheat aphids collected from all grass hosts for 1989 were seven times greater than for 1988. The 1989 survey indicated a more suitable year for Russian wheat aphid migratory flight, host seeking, and survival. Russian wheat aphid suction trap captures corresponded with grass survey data and further verified the differences between the two survey years.

KEY WORDS Insecta, *Diuraphis noxia*, host plants, life stage diversity

THE RUSSIAN WHEAT APHID, *Diuraphis noxia* (Mordvilko) (a pest of winter wheat, *Triticum aestivum* L.) was originally detected near Muleshoe, Tex., in March 1986 (Stoetzel 1987). In Colorado, the cumulative loss in yield reduction and cost of control have been estimated to be $77 million since the 1986 winter wheat crop (Peairs 1990). In northeastern Colorado, the largest dryland wheat production area of the state, winter wheat is normally harvested by July, and next year's crop is planted in late August through September. The most common practice is to fallow land after 1 yr of winter wheat production.

The establishment of volunteer winter wheat after harvest allows Russian wheat aphid numbers to increase rapidly and is a source of infestation for winter wheat planted the following fall (Armstrong & Rudolph 1988). The elimination of volunteer wheat in fallow ground is a necessary cultural practice to prevent fall infestations. The time period between harvest and planting (July–September) is when grass species, either native or introduced for conservation purposes, are suspected of being important alternate hosts of Russian wheat aphids.

In a host suitability study by Kindler & Springer (1989), Russian wheat aphids survived on 47 of 48 cool-season grasses and 18 of 32 warm-season grasses for a 2-wk period. Twelve of the species (eight cool-season, four warm-season) are recommended in conservation reserve plantings by county offices of the Soil Conservation Service, USDA. In an effort to find resistance to the Russian wheat aphid in range grasses, Kindler et al. (1991) conducted a greenhouse experiment and found that *Elytrigia repens* (quackgrass) and two hybrid crosses were resistant to feeding damage by the Russian wheat aphid. These authors suggest that this form of resistance should be used to develop aphid-resistant hybrids for range use. Furthermore, Clement et al. (1990) presented evidence to suggest that accessions of *Festuca arundinacea* Schreb., tall fescue; *Agropyron desertorum* (Fisch. ex Link) Schultes, standard crested wheatgrass; and *Dactylis glomerata* L., orchard grass could support Russian wheat aphid populations between cropping seasons of wheat and barley in the Pacific Northwest.

The objective of our study was to conduct a field survey of grass species to identify which serve as alternate hosts for the Russian wheat aphid between cropping seasons of dryland winter wheat in northeastern Colorado. Life stage diversity of Russian wheat aphids was determined from the different grass species surveyed.

Materials and Methods

Twenty-five grass species were sampled weekly from early August to mid-September near Akron (Washington County), Colo., and near Arriba (Lincoln County), Colo., during 1988. Only the Washington County location was surveyed over the same time period for 1989. Grasses were identified using keys by Ingallis (1988), Johnson & Nichols (1982), and Stubbendieck et al. (1986). Voucher specimens from all grass species collected were deposited at the USDA–ARS Central Great Plains Research Station, Akron, Colo. A list of surveyed grasses is shown in Table 1.

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Table 1. Common and scientific names of grasses sampled on a weekly basis during the summers of 1988 and 1989

Common name[a]	Scientific name
Annuals	
Barnyardgrass	*Echinochloa crusgalli* (L.) Beauv.
Downy brome	*Bromus tectorum* L.
Field sandbur	*Cenchrus pauciflorus* Benth.
Green foxtail	*Setaria viridis* L.
Prairie threeawn	*Aristida oligantha* Michx.
Stinkgrass	*Eragrostis cilianensis* (All.) Lutati.
Witchgrass	*Panicum capillare* L.
Perennials	
Big bluestem*	*Andropogon gerardii* Vitman
Blue grama*	*Bouteloua gracilis* (Willd. ex Kunth)
Canada wildrye	*Elymus canadensis* L.
Crested wheatgrass	*Agropyron cristatum* (L.) Gaertn.
Green needlegrass*	*Stipa viridula* Trin.
Intermediate wheatgrass*	*Agropyron intermedium* (Host) Beauv.
Little bluestem*	*Schizachyrium scoparium* (Michx.) Nash
Needle-and-thread	*Stipa comata* Trin. & Rupr.
Prairie junegrass	*Koeleria cristata* (L.) Pers.
Prairie sandreed*	*Calamovilfa longifolia* (Hook) Scribn.
Pubescent wheatgrass*	*Agropyron trichophorum* (Link) Halacsy
Sand dropseed	*Sporobolus cryptandrus* (Torr.) Agrax
Ring muhly	*Muhlenbergia torreyi* (Kunth) Hitchc. ex. Bush
Sideoats grama*	*Bouteloua curtipendula* (Michx.) Torr.
Smooth brome*	*Bromus inermis* Lexss.
Squirreltail	*Sitanion hystrix* (Nutt.) J. G. Smith
Switchgrass*	*Panicum virgatum* L.
Western wheatgrass*	*Agropyron smithii* Rydb.

[a] *, grasses planted in Conservation Reserve Program for Washington and Lincoln counties, Colo.

In both years, grasses were collected from the same roadside, conservation reserve plantings, wheat fallow, and rangeland sites. All sites bordered a winter wheat field; samples were taken within 20 m of the outside edge of a field. From three random spots within a site, individual plant material was clipped from ground level in enough quantity to fill a 3.8-liter Ziploc bag (Dow Chemical Corporation, Midland, Mich.). Sampling continued throughout the summer even though some of the annual grasses are short-lived and senesced as sampling progressed.

Russian wheat aphids were separated from grass plant material using the methods of Stewart et al. (1989), except that a clear 60-W light bulb was used for extraction instead of formaldehyde. The temperature inside the funnels was 49 ± 2°C, and plant samples were extracted for 24 h. Russian wheat aphid specimens were identified under a dissecting microscope and separated into aptera, alatoid nymph, and alata stages (Palmer 1952). Two suction traps (Allison & Pike 1988) within 32 km of each sample location were used to monitor Russian wheat aphid migratory flights on a weekly basis.

Results and Discussion

In 1988, Russian wheat aphids were collected from 8 and 12 species of grasses in Washington (Table 2) and Lincoln (Table 3) counties, respectively. Numbers of aphids were highest on crested wheatgrass, prairie sandreed (Washington County), and Canada wildrye (Lincoln County). Fewer aphids (less than nine) were found on the remaining grass species surveyed in 1988 (Tables 2 and 3).

Russian wheat aphids were found on 15 different species of grasses in Washington County in 1989, compared with 8 and 12 for Washington and Lincoln counties the previous year (Tables 2–4). Unlike 1988, aphids were found on pubescent wheatgrass, intermediate wheatgrass, needle-and-thread, prairie threeawn, and switchgrass. The first three are classified as cool-season species and the latter two are warm-season species. The order of suitability from the 1989 survey was Canada wildrye and crested wheatgrass > conservation reserve plantings wheatgrasses (pubescent, western, intermediate), and stinkgrass > all other grasses surveyed. These three categories in host suitability are based

Table 2. *D. noxia* collected by Berlese funnel from grass species sampled during summer 1988, Washington County, Colo.

Grass species	Date sampled							Total	Ratio of AP/AD/AL[a]
	Aug.					Sept.			
	2	9	15	22	29	5	13		
Crested wheatgrass	0	0	0	0	0	17	0	17	17:0:0
Prairie sandreed	0	10	1	0	0	0	0	11	11:0:0
Canada wildrye	0	6	0	1	0	0	2	9	7:2:0
Barnyardgrass	4	0	0	0	0	0	3	7	7:0:0
Western wheatgrass	5	0	0	0	0	0	0	5	5:0:0
Green foxtail	2	0	0	0	0	0	3	5	5:0:0
Witchgrass	2	1	0	0	2	0	0	5	5:0:0
Blue grama	0	1	0	0	0	0	0	1	1:0:0
Totals	13	18	1	1	2	17	8	60	58:2:0

[a] AP, aptera; AD, alatoid nymph; AL, alata.

Table 3. *D. noxia* collected by Berlese funnel from grass species sampled during summer 1988, Lincoln County, Colo.

Grass species	Date sampled							Total	Ratio of AP/AD/AL[a]
	Aug.					Sept.			
	3	10	16	23	29	5	14		
Canada wildrye	28	6	33	6	1	0	7	75	53:28:0
Crested wheatgrass	0	0	5	1	0	0	2	8	4:4:0
Downy brome	0	0	0	7	1	0	0	8	8:0:0
Blue grama	7	0	0	1	0	0	0	8	8:0:0
Barnyardgrass	0	0	3	0	0	0	2	5	5:0:0
Western wheatgrass	5	0	0	0	0	0	0	5	5:0:0
Witchgrass	2	0	0	0	1	0	1	4	4:0:0
Green foxtail	0	0	0	0	0	0	3	3	3:0:0
Sand dropseed	1	0	0	0	0	2	0	3	3:0:0
Stinkgrass	2	0	0	0	0	0	0	2	2:0:0
Green needlegrass	2	0	0	0	0	0	0	2	2:0:0
Sideoats grama	0	0	0	1	0	0	0	1	1:0:0
Totals	47	6	41	16	3	2	15	124	98:32:0

[a] AP, aptera; AD, alatoid nymph; AL, alata.

on total number of Russian wheat aphids recovered and whether Russian wheat aphids were present on the last three survey dates when fall sown winter wheat was established and susceptible to infestation (Tables 2–4).

Crested wheatgrass and Canada wildrye had >400 total Russian wheat aphids in 1989 (Table 4). In addition, these two species harbored Russian wheat aphids on every survey date (Table 4). The conservation reserve planting wheatgrasses and stinkgrass all had total Russian wheat aphid numbers between 22 and 40. On pubescent and western wheatgrass and stinkgrass, the occurrence of Russian wheat aphids was sporadic, with greater numbers found earlier in the season; only intermediate wheatgrass had Russian aphids present on the last three sampling dates (Table 4). The remaining grasses, all of which are warm-season except needle-and-thread, had fewer than eight total Russian wheat aphids, most of which were collected on the first three sample dates (Table 4). The colonization of Russian wheat aphids on conservation reserve planting grasses such as pubescent wheatgrass, intermediate wheatgrass, and switchgrass merits concern. For example, Washington County has 56,398 ha of conservation reserve plantings and Lincoln County has 47,324 ha. It is not uncommon to plant one or both of the wheatgrasses together with switchgrass or other grass species as conservation reserve plantings cover in northeastern Colorado. (D. Gonzales, Washington County Soil Conservation Service, personal communication).

Because of the higher total numbers of Russian wheat aphids in 1989, the Washington County survey allowed for a better measure of Russian wheat aphid life stage diversity. Canada wildrye had the

Table 4. *D. noxia* collected by Berelese funnel from grass species sampled during summer 1989, Washington County, Colo.

Grass host	Date sampled								Total	Ratio of AP/AD/AL[a]
	July	Aug.					Sept.			
	26	2	9	16	23	30	6	13		
Crested wheatgrass	154	115	121	23	32	4	1	4	454	453:1:0
Canada wildrye	13	107	125	157	20	4	11	3	440	417:21:2
Pubescent wheatgrass	29	8	0	3	0	0	0	0	40	40:0:2
Western wheatgrass	0	23	2	0	0	0	0	0	25	25:0:0
Intermediate wheatgrass	4	13	1	0	0	1	2	2	23	21:2:1
Stinkgrass	0	1	21	0	0	0	0	0	22	22:0:0
Prairie threeawn	8	0	0	0	0	0	0	0	8	7:1:0
Squirreltail	8	0	0	0	0	0	0	0	8	8:0:0
Sand dropseed	0	1	5	0	0	0	0	0	6	5:1:0
Blue grama	0	0	5	0	0	0	0	0	5	5:0:0
Barnyardgrass	0	3	1	0	0	0	0	0	4	4:0:0
Switchgrass	0	4	0	0	0	0	0	0	4	3:0:1
Green foxtail	0	0	1	0	1	0	0	0	2	1:1:0
Needle-and-thread	2	0	0	0	0	0	0	0	2	0:0:2
Sideoats grama	0	0	0	1	0	0	0	0	1	1:0:0
Totals	218	275	282	184	53	9	14	9	1,044	1,009:27:8

[a] AP, aptera; AD, alatoid nymph; AL, alata.

highest total number of alatoid nymph Russian wheat aphids (Table 4). No more than two alata or alatoid nymphs were found on any other grass species.

In 1988, the Lincoln County suction trap caught a total of 607 Russian wheat aphids, with the peak occurring 30 June (W. Meyer, Department of Entomology, Colorado State University, Fort Collins, personal communication). The 1988 Washington County suction trap caught a total of 177 and peaked on 18 June. These data from two locations in 1988, along with the grass survey, indicate that larger migratory flights of Russian wheat aphid occurred in Lincoln County with a wider range of grass species involved.

The 1989 Washington County suction trap caught a total of 10,717 Russian wheat aphids and peaked on 3 July. This is a 61-fold increase from the Washington County trap for 1988. There was obviously a much more active migratory flight in Washington County in 1989 when compared with either location for 1988.

Our data suggest that crested wheatgrass, a common pasture and roadside grass, and Canada wildrye, a roadside or disturbed area grass, both cool-season perennials, are capable of supporting Russian wheat aphid populations from July to mid-September. Russian wheat aphids were captured on three species of conservation reserve planting grasses in 1989; however, only one of these (intermediate wheatgrass) supported Russian wheat aphids on the last three sampling dates of 1989 (Table 4).

Our conclusion agrees with those of Kindler & Springer (1989) and Clement et. al. (1990), that cool-season perennials are summer alternate hosts of the Russian wheat aphid. In northeastern Colorado, crested wheatgrass and Canada wildrye, two cool-season perennials not recommended for conservation reserve plantings, appear to be the most suitable alternate summer hosts of the Russian wheat aphid.

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