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Abstract. Currently, eight Russian wheat aphid biotypes have been described in the United States. It has been proposed that the alternate grass hosts that Russian wheat aphid feed on may impose selective pressure on the aphids, thereby selecting for biotypes that can better utilize the host plant. Also, holocycly in Russian wheat aphids may be induced by the harsher winter conditions found at elevations higher than the main wheat producing areas in Colorado. In this study, non-cultivated grasses were collected along three Colorado highways, Highway 14, Highway 285 and Highway 50, at ca. 300 m elevational intervals, beginning at the base of the "Front Slope" and ending at the summit. The grasses were identified and observed for Russian wheat aphid. The objectives of this study were threefold: (1) to identify host plants that Russian wheat aphid utilizes at higher elevations; (2) to identify which elevations between 1,500 m and 3,500 m above sea level have the most aphid abundance; and (3) to find sexual forms of Russian wheat aphids or other evidence of holocycly. The greatest number of aphids were collected between 1,500 m and 2,100 m. Peak aphid collections occurred during June on Hwy. 50, mid-June through early August on Highway 14, and late August through early September on Highway 285. Aphid numbers were high on *Agropyron cristatum* L. (crested wheatgrass), *Hordeum jubatum* L. (foxtail barley), and *Pascopyrum smithii* A. Love (western wheatgrass). Sexual forms (oviparae and males) of Russian wheat aphid were not found.

Introduction

Russian wheat aphid, *Diuraphis noxia* (Kurdjumov), is an economic threat to small grain production in the western United States. The development of locally adapted wheat and barley cultivars resistant to Russian wheat aphid has been a major objective to find sustainable management approaches for this pest in Colorado. However, the release of resistant cultivars has become more difficult with the appearance of Russian wheat aphid biotypes, many of which are virulent to the commercially available resistant wheat cultivars (Haley et al. 2004, Burd et al. 2006, Weiland et al. 2008, Randolph et al. unpublished data). During the spring of 2003, severe Russian wheat aphid damage (leaf rolling, chlorotic streaking and plant stunting) to a resistant wheat cultivar was reported from southeastern Colorado (Haley et al. 2004). Experiments with an isolate from this area confirmed the presence of a new biotype, virulent to the *Dn*4 and *Dn*y resistant winter wheat cultivars as well as other available Russian wheat aphid resistance sources (Haley et al. 2004) and was designated as RWA2 in the United States. Since the discovery of RWA2, three more Russian wheat aphid biotypes were identified in Colorado (Weiland et al. 2008). In addition, three other biotypes, two from Texas and one from Wyoming, were described by Burd et al. (2006). This recent increase in biotypic diversity in the United States could be a result of holocycly. Although oviparous female Russian wheat aphids were previously identified in the United States (Kiriac et al. 1990), males or eggs have not been reported. Given that aphid holocycly is more common in climates with more severe winters, we hypothesized that the same would hold for higher elevations in Colorado. Also, alternate grass hosts that Russian wheat aphid feed on may impose more selective pressure on the aphids than wheat does, thereby selecting for biotypes that can better utilize host plants, which is a theory also posed for greenbug (*Schizaphis*

graminum) biotyipic diversity (Anstead et al. 2003). This study was designed to: (1) identify host plants that Russian wheat aphids utilize in montane environments; (2) determine the elevations between 1,500 m and 3,500 m above sea level with greatest aphid abundance; and (3) detect sexual forms of Russian wheat aphids or other evidence of holocycly.

Methods and Materials

Three Colorado mountain highways, Highway 14, Highway 285 and Highway 50, were sampled at ca. 300 m elevational intervals, beginning at the eastern foothills and ending at the summit. Samples were collected once each month from June through September in 2005, 2006 and 2007 for Highways 14 and 285, and 2006 and 2007 for Highway 50.

Each grass species that occurred at each elevation were collected by cutting plants of each species at ground level. Each species of grass was bagged separately, being careful not to include other grass species in the sample. One nearly mature tiller was retained from each sample for species identification, and the remainder of each sample was placed in a separate Berlese funnel for 24 hours. Grass species were identified with the use of grass keys developed by Wingate (1994). Russian wheat aphids were counted and examined for males and oviparae.

Results

Ninety-eight grass species were collected and identified during this study (Table 1). Of the grasses identified, 18 species harbored Russian wheat aphids (Table 2). Russian wheat aphids were collected at each elevation sampled from each highway. On Highway 14, large numbers of Russian wheat aphids were found on *Agropyron cristatum* L. (crested wheatgrass) at 1,630 m and 2,240 m in 2006 and *Elytrigia intermedia* Nevski (intermediate wheatgrass) at 1,630 m in 2006. On Highway 285, substantial numbers of Russian wheat aphids were found on *Hordeum jubatum* L. (foxtail barley) at 2,240 m in both 2005 and 2006, *Elytrigia intermedia* Nevski (intermediate wheatgrass) at 2,595 m in 2005, *Elytrigia repens* Nevski (quackgrass) at 2,120 m in 2006, and *Pascopyrum smithii* A. Love (western wheatgrass) at 2,240 m in 2006. On Highway 50, grasses harboring Russian wheat aphids were *Aegilops cylindrica* L. (jointed goatgrass) at 2,000 m in 2006 and *Hordeum jubatum* L. (foxtail barley) at 2,000 m in 2007. Peak aphid collections occurred 1 July 2005, 4 August 2006 and 11 June 2007 on Highway 14, 1 September 2005 and 25 August 2006 on Highway 285 and 6 June 2006 and 20 June 2007 on Highway 50. No Russian wheat aphids were collected on Highway 285 in 2007.

Discussion

Overall, the most aphids were collected: (1) below 2,135 m, (2) during the 2006 collection year, (3) in June on Highway 50, August on Highway 14 and late August or early September on Highway 285, and (4) on *Agropyron cristatum* L., *Hordeum jubatum* L., and *Pascopyrum smithii* A. Love. Although one of the purposes of this study was to find sexual forms of the Russian wheat aphid, none were found.

Of the 18 grass species found to be hosting Russian wheat aphids in this study, only half were known Russian wheat aphid hosts (Kindler and Springer 1989, Armstrong et al. 1991, Messina et al. 1993, Hammon et al. 1997). However, Russian wheat aphids were more commonly found on

the known hosts. Fewer and younger aphids were collected from previously unreported hosts, indicating that these may be less formidable hosts. Grasses play an important role in the over-summering ability of Russian wheat aphid (Armstrong et al. 1991). In this study, known hosts in suitable condition were found above 2,200 m throughout the summer months, while grasses below 1,800 m generally had senesced by August, or earlier under drought conditions. The availability of suitable hosts in montane environments may be an important factor in the year-round presence of Russian wheat aphid in Colorado.

Russian wheat aphid abundance in montane environments might be related to the size of the Russian wheat aphid flight in the wheat growing areas to the east. However, comparisons made of the elevations collections to suction trap catches directly east of Highways 14, 285 and 50 (Table 3) were inconclusive. Also, abotic factors, such as snowpack or winter temperatures might affect Russian wheat aphid success at higher elevations. While temperature comparisons were inconclusive, Russian wheat aphid abundance appears to be negatively correlated with snowpack (Table 2). Since there is no apparent association with suction trap catches and a potential association with snowpack, it is possible that the sources of the aphids collected were on local noncultivated grass hosts, rather than the current year's wheat crop. Since there are only three years of data related to this phenomenon, future collections will focus on confirming that the aphids being collected are local in origin and if their abundance is related to snowpack or other environmental factors.

Russian wheat aphids over-summer on non-cultivated grass hosts (Clement et al. 1990, Armstrong et al 1991, Messina et al. 1993). While on these grass hosts, Russian wheat aphids may be under selection pressure, which, combined with holocyclic reproduction, could explain the appearance of new biotypes in Colorado. Weiland et al. (2008) collected two biotypes from non-cultivated grasses. Differences in virulency in plant differentials were also noted among Russian wheat aphids collected from winter wheat and non-cultivated grass hosts in the same field (Randolph et al. unpublished data). Holocyclic forms were not found in this study. More intense sampling at higher elevations in preferred hosts may provide evidence for holocycly, as well as insight into the relationship between aphid populations in wheat producing areas on the plains and those on non-cultivated grasses at higher elevations.

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Table 1. Grass species and Russian wheat aphid numbers found at each elevation on highways 14, 285 and 50

Grass species[2] (Common name)	Elevation (# Russian wheat aphids)[1]							
	Highway 14			Highway 285			Highway 50	
	2005	2006	2007	2005	2006	2007	2006	2007
Aegilops cylindrica L. (Jointed goatgrass*)							2	1, 2
Agropyron cristatum L. (Crested wheatgrass*)		1, 3, 4	1, 2, 3, 4		3, 4	2, 3, 4	2, 3	2
Agropyron trichophorum (Pubescent wheatgrass*)		5	5				1	3, 4
Agrostis exarata Trin. (Spike bentgrass)			5		3, 5			
Agrostis gigantea Roth (Redtop bentgrass)		2	3		4			
Agrostis sp. (Bentgrass)		2, 4, 5, 6						
Alopecurus alpinus L. (Alpine foxtail)					3	2		
Alopecurus pratensis L. (Meadow foxtail)	2	5, 6	2, 5, 6	6	3, 6	2, 3, 5, 6		2, 5, 7
Alopercurus aequalis Sobol. (Shortawn foxtail)							5	
Andropogon gerardii Vitm. (Big bluestem)		1	1				1	1
Andropogon hallii Hack. (Sand bluestem)						2		
Aristida purpurea Nutt. (Purple three-awn)					5		2, 3, 6	1, 2
Avena fatua L. (Wild oats)	1, 2, 3, 4							
Blepharoneuron tricholepis Nash. (Hairy dropseed)	4	1, 2	5		4		1, 2, 3, 4, 6	
Bouteloua curtipendula Torr. (Side-oats grama*)							1	

Grass species[2] (Common name)	Elevation (# Russian wheat aphids), continued[1]							
	Highway 14			Highway 285			Highway 50	
	2005	2006	2007	2005	2006	2007	2006	2007
Bouteloua gracilis Lag. (Blue grama*)	2	1, 2, 3, 4	1, 2		3, 4	3, 4	1, 2, 3	1, 2
Bouteloua hirsuta Lag. (Hairy Grama)								1
Bromus anomalus Rupr. ex Fourn. (Nodding brome)					6	1, 5	3	6
Bromus carinatus H. & A. (Mountain brome*)	6		6	5		3	1, 7	
Bromus ciliatus L. (Fringed brome)		2, 6			6		2, 6	
Bromus commutatus Schrader (Hairy brome)			2				1, 2	1
Bromus inermis Leyss. (Smooth brome)	2, 3	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6	3, 4, 5, 6	2, 3, 4, 5, 6	2, 3, 4, 5, 6	1, 2, 3, 4, 5, 7	1, 2, 3, 4, 5, 7
Bromus inermis Leyss. ssp. pumpellianus Wagnon var. arcticus Wagnon (Pumpelly Brome)						5, 6		1
Bromus japonicus Thunb. (Japanese brome)		2				2, 3		
Bromus lanatipes			2		3, 4, 5		6	
Bromus tectorum L. (Cheatgrass*)			1, 2, 3		5	3, 4		1, 2, 3, 4
Bromus tectorum L. (Downy brome*)					3, 5	3	2, 3, 4	
Calamagrostis canadensis P. Beauv. (Canada reedgrass)			3, 5, 6					
Carex duriuscula C.A. Mey (Needleleaf sedge)							7	

Grass species[2] (Common name)	Elevation (# Russian wheat aphids), continued[1]							
	Highway 14			Highway 285			Highway 50	
	2005	2006	2007	2005	2006	2007	2006	2007
Carex nebrascensis Dewey (Nebraska sedge)							7	
Cenchrus longispinus Fern. Longspine Sandbur			1				1, 6, 7	
Dactylis glomerata L. (Orchard grass)	5	2, 4, 5, 6	1, 2, 4, 5, 6	5	2, 3, 4, 5	2, 3, 4, 5	4, 7	7
Danthonia parryi Scribn. (Parry Oatgrass)						6		
Danthonia spicata Beauv. (Poverty oatgrass)		2	2, 3					
Deschampsia cespitosa Beauv. (Tufted hairgrass)			6					
Distichlis spicata Greene var. stricta Scribn. (Desert Saltgrass)						2		
Echinochloa crusgalli Beauv. (Barnyard grass)	5				2, 3			
Elymus canadensis L. Canada wildrye*	2	2, 3	2, 6	5	3, 4	3, 4, 5	1, 2, 3	2, 6, 7
Elymus caninus L. (Bearded wheatgrass)		6	3	3	4, 5, 6	5, 6	6, 7	3
Elymus elymoides Swezey (Squirrel tail*)						3, 6	4, 6	1, 4
Elymus lanceolata X Pseudoroegneria spicata (Griffiths wheatgrass)			2		6			
Elymus sp. L. (Wildrye)				4				
Elymus virginicus L. (Slender wheatgrass*)		1, 2, 3, 5, 6	2, 3, 4, 5, 6	4, 5, 6	2, 3, 5, 6	3, 4, 5, 6	1, 2, 4	2, 6
Elytrigia elongata Nevski (Intermediate wheatgrass*)	1	1	1, 5	3, 4, 6	3, 4	2, 3, 6	1, 3	2, 3, 4, 5

Grass species[2] (Common name)	Elevation (# Russian wheat aphids), continued[1]							
	Highway 14			Highway 285			Highway 50	
	2005	2006	2007	2005	2006	2007	2006	2007
Elytrigia elongata Nevski (Tall wheatgrass*)							1	
Elytrigia repens Nevski (Quackgrass)			1, 5		3, 4	2, 3, 4, 6		
Eragrostis cilianensis Mosher (Stinkgrass*)					2			2, 7
Eragrostis trichodes Wood (Sand lovegrass)			1, 2			2		
Eremopyrum triticeum Nevski. (Annual wheatgrass)					2		2	
Festuca arundinacea Schreb. (Tall fescue)					2			
Festuca dasyclada Hackel ex. Beal (Utah fescue)			2, 3, 4, 5, 6		2, 5, 6	4, 5, 6	2	
Festuca pratensis Huds. (Meadow fescue*)	2							2
Festuca rubra L. (Red fescue)		6	2, 4, 5		4, 5	5		
Festuca thurberi Vasey (Thurber fescue)					3, 6			
Hordeum jubatum L. Foxtail barley*	6			3, 4, 5, 6	2, 3, 4, 5	3, 4, 5, 6		2, 7
Hordeum pusillum Nutt. (Little barley*)		5, 6	1, 5, 6			3	1, 7	3, 7
Koeleria macrantha Schult. (Junegrass)	4, 6		3			6		
Leersia oryzoides Sw. (Rice cutgrass)	2							
Leymus ambiguus Dewey (Colorado wildrye)							1, 3	
Leymus salinus A. Love (Salina wildrye)						3		

Grass species[2] (Common name)	Elevation (# Russian wheat aphids), continued[1]							
	Highway 14			Highway 285			Highway 50	
	2005	2006	2007	2005	2006	2007	2006	2007
Lolium perenne L. (Ryegrass)	3, 4		1		2, 3	3		
Muhlenbergia andina A. S. Hitchc. (Foxtail muhly)	5			5, 6				
Muhlenbergia asperifolia L.R. Parodi (Scratchgrass muhly)						3, 4		
Muhlenbergia cuspidata Rydb. (Plains muhly)					5, 6			
Muhlenbergia montana A.S. Hitchc. (Mountain muhly)		3	3	2	4	4	5	5
Muhlenbergia pungens Thurb. (Sandhill muhly)		5	5	6				
Muhlenbergia ramulosa Swallen (Green Muhly)						3, 4		
Muhlenbergia sp. (Muhly)							5	
Muhlenbergia thurberi Rydb. (Thurber muhly)					4			
Muhlenbergia torreyi A.S. Hitchc. (Ring muhly)	2							
Muhlenbergia wrightii Vasey (Spike muhly)					5		6	
Oryzopsis asperifolia Michx. (Rough-leaved Ricegrass)			3					
Oryzopsis exigua Thurb. (Little ricegrass)					5			
Panicum capillare L. var occidentalis Rydb. (Witchgrass)					2, 3	2, 3	1, 2, 3	1

Grass species[2] (Common name)	Elevation (# Russian wheat aphids), continued[1]							
	Highway 14			Highway 285			Highway 50	
	2005	2006	2007	2005	2006	2007	2006	2007
Panicum obtusum H.B.K. (Vine mesquite grass)					2			
Panicum virgatum L. (Switchgrass)			1					
Pascopyrum smithii A. Love (Western wheatgrass*)	6	2, 3, 4, 5, 6	1, 2, 3, 4, 6	2, 3, 5	2, 3, 4, 5	2, 4, 5	1, 2, 3, 4, 6, 7	1, 2, 3, 4, 5, 6, 7
Phalaris arundinacea L. (Canary reedgrass)		6			3			
Phalaris arundinacea L. (Reed canary grass)		5			3		7	
Phleum commutatum Gaudin. (Alpine timothy)	5							
Phleum pratense L. (Timothy)		2, 4, 5, 6	2, 4, 5, 6		3, 4, 5	3, 4, 5, 6	6, 7	6, 7
Poa agassizensis Boivin & Love (Rocky mountain bluegrass)								6
Poa arida Vasey (Plains bluegrass)			3					
Poa compressa L. Canada bluegrass		2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6	4, 5, 6	3, 4, 6	3, 6	1, 3, 5, 6, 7	6
Poa epilis Scribn. (Skyline bluegrass)						5		
Poa glaucifolia						5, 6		
Poa interior Rydb. (Inland Bluegrass)			2, 3					1, 3
Poa pratensis L. (Kentucky bluegrass)		6	5, 6		6	3, 4, 5, 6		3, 5, 6, 7
Psathyrostachys junceus Nevski (Russian wildrye*)							2	1
Pseudoroegneria spicata A. (Bluebunch wheatgrass)			2					

Grass species[2] (Common name)	Elevation (# Russian wheat aphids), continued[1]							
	Highway 14			Highway 285			Highway 50	
	2005	2006	2007	2005	2006	2007	2006	2007
Puccinellia nuttalliana Hitchc. (American alkaligrass)							7	
Schizachyrium scoparium Nash (Little bluestem)		1, 2	1				1, 2, 3	7
Secale sp. (Rye)		1	1, 2					9
Setaria viridis Beauv. (Green foxtail*)			1	2		2, 4		1
Sporobolus airoides Torr. (Alkali sacaton)						4		
Sporobolus asper Kunth. (Tall Dropseed)			1			2		
Sporobolus contractus A.S. Hitchc. (Spike dropseed)		1	1			2	2	1, 2, 4
Sporobolus cryptandrus Gray (Sand dropseed*)	1	1, 2, 3	3		2		4	4
Sporobolus sp. (Dropseed)							2	
Stipa arida M.E. Jones (Mormon needlegrass)							1	
Stipa comata Trin. & Rupr. (Needle-and-thread Grass)		1, 3, 6	1, 2, 3, 4		5	4, 5	1, 2, 3, 4, 5, 6	1, 2, 4, 5
Stipa hymenoides R. & S. (Indian ricegrass*)		3				6	2, 3, 4	1, 2, 4, 5
Stipa lettermanii Vasey (Letterman needlegrass)		6				6	2	1, 2, 3
Stipa nelsonii Scribn. (Nelson needlegrass)			3		3, 5	4		
Stipa richardsonii			1					
Stipa robusta Scribn. (Sleepygrass)						5	2, 5	

Grass species[2] (Common name)	Elevation (# Russian wheat aphids), continued[1]							
	Highway 14			Highway 285			Highway 50	
	2005	2006	2007	2005	2006	2007	2006	2007
Stipa sp. (Needlegrass*)							3	
Stipa viridula Trin. Green needlegrass*			2, 3		4, 5	5	2, 3, 4, 5	2, 3, 4, 5
Trisetum wolfii Vasey (Wolf's trisetum)		2, 4, 5, 6	5		2, 5, 6	3, 5	1	5
Vulpia octoflora Rydb. (Six-weeks fescue)			4					

[1] Elevations for Highway 14 are 1 = 1627 m, 2 = 1843 m, 3 = 2239 m, 4 = 2472 m, 5 = 2883 m, 6 = 3136 m; altitudes for Highway 285 are 2 = 1757 m, 3 = 2121 m, 4 = 2594 m, 5 = 2762 m, 6 = 3055 m; altitudes for Highway 50 are 1 = 1562 m, 2 = 1840 m – 1996 m, 3 = 2129 m, 4 = 2448 m, 5 = 2730 m, 6 = 3028 m, 7 = 3452 m.

[2]Grass species that are known to be Russian wheat aphid hosts are marked by an *.

Table 2. Grass species and Russian wheat aphid numbers found at each elevation on Highways 14, 285, and 50 during the 2005, 2006, and 2007 seasons.

Grass Species (Common name)[3]	**Elevation *(# Russian wheat aphids collected)*** [1, 2]							
	Highway 14			Highway 285			Highway 50	
	2005	2006	2007	2005	2006	2007	2006	2007
Aegilops cylindrica L. (Jointed goatgrass)*							2***(8)***	1, 2***(3)***
Agropyron cristatum L. (Crested wheatgrass)*		1***(194)***, 3***(3855)***, 4	1, 2, 3, 4		3***(3)***, 4	2, 3, 4	2, 3	2
Alopecurus pratensis L. (Meadow foxtail)	6	5, 6	2, 5, 6	6***(1)***	3, 6	2, 3, 5, 6		2, 5, 7
Aristida purpurea Nutt. (Purple three-awn)					5		2, 3, 6***(1)***	1, 2
Bromus carinatus H. & A. (Mountain brome)*	6		6	5***(3)***		3	1***(1)***, 7	
Bromus inermis Leyss. (Smooth brome)	2, 3	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6	3, 4, 5, 6	2, 3, 4, 5, 6	2, 3, 4, 5, 6	1***(3)***, 2***(1)***, 3, 4, 5, 7	1, 2, 3, 4, 5, 7
Cenchrus longispinus Fern. (Longspine Sandbur)			1				1, 6***(2)***, 7	
Dactylis glomerata L. (Orchard grass)	5	2, 4, 5, 6	2, 4, 5, 6	9	2, 3, 4, 5	2, 3, 4, 5	4***(1)***, 7	7
Elymus canadensis L. (Canada wildrye)*	2***(2)***	2, 3	2, 6	4***(3)***, 9	3, 4	3, 4, 5	1, 2***(1)***, 3	2 ***(6)***, 6, 7
Elymus virginicus L. (Slender wheatgrass)*		1***(6)***, 2, 3, 5, 6	2, 3, 4, 5, 6	4, 5***(5)***, 6***(16)***	2***(3)***, 3***(4)***, 5, 6	3, 4, 5, 6	1, 4	2, 6

Grass Species (Common name)[3]	**Elevation *(# Russian wheat aphids collected)*** [1, 2]							
	Highway 14			Highway 285			Highway 50	
	2005	2006	2007	2005	2006	2007	2006	2007
Elytrigia elongata Nevski *(*Intermediate wheatgrass)*	1	1***(17)***	1, 5	3***(1)***, 4***(20)***, 6	3, 4	2, 3, 6	1, 3***(3)***	2, 3, 4, 5
Elytrigia repens Nevski *(*Quackgrass)			1, 5		3***(21)***, 4	2, 3, 4, 6		
Hordeum jubatum L. *(*Foxtail barley)*	6			3***(19)***, 4, 5***(2)***, 6***(20)***	2, 3***(229)***, 4, 5***(1)***	3, 4, 5, 6		2 ***(175)***, 7
Panicum capillare L. *var occidentalis* Rydb. *(*Witchgrass)					2, 3***(1)***	2, 3	1, 2, 3	1
Pascopyrum smithii A. Love *(*Western wheatgrass)*	6	2, 3, 4, 5, 6	1, 2, 3, 4, 6	2, 3***(2)***, 5***(12)***	2***(2)***, 3***(325)***, 4, 5	2, 4, 5	1, 2***(1)***, 3***(4)***, 4***(2)***, 6, 7***(6)***	1, 2, 3, 4, 5, 6, 7
Poa compressa L. *(*Canada bluegrass)		2, 3, 4, 5, 6***(1)***	1, 2, 3, 4, 5, 6	4, 5, 6	3, 4***(2)***, 6	3, 6	1, 3, 4, 5, 6, 7	6
Stipa comata Trin. & Rupr. *(*Needle-and-thread grass)		1, 3, 6	1***(1)***, 2, 3, 4		5	4, 5	1, 2, 3, 4***(2)***, 5, 6	1, 2, 4, 5
Stipa viridula Trin *(*Green needlegrass)*			2, 3		4, 5	5	3***(1)***, 4, 5	2, 3, 4, 5

[1] Elevations for Highway 14 are 1 = 1627 m, 2 = 1843 m, 3 = 2239 m, 4 = 2472 m, 5 = 2883 m, 6 = 3136 m; altitudes for Highway 285 are 2 = 1757 m, 3 = 2121 m, 4 = 2594 m, 5 = 2762 m, 6 = 3055 m; altitudes for Highway 50 are 1 = 1562 m, 2 = 1840 m – 1996 m, 3 = 2129 m, 4 = 2448 m, 5 = 2730 m, 6 = 3028 m, 7 = 3452 m.

[2] The number of Russian wheat aphids collected is noted in bold and italicized print in parentheses next to the elevation.

[3] Grasses that are known to be Russian wheat aphid hosts are marked by an *.

Table 3. Montane and suction trap Russian wheat aphid catches, average snow water equivalents (snowpack) for associated river basins and average temperatures for Colorado Front Slope Highways 14, 285 and 50.

Year	Highways 14 and 285				Highway 50			
	# Russian wheat aphids		Average Snowpack[2]	Average Temperature[3]	# Russian wheat aphids		Average Snowpack[2]	Average Temperature[3]
	Montane Study	Suction Trap Catches[1]			Montane Study	Suction Trap Catches[1]		
2005	55	925	12.0	41.9	-	1224	17	46.8
2006	4664	108	14.5	41.8	37	178	12	45.1
2007	1	1	16.5	40.9	184	684	13	45.8

[1]Suction trap catches for Highways 14 and 285 are combined from Briggsdale and Akron, Colorado traps. Suction trap catches for Highway 50 are combined from Lamar and Walsh, Colorado traps.
[2]Average peak snow water equivalents (inches). The average snowpacks for the South Platte River Basin were compared to Highways 14 and 285 and the average snowpack for Arkansas River Basin were compared to Highway 50 (data obtained from the Natural Resources Conservation Services).
[3]Average temperatures at approximately 7,000 ft. on each highway (data obtained from Western Regional Climate Center. 2215 Raggio Parkway, Reno, NV 89512).

Figure 1. Map of Russian wheat aphid noncultivated grass host collection sites along Colorado Highway 14, 2005-2007.

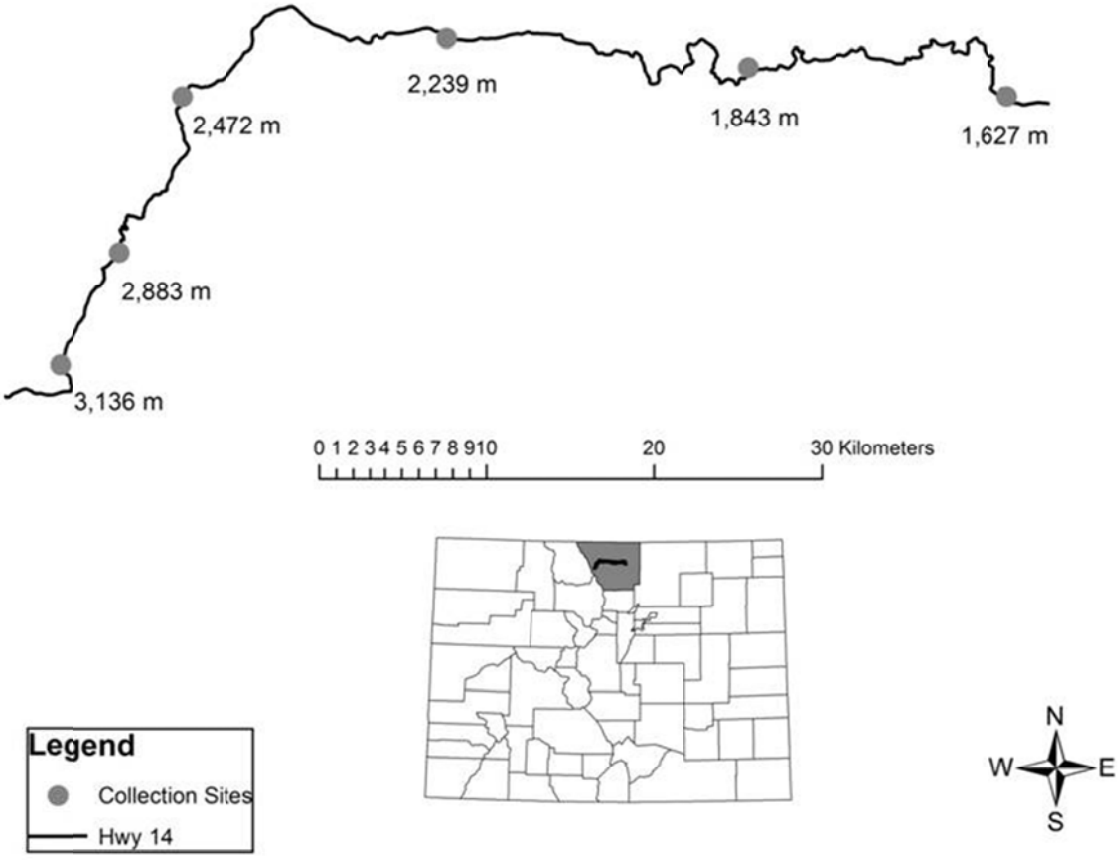

Figure 2. Map of Russian wheat aphid noncultivated grass host collection sites along Colorado Highway 285, 2005-2007.

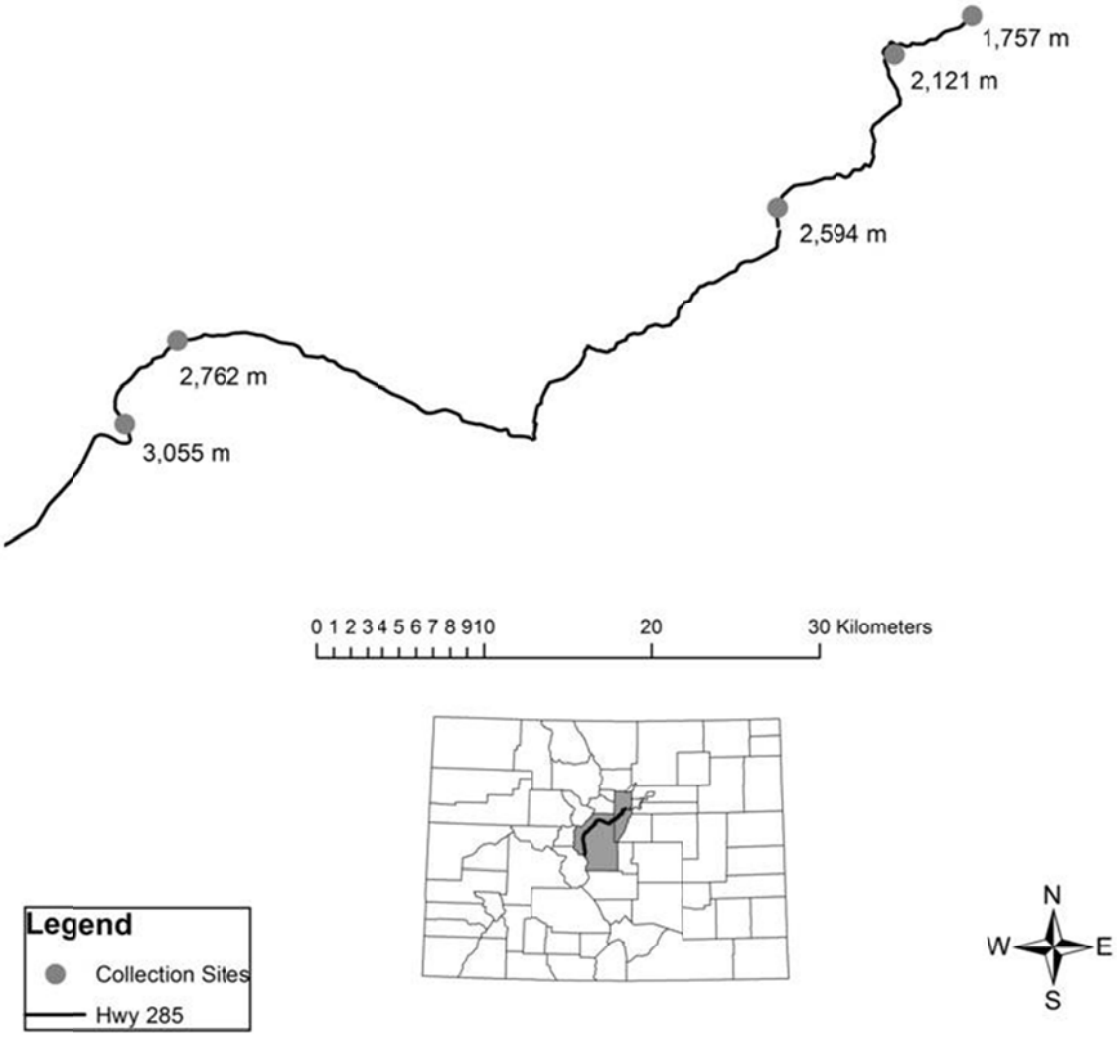

Figure 3. Map of Russian wheat aphid noncultivated grass host collection sites along Colorado Highway 50, 2005-2007.