Aphids (Hemiptera: Aphididae) associated with rhubarb (*Rheum* spp.) in the Matanuska Valley, Alaska: species composition, seasonal abundance, and potential virus vectors

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ABSTRACT

Culinary rhubarb, *Rheum* spp., is one of the priority crop species curated by the United States Department of Agriculture (USDA) Agricultural Research Service (ARS) in Palmer, Alaska. Water-pan traps in commercial rhubarb in the Matanuska-Susitna River Valley near Palmer and in the USDA ARS *Rheum* germplasm collection caught aphids belonging to eight species: *Aphis helianthi* Monell; *Chaitophorus neglectus* Hottes and Friso, *Euceraphis betulae* (Koch); *Hayhurstia atriplicis* (L.); *Macrosiphum euphorbiae* (Thomas); *Myzus persicae* (Sulzer); *Pemphigus spp.; and Rhopalosiphum padi* (L.). Only three of the species (*M. euphorbiae*, *M. persicae,* and *R. padi)* collected in water- pan traps were also handpicked from rhubarb plants. The bird cherry-oat aphid, *R. padi,* was the most abundant species collected in water-pan traps and from rhubarb plants. Based on their disease transmission capability, *A. helianthi*, *M. euphorbiae*, *M. persicae*, and *R. padi,* can be considered to be of potential economic importance to rhubarb production in Alaska.

Key Words: aphids, rhubarb, *Rheum*, Alaska, vectors, germplasm

INTRODUCTION

Culinary rhubarb, *Rheum* spp. (Polygonaceae), is one of the priority crop species curated at the Subarctic Agricultural Research Unit (SARU) of the United States Department of Agriculture (USDA) Agricultural Research Service (ARS). This site in Palmer, Alaska, is the primary rhubarb repository for the USDA ARS National Plant Germplasm System (NPGS 2010) which maintains a diverse collection of plant genetic material. Currently, the SARU *Rheum* collection has 41 clonal accessions (Kuhl and DeBoer 2008), some of which are infected with *Turnip mosaic virus* (TuMV) (Robertson and Ianson 2005), one of the most important diseases affecting rhubarb in Britain (Tomlinson and Walkey 1976) and in Alaska. *Turnip mosaic virus* has a large plant host range and a world-wide distribution (Stobbs and Sterling 1990, Walsh and Jenner 2002, Plant Viruses on Line 2009). The virus spreads me-

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chanically and by aphid transmission. The insect fauna associated with *Rheum* spp. is little known and there is no consensus on the aphid species associated with this plant. In a bibliography of rhubarb and other *Rheum* species, Marshall (1988) listed nine aphid species from seven genera affecting rhubarb throughout the world. Other authors reported three (Capinera 2001), or nineteen species (Blackman and Eastop 2006) of aphids associated with *Rheum* species.

There are no known published reports on aphids associated with rhubarb in Alaska. The present work was initiated to identify the aphids associated with rhubarb in the Matanuska-Susitna River Valley, Alaska, USA and to identify potential vectors of TuMV.

MATERIALS AND METHODS

Aphids associated with rhubarb were surveyed on a commercial farm in the Matanuska-Susitna River Valley near Palmer (N 61.53°, W 149.08°), Alaska. Samples were also taken from the SARU *Rheum* collection in Palmer (N 61.57°, W 149.25°). Habitat types surrounding field sites varied. The commercial farm is located in a developed rural area adjacent to large-scale vegetable production. The SARU collection is located in an isolated area surrounded by grassland and forest. Rhubarb foliage and stems were harvested weekly on the farm, while no harvesting occurred in the SARU germplasm collection. Rhubarb inflorescences were removed at both sites.

To construct a voucher collection, aphids were collected from both sites. Samples were taken weekly or bi-weekly by examining rhubarb plants selected at random from fields on the commercial farm (2005 to 2007) and in 2008 by inspecting all plants in the SARU *Rheum* collection. Collected aphids were placed in 95% ethanol, and stored for slide mounting and eventual identification by the authors using various references (Palmer 1952, Foottit and Richards 1993, Foottit and Maw 1997, Pike *et al*. 2003, Blackman and Eastop 2000, 2006) and museum vouchers. The abaxial and adaxial sides of the top three leaves of every plant in the collection were inspected every seven days during the months of August and September 2008. Aphids were also captured in water pan traps similar to those described by Stoltz *et al*. (1997). Traps were constructed by placing a 7-mm thick, yellow-green acrylic square (10 x 10 cm, Yellow 2037, United States Plastic Corp., Lima, OH, USA) in a 750-ml plastic Rubbermaid® dish (Newell Rubbermaid Company, Fairlawn, OH, USA) filled with a 0.05% soap solution (Ultra Dishwashing Liquid, Planet®, Victoria, BC, Canada). Traps were maintained at canopy height with the aid of adjustable stands (Villanueva and Peña 1991; Stoltz *et al*. 1997). Traps were placed around field perimeters just prior to rhubarb emergence and maintained until all plants were harvested (commercial field) or at first frost (SARU *Rheum* collection). A total of 33 trap stations were set (six traps/year in the commercial field and five traps/year in the germplasm collection) from May to October, 2005-2008. Traps were changed weekly and brought back to the laboratory where insects were strained from the soap solution and preserved in 95% ethanol for identification. The numbers of aphids per trap per week were combined to calculate the total number of aphids per 14-day period over the three years.

Additionally, the University of Alaska Museum of the North (UAM) insect collection was examined for aphids. The UAM collection includes the Washburn insect collection (Washburn 1972; UAM 2009), which was compiled by USDA entomologists J.C. Chamberlin, R.H. Washburn, and others during the 1940's and 1950's. This collection is considered to be the only large general insect collection maintained in the state (Pantoja e*t al.* 2009).

RESULTS AND DISCUSSION

A total of 3,325 specimens representing eight species and genera were collected from water-pan traps in commercial rhubarb and the SARU *Rheum* collection (Table 1). The species include: *Aphis helianthi* Monell; *Chaitophorus neglectus* Hottes and Frison; *Euceraphis betulae* (Koch); *Hayhurstia atriplicis* (L.); potato aphid, *Macrosiphum euphorbiae* (Thomas); green peach aphid, *Myzus persicae* (Sulzer); *Pemphigus spp.;* and bird cherry-oat aphid, *Rhopalosiphum padi* (L.). All species were collected in both locations, but more aphids (72% of total) were collected from the SARU *Rheum* collection than from the commercial field. Approximately 18% of the aphids collected could not be identified. Two species, *R. padi* (34.1%) and *Pemphigus* spp. (21.3%) represented 55% of the overall number of aphids collected. *Rhopalosiphum padi* was the most abundant species, representing 26% and 37% of the aphids collected from the commercial field and the SARU *Rheum* collection, respectively. The difference in aphid counts between sites can be explained by crop association. The SARU *Rheum* collection is located in an isolated site surrounded by forest and grasses, while the commercial rhubarb field was surrounded by vegetables providing additional alternate hosts for the aphids. There were no aphid colonies on rhubarb plants, indicating that this crop does not support development and is not a preferred host for the aphid species reported here.

Examination of the UAM insect collection revealed a total of 38 specimens representing nine identified species from eight genera, but none of the specimens were associated with *Rheum* spp. (Table 2). To our knowledge, the present study represents the first report on aphids from *Rheum* spp. in Alaska.

The seasonal abundances of the two most prevalent species and of three less numerous species that are potential virus vectors (discussed below) are shown in Figures 1 and 2. Both *R. padi* and *Pemphigus* spp. were trapped from late June until mid October, with *Pemphigus* reaching a peak in early July, and *R. padi* peaking in late August (Fig. 1). *Aphis helianthi*, *M. euphorbiae* and *M, persicae* were trapped from early June until mid October, with *A. helianthi* peaking in early July, and the other two species being present at low numbers throughout (Fig. 2).

The majority of the species collected in our study probably represent migratory aphids moving from other plant species. The second most abundant genus, *Pemphigus*, is represented by several species not easily identifiable (Foottit and Maw 1997). Although the *Pemphigus* spp. complex is commonly collected in agricultural fields in Alaska (Stoltz *et al*. 1996, 1997), the distribution and biology of the complex is poorly known and there are no reports on virus transmission studies with this group (Stoltz *et al*. 1997). *Pemphigus* spp. was the prevalent species collected in potato fields in the Matanuska-Susitna River Valley of Alaska representing 23% of the water-pan trap catches (Stoltz *et al*. 1997). An unidentifiable species of the *Pemphigus* spp. complex has been reported affecting rhubarb (*R. rhaponticum*) roots in New Zealand (Savage 1982). The agricultural importance of the *Pemphigus* species complex needs attention and revision (Savage 1982, Foottit and Maw 1997, Stoltz *et al*. 1997, Blackman and Eastop 2000).

Although present in low numbers, *A. helianthi*, *M. euphorbiae*, and *M. persicae* are of potential economic importance to rhubarb production. These three species along with *R. padi* are known vectors of potyviruses (Kortier and Grafius 1994, Foottit and Maw 1997, Blackman and Eastop 2000). *Myzus persicae* is a known vector of TuMV on Cruciferae (Dombrovsky *et al*. 2005). *Aphis helianthi* has been associated with crops of the Compositae and Umbelliferae families, but its biology and vector capacity are not well known (Kortier and Grafius 1994, Blackman and Eastop 2006). *Macrosiphum euphorbiae* and *M. persicae* have been associated with *Rheum* spp., suggesting that they might be vectors

Table 1.
Sums and percentages of aphids captured in water-pan traps in a commercial rhubarb field and in the USDA ARS *Rheum* germplasm collection at the Subarctic Agricultural Research Unit in Palmer, Alaska, USA, during 2005-2008.

	Commercial		Collection	
Species	**Sum**	**%**	**Sum**	**%**
Aphis helianthi Monell	29	3.1	79	3.3
Chaitophorus neglectus Hottes and Frison	18	1.2	94	3.9
Euceraphis betulae (Koch)	167	17.7	247	10.0
Hayhurstia atriplicis (L.)	33	3.5	128	5.4
Macrosiphum euphorbiae (Thomas)	32	3.4	54	2.3
Myzus persicae (Sulzer)	21	2.2	24	1.0
Pemphigus spp.	189	20.1	520	21.8
Rhopalosiphum padi (L.)	244	25.9	891	37.4
Unknown	209	22.2	346	14.5
Total	**942**		**2383**	

Table 2.
Sums and percentages of aphid species present at the University of Alaska Museum of the North in Fairbanks, Alaska, USA.

Species	**Sum**	**%**	**Host**
Aphis helianthi Monell	7	18.4	*Cornus stolonifera* Michx.
Aphis varians Patch	1	2.6	*Epilobium angustifolium* L.
Bornerina variabilis Richards	1	2.6	*Alnus crispa* (Aiton) Turrill
Euceraphis sp.	1	2.6	*Betula resinífera* Britton
Macrosiphum euphorbiae (Thomas)	17	44.7	*Malus* sp., *Lactuca sativa* L.
Nasovonia sp.	2	5.3	*Delphinium* sp.
Nearctaphis bakeri (Cowen)	1	2.6	*Malus* sp.
Nearctaphis yohoensis Bradly	1	2.6	*Sorbus* sp.
Pterocoma populifoliae (Fitch)	4	10.5	*Populus* sp.
Rhopalosiphum padi (L.)	1	2.6	*Prunus padus* L.
Unknown	2	5.3	*Lonicera tatarica* L., *Cornus* sp.
Total	**38**		

of viruses on rhubarb plants (Marshall 1988, Capinera 2001, Blackman and Eastop 2000, 2006). To our knowledge, our report represents the first time *A. helianthi* and *R. padi* are linked with rhubarb.

Fifty-nine alate specimens representing three species, *M. euphorbiae* (n =18), *M. persicae* (n = 6), and *R. padi* (n =31), were handpicked from rhubarb plants, suggesting that these aphid species might serve as virus vectors (Kortier and Grafius 1994, Foottit and Maw 1997, Blackman and Eastop 2000).

Although not collected in this study, the melon aphid, *Aphis gossypii* Glover, and the turnip aphid, *Lipaphis pseudobrassicae* (Kaltenbach), have been previously reported in Alaska (Stoltz *et al*. 1997). Both species have been associated with over 50 plant viruses, including TuMV

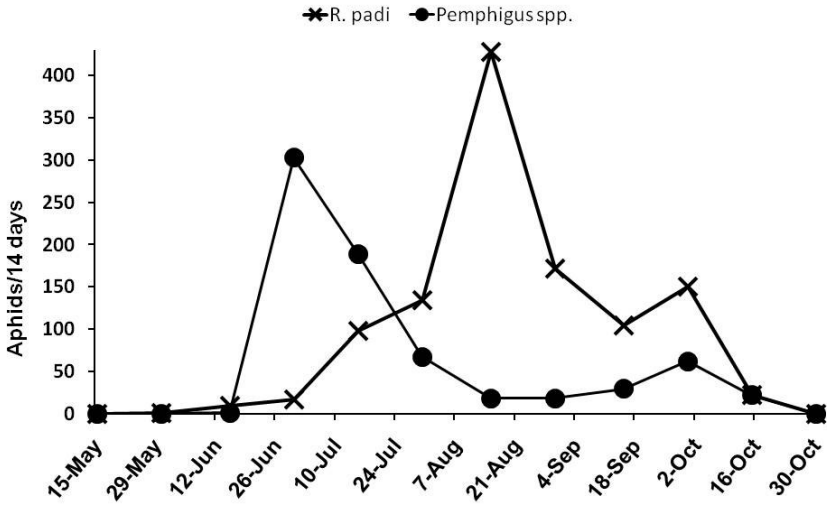

Figure 1. Sums of aphids per 14 days for the two most abundant species, *R. padi* and *Pemphigus* spp. collected with water-pan traps at two sites in proximity to Palmer, Alaska, USA, from 2005 to 2008.

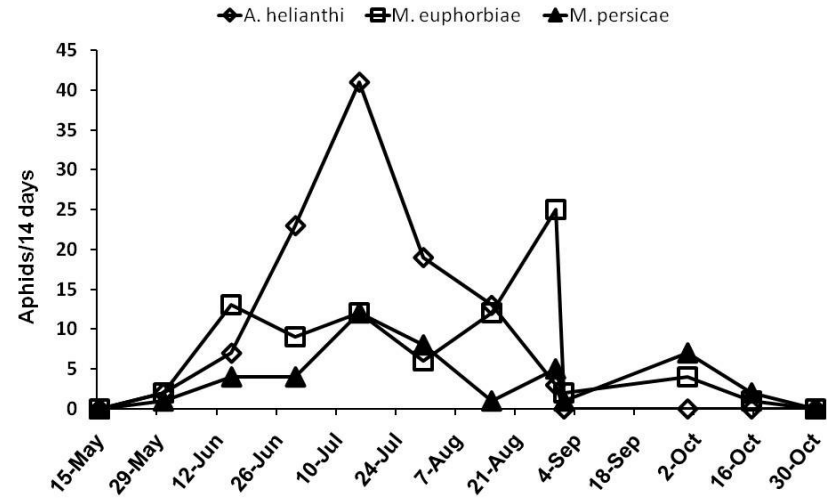

Figure 2. Sums of aphids per 14 days for the three aphid species that are potential virus vectors, *A. helianthi*, *M. euphorbiae*, and *M. persicae*, collected with water-pan traps at two sites in proximity to Palmer, Alaska, USA, from 2005 to 2008.

(Dombrovsky *et al*. 2005, Blackman and Eastop 2006). Pantoja (unpublished data) collected 48 specimens of the cabbage aphid, *Brevicoryne brassicae* (L.) in water pan traps from commercial rhubarb in Palmer, Alaska, in 2004, after a nearby cabbage field was harvested. *Brevicoryne brassicae* is another potential vector of TuMV to rhubarb (Blackman and Eastop 2000). To our knowledge, the presence of *B. brassicae* on rhubarb in the Palmer area represents a new record for agricultural crops in the state as this species is not listed by previous reports (Chamberlin 1949, Washburn 1974, Robinson 1979, Stoltz *et al.* 1996, 1997, UAM 2009) from agricultural settings in Alaska.

Future research should investigate the

correlation between the aphid species present in Alaska and their potential association with TuMV in rhubarb fields, alternate hosts of the abundant species, and overwintering habits of the economically important species. Research is also needed to establish the potential contribution of aphids to the spread of TuMV in the SARU germplasm collection in Palmer.

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