PLANT-INSECT INTERACTIONS

Specialized Host Utilization of *Macrosiphum euphorbiae* on a Nonnative Weed Host, *Solanum sarrachoides*, and Competition With *Myzus persicae*

RAJAGOPALBABU SRINIVASAN1 AND JUAN M. ALVAREZ2

Department of Plant Soil and Entomological Sciences, University of Idaho, Aberdeen R & E Center, 1693 S. 2700 W. Aberdeen, ID 83210


**ABSTRACT** The potato aphid, *Macrosiphum euphorbiae* (Thomas), (Homoptera: Aphididae), is a polyphagous aphid known to feed on over 200 plant species across 20 families. Although this aphid is known as one of the potato (*Solanum tuberosum* L.) colonizing aphids, field observations for populations of *M. euphorbiae* in southern Idaho indicated that they preferentially settled and colonized hairy nightshade, *Solanum sarrachoides* (Sendtner), plants rather than potato plants. Laboratory investigations revealed that *M. euphorbiae* survived only on *S. sarrachoides* and not on potato. A series of subsequent laboratory experiments conducted using laboratory-reared and field-collected aphids confirmed that *M. euphorbiae* survived only on *S. sarrachoides*. Experiments also showed that *M. euphorbiae* produced more winged morphs (alatea) than *Myzus persicae* on *S. sarrachoides* when reared alone under similar conditions. Furthermore, we documented intraguild competition between *M. euphorbiae* and *M. persicae* on *S. sarrachoides*. Results suggested that *M. euphorbiae* can potentially suppress *M. persicae* on *S. sarrachoides*. Competition studies reiterated that *M. euphorbiae* produced more alatea than *M. persicae*. Results also indicated that *M. euphorbiae* may have specialized on *S. sarrachoides*. The loss of polyphagous abilities of this *M. euphorbiae* “biotype” is intriguing and the factors responsible for specialized host utilization pattern remain to be elucidated.

**KEY WORDS** *Macrosiphum euphorbiae*, *Myzus persicae*, host utilization, intraguild competition, alatea

The potato aphid, *Macrosiphum euphorbiae* (Thomas), and the green peach aphid, *Myzus persicae* (Sulzer) (Homoptera: Aphididae) feed on hundreds of plant species across 20 taxonomic families throughout the world and the latter is believed to be more polyphagous than the former (Blackman and Eastop 1984, Cranshaw 1998, Blackman and Eastop 2007). They are common in potato, *Solanum tuberosum* L., ecosystems in Idaho and in the Pacific Northwest (PNW; encompassing the states of Idaho, Washington, and Oregon). Both *M. euphorbiae* and *M. persicae* are known to colonize potato plants and transmit viruses, such as *Potato leafroll virus* (PLRV), and *Potato virus Y* (PVY) (Cranshaw 1998, Alvarez et al. 2003).

*Solanum sarrachoides* (Sendtner) is a nonnative weed believed to have originated in South America. It is ubiquitously found in Idaho’s potato ecosystems and is also a host for the aforementioned aphids and potato viruses (Ogg et al. 1981, Ogg and Rogers 1989, Alvarez et al. 2003, Alvarez and Hutchinson 2005). Earlier studies clearly indicated that *M. persicae* exhibited a strong preference for *S. sarrachoides* than potato and its fecundity was higher on *S. sarrachoides* than on potato (Alvarez et al. 2003, Alvarez and Srinivasan 2005, Srinivasan et al. 2006).

Additional investigations revealed that *M. euphorbiae* populations in Southern Idaho may also exhibit a strong preference for *S. sarrachoides* over potato. *M. euphorbiae* was not found colonizing potato plants or other nearby host plants besides *S. sarrachoides* in potato fields. Laboratory studies indicated that *M. euphorbiae* nymphs produced by adults reared on *S. sarrachoides* failed to become adults on potato (Srinivasan et al. 2008). It is not clear whether this unique adaptation of *M. euphorbiae* to *S. sarrachoides* has deprived its ability to feed and reproduce on other secondary hosts and is further examined in this study.

*M. persicae* is known to overwinter as eggs on peach, *Prunus persica* L. (Batsch), and *M. euphorbiae* overwinters as eggs on wild rose, *Rosa* sp. (Cranshaw 1998, Alvarez et al. 2003). Overwintering hosts are considered as primary hosts. In spring and summer both aphid species colonize secondary hosts including potato and *S. sarrachoides*. Our observations in potato fields at Aberdeen and Kimberly, ID revealed that *M. euphorbiae* colonized *S. sarrachoides* earlier in spring.

---

1 Present address: Department of Entomology, University of Georgia, Coastal Plain Experiment Station, Tifton, GA 31793.

2 Corresponding author, e-mail: jalvarez@uidaho.edu.
than M. persicae. However, in late spring and summer both aphid species were consistently present on S. sarrachoides. This led us to speculate that there could be intraguild competition between M. euphorbiae and M. persicae on S. sarrachoides. Both aphid species belong to the phloem-feeding guild and limitation in guild (phloem) resources can lead to intraguild competition. Competition is more common in managed agricultural systems such as the potato ecosystems than in natural systems (Denno et al. 1995). It is also more common among haustellate sap feeders than among mandibulate insects (Lawton and Hassell 1981; McClure 1989, 1990; Denno et al. 1995). Competition can be affected by host plant quality and species composition. It often leads to emigration of one species to other available hosts or trigger migratory forms in wing polymorphic insects (Watt and Dixon 1981, Edman 1985, Antolin and Addicott 1988, Denno and Rodrick 1992, Denno et al. 1995). Previous studies showed that M. euphorbiae and M. persicae reproduced at higher rates on S. sarrachoides than on potato (Alvarez et al. 2003, Alvarez and Srinivasan 2005, Srinivasan et al. 2008). However, no information is available on competition between the two aphid species on S. sarrachoides.

The availability of host plants in the landscape, their nutritional quality, and crowding or competition may play an important role in influencing host specialization and host utilization patterns of aphids (Moran 1988, Müller et al. 2001). Whether these factors led to the development of a S. sarrachoides-specific M. euphorbiae biotype stills remains to be examined. Even if this were the case, the survival of such a biotype year after year under holocyclic reproductive conditions is highly dubious (Williams et al. 2000). To better understand M. euphorbiae’s interactions with S. sarrachoides in Idaho’s potato ecosystems, we conducted a field sampling study and also a series of laboratory experiments using laboratory-reared and field-collected populations of M. euphorbiae. It has been argued that host specialization in aphids can limit their ability to efficiently use alternate hosts (Moran 1988, Moran and Whitham 1988, Dixon 1998). Continuous laboratory culturing of aphids in a single host can also deprive their ability to survive on other hosts (Williams et al. 2000). Therefore, we tested the colonizing ability of laboratory-reared and field-collected M. euphorbiae populations on several previously recorded alternate hosts. The potential of M. euphorbiae to compete with M. persicae and the production of alatae by both aphid species with and without competition was also investigated in this study. Alatae production can be influenced by host plants and other factors (Johnson 1966, Kidd and Tozer 1984, Williams et al. 2000, Müller et al. 2001). Alatae production may facilitate dispersal to heterogeneously distributed host plants and thereby avoid competition (De Barro 1992, Müller and Godfray 1997, Müller et al. 2001). From a different point of view, increased alatae production in an agriculturally important species such as M. euphorbiae can lead to increased virus transmission in potato.

Materials and Methods

Host Plants. The following plant species were used in the experiments: hairy nightshade (S. sarrachoides), ground cherry (Physalis floridana (Rydberg)), potato (cultivar Russet Burbank), tobacco (Nicotiana tabacum L. variety Samsun), Chinese cabbage (Brassica pekinensis (Ruprecht)), and rose (Rosa ‘BURway’). These hosts were chosen as they were previously reported or putative hosts of M. euphorbiae (Blackman and Eastop 1984, Cranshaw 1998, Alvarez et al. 2003, Blackman and Eastop 2007). Except for potato and rose plants, all the host plants were grown from seeds. Seeds were germinated in petri dishes lined with moist filter paper, sealed with laboratory film (Parafilm, Greenwich, CT), and incubated in growth chambers at 25°C and 90% RH for 5–7 d. The germinated seedlings were then planted in a greenhouse in pots of size 10 × 10 × 15-cm with a 2:2:1 potting mix (sand:peat:vermiculite) and 14:14:14 (N:P:K) encapsulated fertilizer. Subsequently the seedlings were maintained at 19–27°C with a 16 h photoperiod.

Potato plantlets were derived from tissue culture. They were potted and maintained in the greenhouse under aforementioned conditions. Rose stem cuttings were obtained from Dr. Steve Love, Horticulture Team Leader and Superintendent of the Aberdeen R & E center, and planted in pots containing potting mix. Newly rooted healthy rose plants were chosen for our experiments.

Aphids. A colony of M. persicae clone ‘Our’ initially collected by Dr. Guy W. Bishop from potato and maintained on Indian mustard, Brassica juncea (L.) Czernajev for over 25 yr was obtained from Dr. Thomas M. Mowry, retired Entomologist, University of Idaho, Parma R & E Center. The colony is maintained at the Aberdeen R & E Center since 2001 on B. pekinensis in growth chambers at 21–26°C, 90% RH, and a 14 h photoperiod. B. pekinensis seeds were obtained from a commercial facility, germinated, and maintained in the greenhouse as described above.

M. euphorbiae adults were collected from S. sarrachoides plants in potato fields during the summer of 2004 (M. euphorbiae was not found colonizing any other nearby host plants) in Aberdeen and Kimberly, ID. Voucher specimens in 70% ethanol are stored at the Aberdeen R & E center, ID. A colony of M. euphorbiae is being maintained at the Aberdeen R & E Center on S. sarrachoides since the summer of 2004 in growth chambers as described above. Our repeated attempts to establish a M. euphorbiae colony on potato, rose, and P. floridana in growth chambers by transferring M. euphorbiae adults collected from S. sarrachoides in potato fields failed. Nymphs produced by these adults did not reach adulthood.

M. euphorbiae Settling on S. sarrachoides and Potato Under Field Conditions. Aphid counts were taken on 10 randomly selected S. sarrachoides plants present in a potato field and on 10 adjacent potato plants located (<10 cm from each of the sampled S. sarrachoides plants) potato plants from two locations in Kimberly, ID. Potato fields were planted (cultivar Russet Burbank) in...
the second week of May and plants emerged ~30 d later. Counts on three different plant levels (top, middle, and bottom) were completed at weekly intervals for 5 wk from 23 June to 21 July during the 2003 and 2004 growing seasons. Sampling dates were chosen based on the peak aphid abundance at the same location in two preceding years (data not shown). To avoid sampling the same plant on consecutive dates, plants were tagged upon completion of counts.

Because potato leaves are larger than S. sarrachoides leaves equal leaf surface areas of both plant species were examined to maintain uniformity in the sampling procedure. Aphid populations on both host plant species were compared based on a previously established protocol (Alvarez and Srinivasan 2005). To compare the two sampling units a relationship between the two leaf surface areas was established (e.g., 1 top potato leaf = 4 top S. sarrachoides leaves). The count data were subjected to rank transformation (Conover and Iman 1981) before analysis of variance (ANOVA). Proc GLM in SAS 9.2 (SAS institute, 2008) was used for ANOVA to assess the effect of host plants, plant levels (top, middle, and bottom), and their interactions on M. euphorbiae settling. Sampling date was treated as a repeated measures factor. Fisher least significant difference (LSD) was used to assess aphid settling at each location for each host in SAS.

Laboratory-Reared and Field-Collected M. euphorbiae Survival on Selected Host Plants. Three plants of each of the six host plant species described above were used for this experiment. Four laboratory reared adult aphids were individually placed on the ventral side of the treatment plant leaves/leaflets and confined individually in leaf cages. Leaf cages (3 cm diameter and 2 cm tall) were constructed from collection vials (BioQuip, Rancho Dominguez, CA) with a chiffon bottom. Each plant with four leaf cages was considered as a replicate. After 48 h the adult and all but one nymph were removed from the cage. This single nymph in the cage was monitored at 48 h intervals until death. Percentage of nymphs turned into adult alatae/apterae was determined and treatment differences were estimated as explained above.

Evaluating Competition Between M. euphorbiae and M. persicae on S. sarrachoides. All experimentation indicated that no M. euphorbiae nymphs survived on potato plants. Hence competition between two aphid species was evaluated on S. sarrachoides alone. Seed raised S. sarrachoides plants (~10-cm tall) were used for this purpose. Each plant was enclosed in an individual Plexiglas cage (50 × 30 × 50-cm). Ten adults from the laboratory colony were released on each of the test plants. This experiment had three treatments (M. euphorbiae alone [10 adults], M. persicae alone [10 adults], and M. euphorbiae and M. persicae together [10 adults per species]) and each treatment was replicated five times. The plants were maintained in growth chambers at 21–26°C, 90% RH, and 14 h photoperiod. The plants were evaluated at 1, 11, 22, and 33 d postaphid release. At each evaluation period, the number of alatae and apterae of one or both species was counted and their percentages estimated. Nymphs were also included in the apterae category and aphid densities were compared among treatments by ANOVA by using Proc GLM in SAS. The same population was evaluated throughout the experiment; hence date of observation was treated as a repeated measures factor.

Results

M. euphorbiae Settling on S. sarrachoides and Potato Under Field Conditions. Field evaluations on M. euphorbiae settling illustrated a clear preference for S. sarrachoides when compared with potato in both locations on both years (Table 1; Fig. 1). Species and settling level interactions were noticed only at location 2 in 2003 (F = 4.19; df = 2, 54; P = 0.0203). In 2003, at location 2, more aphids were observed at the bottom level of S. sarrachoides plants than at other levels. No differences in settling were observed on S. sarrachoides at location 1 in 2003 as well as at both locations in 2004 (Table 1). Very few aphids were observed during the entire sampling period on potato plants; hence no positional differences were discernible on potato plants (Table 1).

Laboratory-Reared and Field-Collected M. euphorbiae Survival on Selected Host Plants. All the monitored nymphs produced by laboratory-reared adults on S. sarrachoides matured to become adults. Whereas, none of the nymphs on other host plants survived to become adults (F = ∞; df = 5, 66; P = < 0.0001). In the test with field-collected adults 92% of the nymphs survived and reached adulthood on S. sarrachoides. As in the previous experiment, none of the nymphs on other hosts survived to become adults (F = 121; df = 5, 66; P = < 0.0001).

Alatae Production by M. euphorbiae and M. persicae on S. sarrachoides and Potato. Fifteen of the 40 (37.5%) monitored M. euphorbiae nymphs on S. sarrachoides turned into alatae even under noncrowded conditions (one nymph/leaf cage). None of the M. euphorbiae nymphs survived on potato. Conversely,
none of the *M. persicae* adults turned into alatae on either *S. sarrachoides* or potato. Therefore, this bio-
type of *M. euphorbiae* seems to possess an intrinsic 
ability to produce more alatae when compared with *M. 
persicae* under similar conditions on *S. sarrachoides* 
(*F* = 22.86; df = 2, 117; *P* < 0.001).

Evaluating Competition Between *M. euphorbiae* and *M. persicae* on *S. sarrachoides*. Competition studies demonstrated clear differences in population levels between both aphid species. *M. euphorbiae* counts at 11 (*F* = 4.65; df = 1, 3; *P* = 0.0631), 22 (*F* = 0.81; df = 1, 3; *P* = 0.3943), and 33 (*F* = 3.99; df = 1, 3; *P* = 0.0808) days postrelease revealed no differences in population densities with or without the presence of *M. persicae* suggesting that competition had no effect on *M. euphorbiae* (Fig. 2a,b). Conversely, the population density of *M. persicae* in competition with *M. euphorbiae* declined at 11 (*F* = 7.29; df = 1, 3; *P* = 0.0306), 22 (*F* = 28.00; df = 1, 3; *P* = 0.0011), and 33 (*F* = 124.35; df = 1, 3; *P* = < 0.0001) days postrelease indicating that *M. euphorbiae*’s presence had a negative effect on *M. persicae* (Fig. 2b). At 22 and 33 d postrelease the ratio of *M. euphorbiae* to *M. persicae* was 2.1:1 and 1.6:1, respectively. In the absence of competition populations of both species steadily increased at 11 and 22 d postrelease (Fig. 2a). The population density of *M. persicae* was higher than the density of *M. euphorbiae* at 33 d postrelease. *Myzus persicae*’s population increased 850-fold, whereas *M. euphorbiae*’s population only increased 130-fold (Fig. 2a).

As in the previous experiment with leaf cages *M. euphorbiae* produced alatae at a higher rate when compared with *M. persicae*. *M. euphorbiae* produced more alatae than *M. persicae* in the absence (*F* = 543.31; df = 1, 8; *P* < 0.0001) and presence of competition (*F* = 42.18; df = 1, 8; *P* = 0.0002). The production of alatae increased for 22 d postrelease and then declined thereafter (Fig. 3a,b). In the absence of competition, *M. euphorbiae* produced more alatae than *M. persicae* at 11 (*F* = 11.49; df = 1, 8; *P* = 0.0095) and 22 (*F* = 112.99; df = 1, 8; *P* < 0.0001) days postrelease.

### Table 1. Average no. of *M. euphorbiae* per plant level on *S. sarrachoides* and potato at two locations in Kimberly, ID, over 2 yr

<table>
<thead>
<tr>
<th>S. sarrachoides (n = 50)</th>
<th>Potato (n = 50)</th>
<th>Species* level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location 1 2003</td>
<td>0.6 ± 0.3</td>
<td>1 ± 0.5</td>
</tr>
<tr>
<td>Location 2 2003</td>
<td>0.1 ± 0.1</td>
<td>0.2 ± 0.1</td>
</tr>
<tr>
<td>Location 1 2004</td>
<td>4.5 ± 1.5</td>
<td>1.1 ± 0.4</td>
</tr>
<tr>
<td>Location 2 2004</td>
<td>2.2 ± 0.7</td>
<td>0.9 ± 0.3</td>
</tr>
</tbody>
</table>

Counts are presented as mean ± SE, *n* is no. of plants scouted.

*P* refers to the no. of aphids at different plant levels (top, middle, and bottom) at each location; *a* indicates significant differences among levels. Treatment means followed by the same letter are not significantly different from each other.

*P* refers to the no. of aphids on different plant hosts (*S. sarrachoides* and potato) at each location; *b* indicates significant differences between species.

*p* refers to the interaction between host species and aphid settling at three different levels; *c* indicates significant interaction between settling levels and plant species.
Fig. 3. Alatae production by *M. euphorbiae* and *M. persicae* on *S. sarrachoides* (a) without and (b) with competition. Lines with standard error bars represent percent alatae at various time intervals.

postrelease. However, at 33 d (*F* = 4.39; df = 1, 8; *P* = 0.0694) no differences were observed (Fig. 3a). A similar trend was observed in the presence of competition. *M. euphorbiae* produced more alatae than *M. persicae* at 11 (*F* = 20.34; df = 1, 8; *P* = 0.0020) and 22 (*F* = 35.05; df = 1, 8; *P* = 0.0004) days postrelease. However, at 33 d (*F* = 4.52; df = 1, 8; *P* < 0.0661) no differences were observed (Fig. 3b). Peak alatae production with and without competition was observed at 22 d postrelease. At 22 d, the rate of alatae production of *M. euphorbiae* was at least seven times higher than *M. persicae* when the two species were together and 15 times higher than *M. persicae* in the absence of competition (Fig. 3a,b).

Discussion

Our earlier studies have illustrated that *S. sarrachoides* plants were preferred by *M. persicae* over potato and the longevity and fecundity of *M. persicae* and *M. euphorbiae* were higher on *S. sarrachoides* than on potato (Alvarez and Srinivasan 2005; Srinivasan et al. 2006, 2008). *M. persicae* also reproduced more efficiently on *S. sarrachoides* than on other orchard weeds (Tamaki and Olsen 1979) suggesting that *S. sarrachoides* may be nutritionally superior to potato and other hosts. The presence of phagostimulants such as aminoacids and the absence of phagorepellents such as glykoalkaloids in *S. sarrachoides* could contribute to its nutritional superiority (Guntner et al. 1997, Karley et al. 2002). Structural components of host plants such as glandular trichomes can also affect aphid survival (Tingey et al. 1982). Most potato cultivars do not possess glandular trichome-induced aphid resistance and trichome types in *S. sarrachoides* have not been identified. Pelletier et al. (2010) evaluated seven wild *Solanum* sp. against aphids and documented resistance but did not identify the mechanisms.

Field evaluations in this study indicated that *M. euphorbiae* also exhibited a strong preference for *S. sarrachoides* over potato. However, no *M. euphorbiae* positional settling patterns were observed on *S. sarrachoides* and potato as opposed to *M. persicae*, which preferentially settled on the lower part of host plants (Alvarez and Srinivasan 2005). No *M. euphorbiae* colonization was observed on potato during these field evaluations suggesting that the observed *M. euphorbiae* could have possibly moved from *S. sarrachoides* located adjacent to potato plants (<10 cm apart). It is also common for potato and *S. sarrachoides* foliage to overlap. Such overlapping could have facilitated movement between *S. sarrachoides* and potato plants and vice versa. These results corroborate our earlier findings wherein we documented no *M. euphorbiae* survival on potato unless they were infected with PLRV (Srinivasan et al. 2008). PLRV infection induces visible symptoms on infected potato plants and viral infections in general are known to alter plant physiology (Markkula and Laurema 1964, Ajayi 1986, Lobeinstein 2001). These changes may have influenced the survival of *M. euphorbiae* on PLRV-infected potato plants in our earlier study. There were no visible PLRV symptoms on potato plants tagged for field sampling of *M. euphorbiae*.

Studies using the laboratory-reared and field-collected *M. euphorbiae* yielded similar results. *M. euphorbiae* nymphs survived to become adults only on *S. sarrachoides*. These results demonstrate that the inability to survive on other host plants is not due to continuous culturing on the same host but due to specialization. Continuous culturing in a host is known to reduce the ability of arthropod herbivores to survive on other hosts (Williams et al. 2000), but the inability of nymphs produced by field-collected adult aphids to survive on various host plants indicates that *M. euphorbiae* has adapted to specialized feeding on *S. sarrachoides*. Potato plants used in this study were obtained through tissue culture and were genetically identical. Genetic diversity among potato cultivars is known to differentially affect aphid survival and reproduction (Davis et al. 2007). However, the inability of both lab-reared and field-collected *M. euphorbiae* to survive on other known host plants once again shows that this *M. euphorbiae* biotype has adapted to specialization on *S. sarrachoides*.

Insects in general are known to adapt to invasive plant species (Carroll et al. 2008). Such adaptations can sometimes lead to host specialization (Moran 1988, Moran and Whitham 1988). Host specialization in aphids is influenced by numerous factors including facultative endosymbionts (Jaenike 1990, Losey and Eubanks 2000, Leonardo and Muiru 2003, Carletto et al. 2009). Specialization can also reduce the ability of aphids to efficiently use other secondary hosts (Moran and Whitham 1986, Moran 1988, Dixon 1998). The
inability of this specific *M. euphorbiae* biotype to survive on other known alternate hosts reiterates that it has specialized on *S. sarrachoides*.

Experiments also lucidly demonstrated severe competition between the two aphid species. Interactions among sap feeders using the same phloem resource have been well documented (Denno et al. 1995). Such interactions are often asymmetric or symmetric; in this case competition did not affect *M. euphorbiae*. Conversely, *M. persicae* was affected by the presence of *M. euphorbiae*. *M. persicae* population counts were up to 34 times lower in the presence of *M. euphorbiae* indicating asymmetry in competition.

Leaf cage experiments with individual aphids revealed that *M. euphorbiae* produced more alatae than *M. persicae*, 37.5% of *M. euphorbiae* nymphs turned into alatae whereas none of *M. persicae* nymphs turned into alatae. Other studies have also documented high variability in alatae production among aphid species (Foot 1977, Tamaki and Olsen 1979, Williams et al. 2000). Even individually caged *M. euphorbiae* aphids produced more alatae than *M. persicae* suggesting that *M. euphorbiae* has an intrinsic ability to produce more alatae than *M. persicae*. Such an innate ability might facilitate early colonization of available *S. sarrachoides* plants in the landscape. Experiments by Williams et al. (2000) demonstrated that *Aphis fabae* (Scopoli) produced more alatae than *M. persicae* and *M. euphorbiae* on sugar beet, *Beta vulgaris L.*, at equivalent population densities. Conversely, the same study found a greater proportion of *M. persicae* alatae on oilseed rape, *Brassica napus L.*, than on sugar beet suggesting a host effect. A number of studies using artificial diets have illustrated that poor nutritional quality leads to lower alatae production (Mittler and Kleinjan 1970, Harrewijn 1976). On the contrary, aphids also produced more alatae while feeding on poorer diets (Mill et al. 2001) suggesting that the higher proportion of *M. euphorbiae* alatae could also be due to the nutritional quality of *S. sarrachoides* or a combination of intrinsic ability and host plant quality.

*M. persicae* in the PNW is known to survive on a multitude of hosts (Wallis 1967b, Alvarez et al. 2003). *S. sarrachoides* specific biotype of *M. euphorbiae* despite its polyphagous feeding abilities has resorted to specialized feeding, Williams et al. (2000) argued that the probability of a crop specific *M. persicae* biotype, which has a low alatae production ability (0.2%), to recolonize the same crop the following year, is 1:40,000. This suggests that there is negligible transfer of specific genetic material. In contrast, *M. euphorbiae* has high alatae production ability (up to 37.5% under crowded conditions on *S. sarrachoides*), thereby the chances of specific gene flow and retaining its crop specificity increases several fold. Aphid species such as *M. persicae* have also been documented to undergo anholocyclic reproduction and survive the winter as nymphs and adults in the PNW (Wallis 1967a,b; Duffus 1971; Alvarez et al. 2003). If this were true with *M. euphorbiae* then there is a higher probability for the evolution of a *S. sarrachoides* specific biotype. Diehl and Bush (1984) defined biotypes as insects that are morphologically similar but differ by subtle biological traits such as ability to survive on different hosts. Our results seem to suggest that there exists a *S. sarrachoides* specific biotype of *M. euphorbiae* in Idaho’s potato systems. More studies are required to further characterize this biotype.

**Acknowledgments**

We thank Pamela J.S. Hutchinson (PSES, University of Idaho) for providing hairy nightshade seeds. We thank Lorie Ewing and Diane Brady (University of Idaho) for providing the tissue culture potato plantlets, Steve Love for rose stem cuttings, and William Price for statistical assistance. We also thank Harold Libby for technical support, and the anonymous reviewers for improving this manuscript. This is Idaho Agricultural Experiment Station manuscript PSES-0452.

**References Cited**


