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Development of the Potato Leafhopper On Selected Legumes

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ABSTRACT

Developmental rates for the potato leafhopper *[Empoasca fabae* (Harris)] were determined at 2 constant temperatures, 24°C and 27°C. Seven kinds of leguminous host plants were used: 'Apollo', 'Buffalo', and 'Riley' alfalfa; 'Major' broad bean; 'Kenstar' and 'Kuhn' red clover; and 'Williams' soybean. Development of the leafhopper varied among hosts. The least time was required to develop from egg to adult emergence on broad bean; the leafhoppers developed at the rates of 5.08% and 6.0% per day at 24°C and 27°C, respectively. A relatively slow rate of development was attained by potato leafhoppers on soybean (4.44% and 5.39% per day at 24°C and 27°C, respectively). Males developed faster than females in most cases.

INTRODUCTION

The potato leafhopper, *Empoasca fabae* (Harris), is a polyphagous insect which is commonly found on alfalfa, clover, soybean, and many other cultivated and wild plants in Kentucky. Broad bean *(Vicia faba* L.) is a plant on which the potato leafhopper is easily reared. Consequently, much information on the potato leafhopper has been compiled using broad bean as the host. However, broad bean is not commonly grown in the areas where this insect is a pest. Simonet and Pienkowski (1) (using broad bean as the host) and Kouskolekas and Decker (2) (using 'Buffalo' alfalfa as the host) reported different threshold temperatures for nymphal development of the potato leafhopper. Saxena et al. (3), working with other species of leafhoppers, reported that host plants can influence the developmental rate of leafhoppers.

It is imperative that the biology of the potato leafhopper be understood in order to devise sound management strategies for this pest. The study reported herein tested for influence of host plant on the development of the potato leafhopper.

MATERIALS AND METHODS

Seven kinds of greenhouse-grown, leguminous host plants were used for developmental studies: 'Apollo', 'Buffalo' and 'Riley' alfalfa; 'Major' broad bean; 'Kenstar' and 'Kuhn' red clover (the former a pubescent variety and the latter a variety with a few closely-appressed hairs); and 'Williams' soybean. Alfalfa and red clover plants were cut and allowed to regrow 1.5 to 2 weeks (to a height of 10 to 15 cm) prior to being used in this study. Broad bean plants ca. 15 cm tall and soybean plants at growth stages V2 through V3 (4) were selected to start the experiment. Two environmental chambers were maintained at a 15:9 L:D photoperiod and at 24 ± 2°C and 27 ± 2°C, mean temperatures which the potato leafhopper frequently encounters in its natural environment. Illumination was by high output, cool white, 40 watt fluorescent lamps.

The host plants were caged with 61 cm x 15.2 cm diameter plexiglas tubing, the detailed design of which was described by Simmons (5), and placed in the environmental chambers in a randomized block design, 2 blocks/chamber. There were 5 such replicates at each temperature. Relative humidity varied from 60% to 99%, depending on the temperature and when the plants were watered. Plants were watered from the bottom as needed.

Insects were collected from an alafalfa field in Fayette Co., KY, with a sweep net. The contents were emptied into a 30 x 30 x 40 cm plexiglas cage, which had a sleeve opening (covered with stockinnette) which permitted hand entry. The leafhopppers could easily be sexed without magnification as they rested on the sides of the transparent cage. Adult female potato leafhoppers were aspirated from the cage into a 65 ml cup, the lid

of which had a 2 cm diameter opening; an alfalfa stem was placed in each cup and a piece of cotton was inserted into the opening after aspirating the leafhoppers. Ten females were collected per cup, one cup being used for each host plant. During hot weather the cups of leafhoppers were placed in an ice chest until they were transported to the laboratory.

Female potato leafhoppers were allowed to oviposit over a 12 hour period of continuous light. The amount of time required by the potato leafhopper to develop from egg to adult emergence at 24°C and 27°C on each host plant was recorded. The first day was counted as 12 hours after the oviposition period ended. Adults which emerged on each day were removed from the cage, sexed, and the number of each gender recorded for each host plant.

Duncan's Multiple Range Test was used to separate the mean developmental rates of the leafhoppers among host plants. Treatment (host plant) means were compared within temperatures (24°C and 27°C) for the sexes combined, as well as for males and females separately.

Results and Discussion

The number of days required for the potato leafhopper to develop from egg to the adult stage on 7 leguminous hosts at 24°C and at 27°C is presented in Table 1. The number of days required for the potato leafhopper to develop at 24°C ranged, among the plants tested, from 19.8 days (19.4 for males and 20.1 for females) on broad bean to 22.7 days (22.4 for males and 22.9 for females) on soybean. A similar duration (ca. 19.0 days) for newly oviposited eggs to reach the adult stage on broad bean at 24°C can be calculated from a study by Simonet and Pienkowski (1). At 27°C the duration in days for development ranged from 16.7 days (16.5 for males and 17.4 for females) on broad bean to 18.7 (18.1 for males and 19.2 for females) on soybean.

Developmental rates for the potato leafhopper on the 7 host plants at 24°C and 27°C are presented in Tables 2 and 3. Significant differences ($P<0.05$) were found among developmental rates of leafhoppers on different host plants. The fastest development was on the broad bean at 27°C; one of the 2 fastest rates at 24°C also occurred on the broad bean. The mean per cent development per day on broad bean was 5.08 (5.17 for males and 5.0 for females) at 24°C; at 27°C the rate was 6.0%/day (6.07%/day for males and 5.85%/day for females). In the order of decreasing rate of development on the other host plants, the trend was as follows: alfalfa, red clover, and soybean. Among the 3 alfalfa varieties, the potato leafhopper developed at the fastest rate on 'Buffalo' at 24°C, but there were no differences among alfalfa varieties at 27°C. Between the 2 red clover varieties, the fastest rate was on Kuhn at 24°C, but no significant difference in developmental rates was observed between red clover varieties at 27°C. Development of the potato leafhopper on soybean was the slowest of all plants tested at 24°C and one of the 2 slowest at 27°C. At 24°C on soybean, the developmental rate was 4.44%/day (4.5%/day for males and 4.38%/day for females), and at 27°C the developmental rate was 5.39%/day (5.54%/day for males and 5.24% day for females).

Male potato leafhoppers developed faster than females (Tables 2 and 3). This was true for development at both temperature regimes and on all plants tested, with 2

Table 1. Duration in days for development of the potato leafhopper from egg to the adult stage on different leguminous hosts at 24°C and 27°C.

Host plants	Male	Female	Both sexes
	24°C		
Broad Bean	19.4	20.1	19.8
Buffalo (alfalfa)	19.5	20.5	20.0
Kuhn (red clover)	20.3	21.0	20.7
Apollo (alfalfa)	20.2	21.5	20.9
Riley (alfalfa)	20.5	21.9	21.2
Kenstar (red clover)	21.5	22.2	21.8
Soybean	22.4	22.9	22.7
	27°C		
Broad Bean	16.5	17.4	16.7
Buffalo (alfalfa)	16.7	17.8	17.2
Riley (alfalfa)	16.4	17.9	17.5
Apollo (alfalfa)	17.2	18.0	17.6
Kuhn (red clover)	17.5	18.3	17.9
Kenstar (red clover)	18.0	18.8	18.5
Soybean	18.1	19.2	18.7

TABLE 2. MEAN PER CENT DEVELOPMENT PER DAY (EGG TO ADULT) OF MALE AND FEMALE POTATO LEAFHOPPERS ON LEGUMINOUS PLANTS AT 24 +2°C.

	Male		Female		Both sexes
Host plants	N	Mean	N	Mean	Mean
Broad Bean	30	5.17a*,**	29	5.0a	5.08a
Buffalo (alfalfa)	56	5.15a	50	4.90ab	5.03a
Kuhn (red clover)	60	4.95b	66	4.79bc	4.86b
Apollo (alfalfa)	49	4.97b	55	4.67cd	4.81bc
Riley (alfalfa)	73	4.90b	73	4.60de	4.75c
Kenstar (red clover)	36	4.68c	31	4.50ef	4.60d
Soybean	26	4.50c	33	4.38f	4.44e

* Means within a column and followed by the same letter are not significantly different (P>0.05).

** On each host plant males developed significantly (P<0.05) faster than females, except for soybean on which there was no difference between developmental rates of the sexes.

TABLE 3. MEAN PER CENT DEVELOPMENT PER DAY (EGG TO ADULT) OF MALE AND FEMALE POTATO LEAFHOPPERS ON LEGUMINOUS PLANTS AT 27 +2°C.

	Male		Female		Both sexes
Host plants	N	Mean	N	Mean	Mean
Broad Bean	50	6.07a* **	20	5.85a	6.0a
Buffalo (alfalfa)	36	6.05ab	31	5.68ab	5.87b
Riley (alfalfa)	43	5.93b	55	5.54bc	5.78b
Apollo (alfalfa)	36	5.86b	34	5.67ab	5.72bc
Kuhn (red clover)	35	5.70cd	35	5.46cd	5.60cd
Kenstar (red clover)	7	5.58cd	10	5.29de	5.54de
Soybean	15	5.54d	16	5.24e	5.39e

* Means within a column and followed by the same letter are not significantly different (P>0.05).

** On each host plant males developed significantly (P<0.05) faster than females, except for 'Kenstar' red clover on which there was no difference between developmental rates of the sexes.

exceptions: no significant differences were observed between sexes on soybean at 24°C or on 'Kenstar' red clover at 27°C. Newton and Barnes (6) also noted that female potato leafhoppers required longer than males to develop.

The sex ratio of all adults which emerged was 51:49, male to female (49:51 at 24°C and 52:48 at 27°C).

The results reported herein indicate that host plants can influence the developmental rate of the potato leafhopper. This suggests that some of the earlier data obtained on the biology of the potato leafhopper using broad bean as a host plant may not be directly applicable to other host-plant systems. For example, if one utilized developmental data obtained from potato leafhoppers reared on the broad bean to predict phenological events occurring on soybeans, those events would occur later than predicted. On the other hand, those same data should provide accurate predictions of development on 'Buffalo' alfalfa, a variety commonly grown in Kentucky.

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