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Screening of Cabbage Varieties for Resistance to Turnip Aphids (Homoptera: Aphididae): Preference by Alate Aphids

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ABSTRACT

Twenty-four cabbage varieties were screened for preference by the turnip aphid, *Lipaphis erysimi* (Kaltenback), in the laboratory. Alate aphids were allowed to choose the varieties on which to land, feed and produce. The number of aphids (all forms) were examined on days 1, 5, and 12. Numbers of alate aphids on the 24 varieties were significantly different in the first 24 h, with no aphids observed on 9 varieties. Alate aphids were found on all plants on days 5 and 12. Because the numbers of alate aphids per plant among the 24 varieties varied greatly on the two dates, differences were not significant.

RESUMEN

Se evaluaron veinticuatro variedades de col en lo referente a su atracción sobre el áfido del nabo, Lipaphis erysimi (Kaltenback) bajo condiciones de laboratorio. Se permitió que los áfidos alados eligieran las variedades en las cuales posarse, alimentarse y reproducirse. Se examinó el número de áfidos (de todas los estadíos) los días 1, 5, y 12. El número de áfidos alados en las 24 variedades fue significativamente diferente en las primeras 24 horas, sin realizarse observaciones de áfidos en 9 variedades. Los áfidos alados fueron encontrados en todas las plantas en los días 5 y 12. Debido a que los números de áfidos alados por planta entre las 24 variedades presentó gran variación en las dos fechas, las diferencias no fueron significativas.

Additional index words: Lipaphis erysimi, Brassica oleracea var capitata, plant resistance

The turnip aphid, *Lipaphis erysimi* (Kaltenbach), is a worldwide pest of *Brassica* crops (Prasad and Phadke 1982, Prasad 1988, Chander and Phadke 1994, Begum 1995, Liu et al.1997). The aphid is one of the most serious pests of cole crops, including cabbage, broccoli, Brussels sprouts, cauliflower, collard, kale, mustard, rape, and turnip. With heavy infestations, the aphids stunt or kill plants in early stages of growth, curling and distortion of actively-growing leaves, and contaminate leaves with honeydew which may gums up the plants and serves as a medium for sooty mold fungus. Repeated applications of insecticides are therefore frequently needed to keep leafy vegetables free of aphids or at a minimal level on other vegetables. However, it is often uneconomical to control aphids and other pests on cabbage with multiple applications of insecticides. To overcome these problems, biologically-based management methods, such as the development of cultivars resistant to aphids are essentially needed, and are receiving more attention. Research on host plant resistance was primarily conducted on oilseed and mustards in Asia. It has been reported that the varieties of oilseed and mustard could significantly affect aphid development, reproduction and population (Kennedy and Abou-Ghadir 1979, Singh et al.1983, Amjad and Peters 1992, Bhadauria et al. 1992, 1995). However, the influences of cabbage varieties planted in South Texas on *L. erysimi* have not been comprehensively studied and reported. Since host plant resistance is an important component of integrated pest management, we conducted this study to provide information lacking on cabbage variety resistance to *L. erysimi*.

Our objective in this study was to screen common cabbage varieties growing in the Lower Rio Grande Valley of Texas for resistance to turnip aphids, and to evaluate with the potential of integrating any aphid-resistant ones into aphid management programs.

MATERIAL AND METHODS

Cabbage Varieties. Twenty four cabbage varieties were used in this study (Table 1). The cabbages were seeded, 5 in each cell, in styrofoam germination trays in a greenhouse using standard potting media (Scotts Metro-Mix 300, Scotts-Sierra Horticultural Product Co., Marysville, OH). Seedlings were thinned when the plants were about 5-cm high, leaving only one plant in each cell. Seedlings were transplanted individually to plastic pots (7.6 cm in diam) when they were ≈8 cm high. Granule fertilizer (N:P:K=20:20:20; Peters Professional Water

Soluble, Scotts-Sierra Horticultural Product Co., Marysville, OH) was used in each pot and the plants were irrigated every other day.

Aphid Source. *L. erysimi* collected from an experimental cabbage field at Texas Agricultural Experiment Station at Weslaco were maintained on potted cabbage plants in an insectary at 25-28ºC, 55-65% RH. Photoperiod in the insectary was set at 12:12 (L:D) h with light intensities measured as photosynthetically active radiation at 37-55 $\mu mol^{-1}.m^{-2}.s^{-1}$ on the benches (Li-COR, Steady State Photometer, Model LI-1600, Lincoln, NE). Plants were fertilized and watered as required. Clean potted cabbage plants were added when required for maintaining high aphid populations.

Aphid Infestation and Variety Preference by Alate Aphids. The experiment was conducted in an insectary with 2 benches at 2 m apart. Cabbage plants on one bench were aphid-sources, and alate aphids were intentionally allowed to fly and land on the aphid-free plants on the other bench. On the aphid-source bench, 50 cabbage plants (‘Grand Slam’) were heavily infested with *L. erysimi* (>1,000 apterous and alate on each plant). On the adjacent bench, 3 aphid-free plants of approximately equal size from each of the 24 varieties were labeled and randomly arranged. Only 5 young, fully expanded leaves on each plant remained and all other leaves were removed. The numbers of alate aphids on each plant, an indication of infestation and preference on each variety, were examined 1, 5 and 12 d after the experiment was initiated.

Data Analysis. Numbers of aphids on each variety on each date were analyzed with analysis of variance (ANOVA), and means were separated using the least significant difference test at $P = 0.05$ (SAS Institute 1994).

RESULTS AND DISCUSSION

Alate adult aphids began landing on the aphid-free plants a few hours after the plants were set up on the bench. On day 1, the numbers of alate aphids on the 24 cabbage varieties were significantly different ($F = 1.73$; df = 23, 48; $P = 0.050$) (Table 1). Of the 24 varieties, 9 varieties did not have any alate aphids, and 15 had from 0.3 aphids per plant on ‘Grand Slam’ to 2.7 aphids per plant on ‘Pennant.’ On day 5, alate aphids were found on all plants. The numbers of alate aphids on those varieties varied markedly, ranging from 0.33 aphids per plant on ‘Grand Slam’ to 8.33 aphids per plant on ‘Fortress’. However, the differences were not statistically significant ($F = 1.59$; df = 23, 48; $P = 0.09$). Similarly, on day 12, the numbers of alate aphids per plant among those varieties varied greatly from 12.0 aphids per plant on ‘Talisman’ to 79.7 aphids per plant on Solid Blue -790’. However, the alate aphid densities among the 24 varieties were again not significantly different ($F = 0.78$; df = 23, 48; $P = 0.74$). These results indicated that *L. erysimi* alates showed some degree of host preferences among the 24 varieties in the first day, and did not show significant preferences thereafter.

Table 1. Numbers of alate aphids recorded on various cabbage varieties 1, 5 and 12 d after the initiation of the host preference experiment.

		Alate aphids/plant ± SE		
Varieties	Supplier	Day 1	Day 5	Day 12
Applause	Baxter	0.0 ± 0.0d	3.7 ± 0.7a	33.3 ± 8.7a
Atlantis	Peto Seed	1.3 ± 1.3a-d	2.7 ± 1.2a	31.0 ± 9.0a
Augusta-Novartis	Novartis Seed	2.0 ± 1.2ab	3.0 ± 1.2a	35.0 ± 16.5a
Blue Thunder	Baxter	0.0 ± 0.0d	3.0 ± 1.5a	30.0 ± 5.5a
Blue Vantage	Baxter	0.0 ± 0.0d	4.7 ± 3.2a	43.3 ± 10.4a
Bravo	Baxter	0.3 ± 0.3cd	6.3 ± 3.5a	35.3 ± 18.6a
Cheers-Takii	Takii Seed	0.0 ± 0.0d	2.7 ± 1.5a	59.0 ± 30.4a
Columbia	Peto Seed	2.0 ± 1.0ab	5.0 ± 2.1a	37.7 ± 8.4a
Coustanza	Baxter	0.0 ± 0.0d	1.7 ± 1.2a	26.3 ± 9.8a
Discovery	Peto Seed	0.0 ± 0.0d	1.0 ± 0.6a	26.0 ± 11.9a
Fortress	Baxter	0.7 ± 0.7bcd	8.3 ± 3.7a	71.7 ± 36.4a
Fortuna	Seminis	0.0 ± 0.0d	1.0 ± 0.6a	35.3 ± 16.8a
Grand Slam	Northrop King	1.0 ± 0.58bcd	0.3 ± 0.3a	17.3 ± 6.2a
Pennant	Novartis Seed	2.7 ± 0.3a	3.3 ± 2.0a	22.3 ± 7.7a
Red Dynasty	Asgrow	0.7 ± 0.3bcd	3.0 ± 1.2a	23.3 ± 9.2a
Solid Blue-760	Abbott & Cobb	1.0 ± 0.6bcd	6.0 ± 1.5a	28.7 ± 8.9a
Solid Blue-780	Abbott & Cobb	0.3 ± 0.3cd	0.7 ± 0.3a	65.0 ± 51.1a
Solid Blue-790	Abbott & Cobb	0.7 ± 0.7bcd	4.7 ± 1.3a	79.7 ± 41.2a
Solid Red- 831	Abbott & Cobb	0.3 ± 0.3cd	3.7 ± 2.2a	29.3 ± 11.0a
Solid Red- 841	Abbott & Cobb	0.0 ± 0.0d	0.3 ± 0.3a	48.3 ± 17.7a
Talisman	Ferry-Morse	0.0 ± 0.0d	2.0 ± 1.0a	12.0 ± 3.6a
Vantage Point	Sakata Seed	1.7 ± 1.2abc	1.0 ± 0.6a	31.7 ± 14.7a
XPH-15513	Asgrow	0.7 ± 0.7bcd	0.7 ± 0.7a	32.0 ± 16.0a
F		1.73	1.59	0.78
P (df = 23, 48)		0.05	0.09	0.74

Means (± SE) in the same column followed by the same letters do not differ significantly at $P = 0.05$ (LSD, SAS Institute 1994).

Alate aphids find their hosts by plant colors and chemicals within the plant, which vary among different plant varieties. In our earlier study (Yue and Liu, 2000), we found that turnip aphids land and feed on green varieties rather than on red varieties in the first 3 days, but those differences become less significant in 2 weeks. However, no significant differences in aphid densities on the cabbage varieties with different colors were found in this study. Results of this study indicated that alate aphids did prefer some varieties to others in the first day, but these preferences diminished in days 5 and 12, albeit the differences in aphid densities on those cabbage varieties varied greatly. Because alate aphids are the primary dispersal form in the field and can migrate some distance, it is essential to understand how alate aphids differentiate host varieties and the foliage among host plants.

We are aware that an indoor trial alone may not provide an adequate measure of resistance since the physiological, chemical and physical characteristics for the plants cultured indoors differ significantly from those in the field (Watson and Dixon 1984). Therefore, the results from this laboratory study must be confirmed under field conditions. Additionally, we have been conducting more laboratory experiments to determine the effects of different cabbage varieties on development, reproduction, fecundity and survival of *L. erysimi*. This information will help to select commercially-acceptable, high quality cabbage varieties for use in integrated pest management programs.

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