Phenology and Development of the Yellow Rose Aphid, *Acythrosiphon porosum* (Sanderson), in Northern Florida and Southern Georgia[1]

Russell F. Mizell, III[2] and William G. Hudson[3]

North Florida Research & Education Center, University of Florida, Quincy, Florida 32351 USA

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Abstract The yellow rose aphid, *Acythrosiphon porosum* (Sanderson), is a cosmopolitan pest of roses and strawberries. *Acythrosiphon porosum* is one of only a few arthropod pests of roses occurring in northern Florida and southern Georgia. Hybrid roses are widely planted around the city of Thomasville, GA, which is known as the Rose City. Three 'Grandiflora' rose cultivars 'Queen Elizabeth', 'Roundelay' and 'Spartan' were used to determine cultivar and location effects on *A. porosum* seasonal abundance and natural enemies. Developmental rate, longevity and nymph production of *A. porosum* were also investigated at 4 temperatures, 10.0, 15.5, 21.1, and 26.7°C, in environmental chambers using cut leaf discs of 'Queen Elizabeth' on agar plates. *Acythrosiphon porosum* occurred throughout much of the year except for the coldest winter and warmest summer months and reached highest populations during the cooler weather of spring and fall. Cultivar differences were statistically significant at all locations where 'Queen Elizabeth' averaged higher aphids per leaf than 'Roundelay', which averaged higher aphids than 'Spartan'. Aphid numbers did not significantly differ in comparisons of leaves sampled from the bottom, middle or top third of the plant's canopy height. Developmental rate calculated as the time from nymph to nymph was most rapid ($\bar{x}$ = 10.3 d) at 21.1°C, but no aphid development was observed at 26.7°C. Total egg production was highest ($\bar{x}$ = 27.5 nymphs per aphid) at 10.0°C as was longevity of 60.1 d. Highest nymph production (1.5 per d) was observed at 21.1°C. Many generalist predators and two parasitoid species were found in low numbers attacking *A. porosum*: *Syrphophagous aphidovorus* (Mayr) (Hymenoptera: Encyrticidae) and *Ephedius* sp. (Hymenoptera: Aphidiidae).

Key Words yellow rose aphid, *Acythrosiphon porosum*, rose, phenology, cultivar

The yellow rose aphid, *Acythrosiphon porosum* (Sanderson), is an important pest of roses (Blackman and Eastop 1984) and strawberries (MacGillivray 1961) with cosmopolitan distribution. First described in North America, it is now found on every continent except Asia (Blackman and Eastop 1984). In North America, it is monoecious holocyclic, but generally anholocyclic on cultivated *Rosa* spp. elsewhere. Blackman and Eastop (1984) described the appearance of the aptera as follows: brownish yellow head, remainder bright yellow to yellow-green, rather shiny, size 1.2-2.5 mm. The alatae have a bright green abdomen without black dorsal markings and are 1.4-2.2 mm in size (Blackman and Eastop 1984). Alverson and Parler (1983) reported on *A.*

[1]Received 14 April 2008; accepted for publication 07 May 2008.
[2]Address inquires (email: rfmizell@ufl.edu).
[3]Horticulture Building, University of Georgia, Tifton, GA 31794.

porosum field development, life table parameters and the outcome of competition between *A. porosum* and *Myzus persicae* (Sulzer) on hybrid tea roses in South Carolina. They found that *A. porosum* developed in 8.1 d from birth to adult. Adult virginoparae lived 17.8 d with a life expectancy of 25.8 d. Nymphs were produced at a rate of 1.56/d over the adult's 17.8 d lifespan. Net reproductive rate was calculated as 27.25 daughters per female (Alverson and Parler 1983).

Acythrosiphon porosum is the dominant arthropod pest of roses grown in northern Florida and southern Georgia. Whereas it often reaches populations of 15-30/compound leaf during its peak seasonal abundance in winter-spring causing occasional leaf drop, most damage to roses is indirect due to sooty mold growth on the aphid honey dew. However, on roses susceptible to black spot fungus, *Diplocarpon rosae* Wolf, the fungus is a far more common and a greater threat to plant appearance and defoliation than the aphid. Adults and nymphs of the leaffooted bug, *Euthochtha galeator* (F.), are also found feeding on rose buds during summer months, but appear to cause only minor damage. The objectives of this study were to determine and compare the phenology of *A. porosum* on several rose cultivars in northern Florida-southern Georgia, for potential sampling purposes, to determine if leaf position relative to plant height affected aphid distribution and abundance, and to determine the impact of constant temperature regimes on aphid development and reproduction. The occurrence of parasitoids and predators is also reported.

Materials and Methods

Two 'Grandiflora' rose plantings in Thomasville, GA, were chosen for the study. Additionally, the 3 most common rose cultivars, 'Queen Elizabeth', 'Roundelay', and 'Spartan', found in the Georgia locations were planted, 10 plants per cultivar, in a completely random design 1 m apart at the UF-IFAS North Florida Research and Education Center in Monticello, FL. 'Queen Elizabeth' with a brilliant pink bloom is widely planted, 'Roundelay' is also widely planted with a deep, dark-red bloom and 'Spartan' has a red bloom somewhat lighter than 'Roundelay'. Rose beds in all locations were mulched with pine straw or pine bark each spring and fertilized periodically with 10-10-10 N-P-K commercial fertilizer. Roses were also sprayed with fungicide haphazardly to manage black spot leaf disease.

The location designated as the cemetery plot (Peaceful Rest Cemetery) was on the north side of Thomasville, GA, and consisted of 4 rows approx. 50 m in length of each of the cultivars 'Queen Elizabeth' and 'Roundelay'. Roses were planted at 1.0 m spacing within the rows and 2.5 m between the rows. Grass sod surrounded the beds and was kept mowed. The location designated as the Old Monticello Road plot was located on the southeast side of Thomasville, GA, at the corner of Old Monticello Road and State Highway 19. This location consisted of the cultivar 'Queen Elizabeth' with approx. 50 plants spaced 1.0 m apart in a circular arrangement.

Sampling for yellow rose aphid and its natural enemies was achieved by weekly visits to the plots over different periods of time as indicated (Figs. 1-3). The laboratory plot was sampled from 1992-1994, the cemetery plot 1992-1994 and the Old Monticello Road plot in 1993-1994. At each visit 5 plants from each cultivar present were chosen at random from within the plot. From each plant, 3 compound leaves, 1 each from the bottom, middle and top third of the available leaf canopy, were removed and the number of yellow rose aphids per leaf was recorded. Before removing the leaf samples, each sample plant was carefully searched for the presence of common

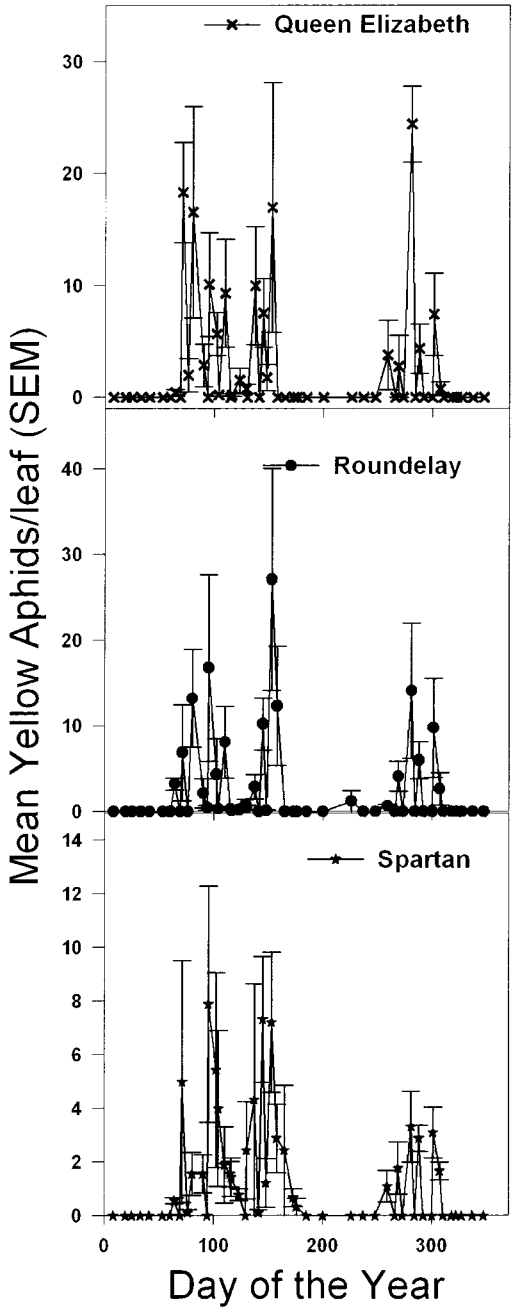

Fig. 1. Mean (±SEM) yellow rose aphids per leaf on a per plant basis at Monticello, FL in 1992-1994. Counts are averaged over all sampled roses for each of the three cultivars 'Queen Elizabeth', 'Roundelay' and 'Spartan'

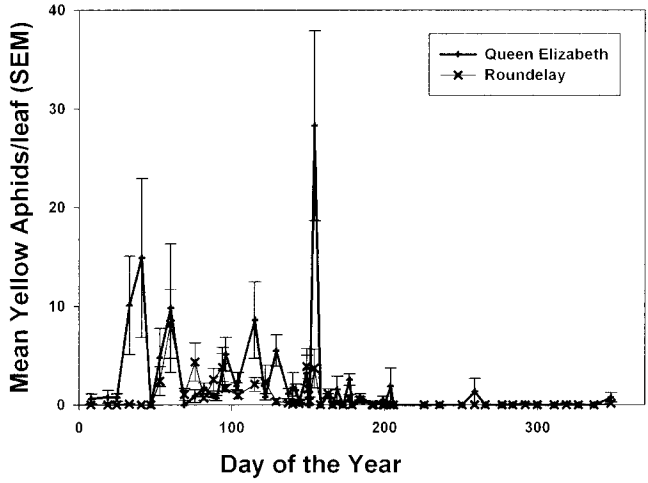

Fig. 2. Mean (±SEM) yellow rose aphids per leaf on a per plant basis at Thomasville, GA cemetery plot in 1992-1994. Separate counts are from roses of two cultivars 'Queen Elizabeth' and 'Roundelay'

aphid natural enemies such as Chrysopidae, Coccinellidae and Syrphidae and parasitoid mummies.

Developmental parameters of the yellow rose aphid were investigated at four temperatures—10.0, 15.5, 21.1, and 26.7°C—in environmental chambers. Leaf discs obtained using a #14 corkborer were placed on agar in 10 cm Petri dishes with the

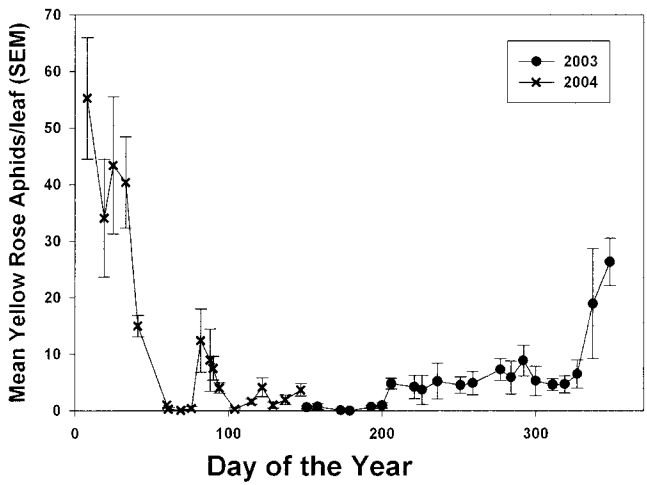

Fig. 3. Mean (±SEM) yellow rose aphids per leaf on a per plant basis at the Thomasville, GA Old Monticello Road plot in 1992-1994. Counts are from 'Queen Elizabeth' roses

abaxial surface touching the agar (Reilly and Tedders 1990). Petri dishes were inverted to provide the natural leaf orientation of adaxial side down. Adult aphids were placed on the discs and allowed to feed. Once a nymph was produced, the female was removed and the Petri dish containing the disc with the nymph was placed in the rearing chamber. For each treatment 30-35 nymphs were placed originally on discs for the study, but only 22, 26, 22 and 0 survived past 3 d, respectively, for the 10.0, 15.5, 21.1 and 26.7°C. Several life history parameters were computed from this experiment including adult longevity, cohort survivorship, fecundity and developmental time from nymph to nymph.

The weekly aphid counts were highly skewed with a large number of zeros and did not meet the normality and homogeneity of variances assumptions of analysis of variance. Therefore, statistical analyses were conducted using Proc Genmod with a Poisson distribution and a log link function (SAS 2007). Goodness of fit for the model was determined based on the scaled deviance parameter and means separation was completed using planned contrast statements at $P < 0.05$. Statistical differences by year, cultivar and sample leaf position, top, middle and bottom third of foliage, were investigated over all sample dates as appropriate for each location and results from the Type 3 analysis are reported for the main effects (SAS 2007). Mean aphids per compound leaf were computed on a per plant basis and are presented as the mean seasonal abundance per sample date per location (Figs. 1-3). The developmental data were analyzed using SAS Proc Mixed and differences in treatment means were assessed at $P \leq 0.05$ using the lsmeans/pdiff statement (SAS 2007).

Results and Discussion

Acythrosiphon porosum occurred throughout much of the year attaining highest populations during the cooler weather of spring and fall and lowest during winter and summer at all locations (Fig. 1-3). Aphid numbers by cultivar were significantly different statistically at the Laboratory and Cemetery locations which had more than one cultivar. At the Laboratory location, aphid numbers were significantly different among the 3 yrs and the 3 cultivars but the interaction term year*cultivar was not significant ($F = 1.47$, $df = 6,1593$, $P = 0.1828$). Leaf position was also not significantly different ($F = 1.81$, $df = 18,1593$, $P = 0.1083$). Mean aphid populations in 2002 were significantly greater than in 2003 and 2004 ($F = 34.6$, $df = 2,1593$, $P < 0.0001$) but 2003 and 2004 populations did not differ ($F = 2.41$, $df = 2,1593$, $P < 0.1211$). Aphid populations on 'Queen Elizabeth', 2.74 ± 0.4 (mean±SEM) ($F = 9.3$, $df = 2,1593$, $P < 0.0023$) were significantly greater than both 'Roundelay', 2.68 ± 0.4 and 'Spartan' 1.38 ± 0.17, and the mean aphid populations on 'Roundelay' were significantly greater than 'Spartan' ($F = 24.91$, $df = 2,1593$, $P < 0.0001$).

At the Cemetery location, the interaction term year*cultivar also was not significant. The mean aphid populations were significantly greater on 'Queen Elizabeth' (2.18 ± 0.35, mean ± SEM over all years) than on 'Roundelay' (0.81 ± 0.28) in all 3 years. Aphid populations also varied significantly by year with 2004 > 2003 > 2002 ($F = 29.96$, $df = 1,1643$, $P < 0.0001$ for 2004 versus 2003 and 2002, $F = 400.6$, $df = 1,1643$, $P < 0.0001$, 2003 versus 2002, respectively) (Fig. 2). Mean aphids for 'Queen Elizabeth' were 2004 (4.84 ± 0.71) >2003 (0.17 ± 0.05) >2002 (1.60 ± 0.28), and for 'Roundelay' 1.65 ± 0.28, 0.88 ± 0.22, and 0.03 ± 0.35, respectively.

No aphid development was observed at 26.7°C (Table 1). All developmental parameters followed similar patterns across the 3 lowest temperature regimes with the

Table 1. Mean (± SEM) developmental rate, nymph production, and longevity of the yellow rose aphid, *Acythrosiphon porosum,* under 4 temperature regimes

Temperature (°C)	N	Time to 1st nymph	Nymph production	Longevity (days)	Mean nymphs/ day**
10.0	22	32.0 ± 1.0A*	27.5 ± 2.3A	60.1 ± 2.2A	0.8 ± 0.04A
15.5	37	12.6 ± 0.4B	12.7 ± 1.4B	25.8 ± 1.5B	0.9 ± 0.1AB
21.1	25	10.3 ± 0.4B	16.0 ± 1.3B	26.0 ± 1.6B	1.5 ± 0.10B
26.7	15	—	—	—	—

* Means not followed by same letter in column are significantly different $P < 0.05$ as determined by Proc Mixed least squares means/pdiff test.

** Over the nymph production days only, not entire lifetime.

parameters at 10.0°C significantly different ($P < 0.05$) than the parameters at 15.5 and 21.1°C, which were equivalent. Developmental rate calculated as the time from nymph to nymph was most rapid (10.3 d) at 21.1°C. Total nymph production was highest 27.5 at 10.0°C. Highest nymph production per aphid (1.5 per d), was observed at 21.1°C. These values are in close agreement with the life table parameters reported from field studies of *A. porosum* in South Carolina (Alverson and Parler 1983). Greatest longevity, 60.1 d, was also observed at 10.0°C (Table 1, Fig. 4).

Two parasitoid species were found in low numbers attacking *A. porosum*: *Syrphophagous aphidovorus* (Mayr) (Hymenoptera: Encyrticidae) and *Ephedius* sp. (Hymenoptera: Aphidiidae) in the Georgia locations but not in Florida. *Syrphophagous aphidovorus* produces a whitish mummy and was most abundant, whereas *Ephedius* sp.

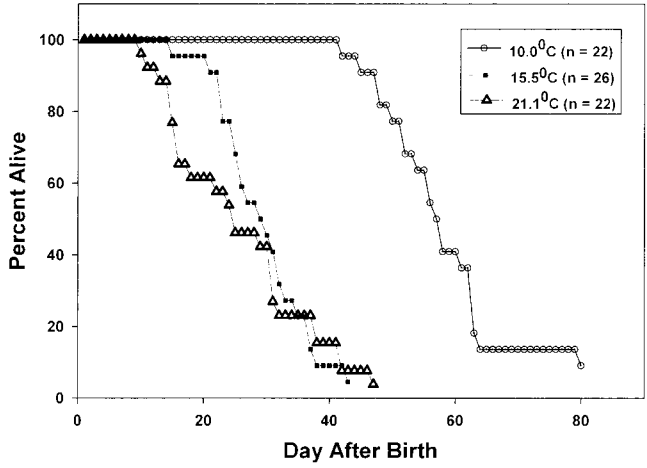

Fig. 4. Cohort percent survival of yellow rose aphids on leaf disks of 'Queen Elizabeth' at three different temperatures in a growth chamber. No aphids survived more than 3 days at a temperature of 27.7°C

has a black mummy. Neither parasitoid was very common. Other observed natural enemies included the coocinellids, *Harmonia axyridis* (Pallas), *Coccinella septempunctata* L., *Hippodamia convergens* (Guerin-Meneville), the chrysopid, *Chrysoperla rufilabris* (Bermeister), and an occasional syrphid larva. No species of these predators were observed in any consistent numbers in any location on any date, probably as a result of the cooler temperature regimes that occur during the early spring, which the yellow rose aphid preferred (Figs. 1-3).

The phenology of yellow aphid in northern Florida and southern Georgia on roses in this study was much different than the phenology of the crapemyrtle aphid, *Sarucallis kahawaluokalani* (Kirkaldy) on *Lagerstroemia indica* L. Mizell and Schiffhauer (1987) and Mizell and Knox (1993) reported that crapemyrtle aphid populations appeared in late May-early June, peaked consistently during late July and lasted often until first frost. Like yellow rose aphids, crapemyrtle aphid populations vary dramatically among cultivars (Mizell and Knox 1993). However, the numbers of generalist predators found feeding on the yellow rose aphid were much lower than found on crape myrtle (Mizell and Schiffhauer 1987), although the predator species found so far are common to both. Interestingly, no parasitoids are known from crapemyrtle aphids (Mizell et al. 2002) and the 2 reported here on yellow rose aphid were only found in low numbers. Roses are widely planted in northern Florida and southern Georgia and when common infestations of the yellow rose aphid are present, the aphids may serve as an important host for beneficial insects in the landscape during the cooler periods of the year when most aphid species such as the pecan aphid complex are dormant (Mizell and Schiffhauer 1987).

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