

Preference, Developmental Time, Adult Longevity and Fecundity of Green Peach Aphid (Homoptera: Aphididae) on Spinach¹

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ABSTRACT Spinach, *Spinacia oleracea* L. breeding lines and a commercial cultivar were evaluated for differences in green peach aphid, *Myzus persicae* (Sulzer), preference, developmental time, adult longevity and fecundity. Aphid preference varied significantly among the breeding lines and the commercial cultivar 'Kent.' Line F70 was the only line significantly non-preferred when compared with 'Kent'. Significant differences in aphid developmental time, adult longevity and fecundity were detected. Aphids held on line F70 required a longer period to reach reproductive age and produced fewer young than aphids held on 'Kent.'

KEY WORDS *Myzus persicae*, *Spinacia oleracea*, green peach aphid, spinach, host plant resistance, insect.

Quality spinach is becoming increasingly difficult to produce in Arkansas, Oklahoma and Texas. Several factors are responsible for reductions in spinach quality, including disease, weeds, environmental stress, and insects. The greatest insect threat is the green peach aphid, *Myzus persicae* (Sulzer). The aphid occurs on spinach throughout the season but often is most abundant in early spring on overwintered spinach (McLeod 1989). Aphid management efforts have primarily been based on foliar sprays of dimethoate or mevinphos. Insecticide screening studies during recent years have shown that neither insecticide consistently provided acceptable levels of aphid suppression (McLeod 1986, 1987, 1988). Furthermore, no other insecticide currently registered for use on spinach provided acceptable aphid suppression. Although some newer insecticides increased aphid suppression when compared to currently registered materials, registration of these newer insecticides will likely take several years. Thus, it is evident that alternative methods of aphid management on spinach be developed.

In 1986, significant variation in levels of aphid infestation was observed on spinach breeding lines grown for the University of Arkansas spinach breeding program at the Texas A&M Experiment Station, Uvalde, TX. In order to explore the potential for using plant resistance as an aphid management tool, a study was undertaken in 1987 to measure differences in green peach aphid preference, developmental time, adult longevity and fecundity on six spinach breeding lines and compare these measurements to those obtained with a commercial cultivar.

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Materials and Methods

Spinach lines chosen for the study included F68, F69, F70, F71, F77, and F92 from the University of Arkansas spinach breeding program and 'Kent' (Asgrow Seed Co.). These lines were chosen for study on the basis of observed differences in aphid abundance in spinach plots at the Texas A&M Experiment Station, Uvalde, TX (Frank Dainello, personal communication). Plants were produced in 9-cm diameter pots containing Redi-Earth Peat-Lite Mix (W. R. Grace and Co., Cambridge, MA 02140) from November 1986 to May 1987 in a greenhouse at the Main Experiment Station, Fayetteville, AR. Temperature was maintained at 22 $\pm$ 4°C under natural daylength. Plants received weekly applications of fertilizer (13 g Peters General Purpose 20-20-20 in 3.8 l water). After developing approximately eight leaves, plants were transferred to the laboratory for testing. Green peach aphids used in the study were maintained on spinach cv 'Grandstand' in a laboratory cage. All tests were conducted in environmental chambers at 21°C and a photoperiod of 12:12 (LD).

Preference. The preference test arenas consisted of 100 $\times$ 15 mm non-vented plastic petri dishes containing moistened filter paper on the bottom. The arena permitted aphid preference for two lines (A or B) to be compared. Two 1-cm leaf disks were removed from each of the two test plants with a cork borer. The four leaf disks were placed around the dish bottom perimeter in alternating sequence, i.e., ABAB. In order to minimize cabinet effects, the sequence was alternated for each replication, i.e., BABA. Following leaf disk placement, 10 adult apterous aphids were placed near the center of each filter paper. Dishes were covered and transferred to the environmental chamber. The location of aphids was determined after four hours. Each of the 21 possible paired comparisons was repeated eight times and analyzed by Chi Square (SAS, 1985).

Antibiosis. The degree of antibiosis was determined by measuring aphid developmental times and reproductive rates on leaves of each plant type. Test arenas consisted of a single excised leaf held in moist floral foam. The test was initiated by transferring one 1st instar green peach aphid to the upper leaf surface with a camel-hair brush. Only aphids born within 12 h prior to the initiation of the test were used. Each test consisted of 15 leaves of each of the six breeding lines and the cv 'Kent.' The test was repeated three times. Each day aphids were examined for molting, progeny, and mortality. Aphids were transferred to fresh leaves every other day. Measurements included number of days to first progeny, number of days as an adult and number of progeny produced. Data were analyzed by ANOVA, and means were separated by Duncan's Multiple Range Test (SAS 1985).

Results and Discussion

Preference. Of the 21 pairwise combinations tested with a one-way Chi square classification, five comparisons yielded a significant preference (Table 1). The F70 line was non-preferred when compared to 'Kent' or F71. No line except F70 was significantly non-preferred when compared to the commercial cultivar 'Kent.' If no preference was exhibited by the total of 560 aphids used for comparison, 240 aphids would have been counted on each line. Across all comparisons, 202 aphids were found on the F70 line, indicating low preference. A total of 306 aphids was

Table 1. Spinach lines preferred by adult apterous green peach aphids when given a pairwise choice.

		preferred spinach line						
		F92	Kent	F77	F71	F70	F69	F68
	F68	5.03*	NS**	NS	NS	NS	NS	—
	F69	NS	NS	NS	NS	NS	—	
non-preferred	F70	NS	3.89	NS	9.50	—	—	
spinach line	F71	NS	NS	4.45	—			
	F77	NS	NS	—				
	Kent	3.18	—					
	F92	—						

* Numerical Chi Square values indicate a significant preference for one line (1 df); e.g., F92 was preferred over F68.

** Preference was not significant.

detected on line F77, an indication of aphid preference for this line. The preference test provided an indication of aphid avoidance in spinach. However, non-preference alone may not be sufficient to prevent aphid establishment under field conditions of “no choice.” Furthermore, observations indicated that young aphids were produced on lines not preferred by adult aphids.

Antibiosis. Significant differences were detected with each of the three measurements used for antibiosis testing (Table 2). The mean number of days to first reproduction varied from 10.5 on ‘Kent’ to 12.9 on F70 — a difference of 2.4 days. Line F70 was the only line on which aphid development was significantly slower than that on the commercial cultivar ‘Kent.’ Because the number of aphid generations on overwintered spinach is substantial, a cultivar that slows aphid maturation may greatly reduce aphid population at the spring harvest.

Adult aphid longevity also varied significantly on the different spinach lines (Table 2). The mean longevity ranged from 15.7 days on F92 to 11.3 days on F70. No line significantly reduced adult longevity when compared to ‘Kent.’ The greatest variation in spinach antibiosis was observed in the number of progeny. Aphids held on F92 produced 52.7 young per adult while those confined on F70 produced 23.9 young per adult (Table 2), or 54.6% less. Line F70 was the only line to significantly reduce fecundity when compared to the commercial line ‘Kent.’

The longer aphid development period and lower fecundity evident in line F70 may combine to substantially decrease aphid population development under field conditions because numerous aphid generations occur each season. Although field testing will be required for final selection of aphid resistant spinach, the technique discussed in this study offers a rapid method for screening numerous breeding lines. Furthermore, this technique offers the advantage of preliminary screening that may reduce the number of lines needed in field testing.

Table 2. Green peach aphid pre-reproductive period, adult longevity and fecundity on six spinach breeding lines and the commercial cultivar 'Kent.'

Spinach line	Mean no. days until first reproduction	Mean adult longevity (days)	Mean no. progeny per adult
F68	12.2 ab*	13.3 ab	30.7 ab
F69	11.3 ab	14.0 ab	40.4 ab
F70	12.9 a	11.3 a	23.9 a
F71	11.3 ab	15.2 ab	44.1 ab
F77	11.8 ab	13.2 ab	32.4 ab
F92	11.2 ab	15.7 b	52.7 b
Kent	10.5 b	13.2 ab	48.7 b

* Mean separation in columns by Duncan's multiple range test, 5% level.

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