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COMPARATIVE HOST PLANT RANGE STUDIES OF THE BLUE ALFALFA APHID, ACYRTHOSIPHON

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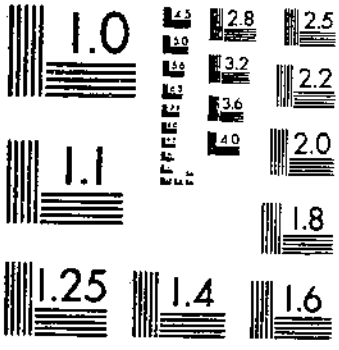

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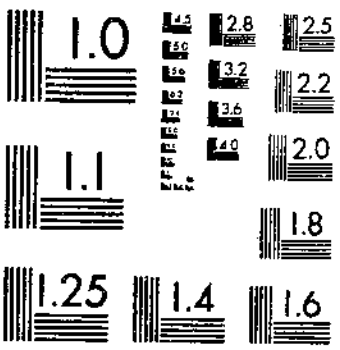

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Comparative Host Plant Range Studies of the Blue Alfalfa Aphid, *Acyrthosiphon Kondoi* Shinji, and the Pea Aphid, *Acyrthosiphon Pisum* (Harris) (Homoptera: Aphididae)

Acknowledgments

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Abstract

Ellsbury, Michael M., and Nielson, Mervin W. 1981. Comparative Host Plant Range Studies of the Blue Alfalfa Aphid, *Acyrthosiphon kondoi* Shinji, and the Pea Aphid, *Acyrthosiphon pisum* (Harris) (Homoptera: Aphididae). U.S. Department of Agriculture, Technical Bulletin No. 1639, 14 p.

Host plant ranges of the blue alfalfa aphid (BAA), *Acyrthosiphon kondoi* Shinji, and the pea aphid (PA), *Acyrthosiphon pisum* (Harris), were investigated on leguminous plant species. Fecundities of BAA and PA were determined on 84 plant species from the genera *Astragalus, Coronilla, Lathyrus, Lens, Lotus, Lupinus, Medicago, Melilotus, Ononis, Phaseolus, Pisum, Trifolium, Vicia,* and *Vigna* in greenhouse studies. Both aphids displayed a broad reproductive host range extending to species in all genera tested except *Phaseolus.* Few well-defined differences were evident between reproductive host ranges of the two aphid species.

Field studies on 45 plant species selected from genera tested in the greenhouse indicated that BAA caused more severe seedling damage than PA at equal population levels. Populations of both aphids were observed in the field on plant species that were poor hosts for reproduction in the greenhouse.

Susceptibility ratings were developed for 44 plant species based on field and greenhouse data for BAA and PA. Plants on which aphids reproduced poorly or not at all in the greenhouse but which supported aphid populations in field cages were classified as possible nonhosts.

Field and greenhouse studies demonstrated that a large number of legumes, other than alfalfa, should be considered possible alternate hosts for spread and survival of the BAA. Economically important plant species identified as possible hosts for the BAA were from the genera *Coronilla, Lens, Lotus, Medicago, Melilotus, Pisum, Trifolium,* and *Vigna.*

Keywords: Pea aphid, blue alfalfa aphid, aphids, clover, alfalfa, legumes, host range, Homoptera, Aphididae.

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COMPARATIVE HOST PLANT RANGE STUDIES OF THE BLUE ALFALFA APHID, *ACYRTHOSIPHON KONDOI* SHINJI, AND THE PEA APHID, *ACYRTHOSIPHON PISUM* (HARRIS) (HOMOPTERA: APHIDIDAE)

By Michael M. Ellsbury and Mervin W. Nielson[1]

Introduction

Acyrthosiphon kondoi Shinji is an introduced pest of alfalfa, *Medicago sativa* L., in the Western United States. The name "blue alfalfa aphid" (BAA) was applied to *A. kondoi* in reference to the bluish-gray cast apparent in BAA colonies when they are compared with colonies of the pea aphid (PA), *Acyrthosiphon pisum* (Harris). Although the common name has not gained official recognition, it has been widely adopted for use by entomologists in the United States. The aphid has also been called the blue-green aphid in Australian literature. *(8, 9).*[2] Reports of BAA in the United States first appeared from California and Nevada during 1974 *(20).* Spread of the BAA was rapid throughout the Southwestern United States.

Attention was initially drawn to BAA by apparent reduced effectiveness of chemical controls normally applied for the PA. The BAA exhibited a high capacity to reinfest treated fields *(16)* and caused economic loss at lower populations than the PA *(3).* Alfalfa infested by BAA shows severe stunting, leaf curling, yellowing, and slow recovery after cutting. Damage may also result from injection of a toxin during feeding by the aphid *(3, 6).*

Initial detection of the BAA in the United States was probably delayed because of its morphological similarity to the PA, which makes differentiation of the two species difficult under field conditions. Shinji and Kondo *(17)* separated them taxonomically on the basis of differences in number and placement of antennal sensoria and structure of the cauda. Kono *(7)* has provided comparative illustrations and descriptions of both aphids to facilitate positive identification of BAA. Characteristics of relative size, color, and antennal banding may be used to separate the two species under field conditions *(18).*

Little information is available on the biology of the BAA. Although the host plant range of the PA has been well established *(1, 2, 5, 12, 13, 14),* it has not been determined for the BAA.

When *A. kondoi* was discovered in the United States, records of its host plants included only alfalfa and clovers, *Trifolium* spp. *(4, 17, 18).* Several new host plant records appeared in survey reports from the Western United States *(5),* including *Lotus scoparius* Ottley, *L. corniculatus* L., *Trifolium pratense* L., *Melilotus officinalis* (L.) Pall., *Melilotus alba* Desr., lupine, and vetch. Dickson *(3)* and Nielson and Kodet *(10)* found in laboratory host plant studies that BAA was able to survive and reproduce on a number of leguminous plants from the genera *Astragalus, Caragana, Lotus, Medicago, Melilotus,* and *Trifolium.* Mathison *(8)* and Mathison and Baldwin *(9)* reported that certain medic cultivars *(Medicago* spp.) and subclover cultivars *(Trifolium* supp.) were susceptible to BAA in Australia.

These observations indicated that BAA had the potential to become a pest on forage crops other than alfalfa. Nielson et al. *(11)* have suggested that BAA may, in fact, prefer hosts other than alfalfa. Alternate hosts may serve as sources of aphid infestation and dispersal and may be important for aphid survival during periods of adverse climate or limited host availability.

BAA have been recorded from several hosts other than alfalfa, but their ability to survive and reproduce on alternate hosts has not yet been systematically examined. Comparative studies were carried out to determine: (1) fecundity of BAA and PA under greenhouse conditions on a large number of leguminous plants, (2) preference for leguminous plants offered under caged field conditions, and (3) comparative mortality of aphid-infested seedlings in field cages.

Materials and Methods

Experiments reported herein were performed at the USDA Forage Insects Research Laboratory in Tucson. Studies were initiated in the spring of 1976 and completed in the summer of 1978. Plants used in the study were grown from commercial seed or from seed provided by Regional Plant Introduction Stations of the U.S. Department of Agriculture and the Plant Materials Center of the Soil Conservation Service, Tucson. (See appendix for tabulation of seed.)

Greenhouse Studies

Aphid colonies used for greenhouse studies were reared in aluminum frame cages (70 by 70 by 50 cm) enclosed by nylon screen (32 mesh). PA were maintained on broad-bean, *Vicia faba* L., at temperatures between

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[2] Italic numbers in parentheses refer to Literature Cited, p. 6.

22.3 ± 1.8°C (day) and 9.4 ± 3.2°C (night). BAA were cultured on potted 'Caliverde' alfalfa, *Medicago sativa* L., cloned from a single individual and designated CA-1. Temperature in BAA colonies was maintained between 24.1 ± 1.6°C (day) and 10.2 ± 1.8°C (night), and relative humidity was allowed to fluctuate with seasonal conditions.

Reproduction of BAA and PA was compared in greenhouse studies on 84 leguminous plant species. Seeds were germinated in metal flats (35 by 50 by 100 cm) in a mixture of Canadian peat and sandy loam (1:1). Seedlings with at least two fully expanded leaves were transplanted to pots with Canadian peat and sandy loam (1:1). Temperature during the tests was maintained between 23.4 ± 2.4°C (day) and 11.3 ± 2.4°C (night) with photoperiod extended to 16 h by artificial lighting.

Test groups of 20 to 26 species each were studied on five separate dates to accommodate the 84 species tested. Twenty plant species were included in two different test groups, and two species, *Medicago sativa* 'Caliverde' and *Melilotus officinalis* Lam. (yellow sweetclover), were included in each of the five test groups as check species to determine whether test date had influenced aphid reproduction.

Replications consisted of four plants per species, age 6 to 8 weeks, and selected for uniformity of size and vigor. Two leaves of each plant were fitted with cages made of dialyzing tubing stoppered with slotted polyurethane foam plugs 1.25 cm thick. Tubing of variable length, 2.54 or 5.72 cm in diameter, was used, depending on size and configuration of the plant. Five third- to fourth-stage nymphs of each aphid species were introduced into separate cages on the same plant and allowed to mature and reproduce. Total number of progeny was recorded 14 days after infestation of the first group of test plants and 21 days after infestation of the second through fifth groups. Progeny were removed periodically during the test period to prevent undue stress on infested leaves.

Field Studies

Field studies of aphid host preference and host susceptibility were carried out in four pollination cages (3.66 by 7.32 m) with 32 mesh nylon screen. Each cage was divided longitudinally into two sections, and 13 rows, 1.24 m long, were laid out in each section for aphid culture plants. PA-resistant alfalfa (PA-1) was planted in two nonadjacent cages on October 18, 1977, as a culture plant for BAA. Alfalfa was allowed to mature, and a population of BAA was built up by weekly infestations with 50 cm^3 of field-collected BAA beginning January 2, 1978. Alternate rows of alfalfa were cut back at 4, 6, and 8 weeks after initiation of infestation to insure a continuous supply of new plant growth for aphids.

Broadbeans were similarly planted on February 4, 1978, in the remaining two cages as culture plants for PA. Each cage was uniformly infested with 50 cm^3 of laboratory-reared PA on March 4, 1978.

Four paired rows of test plants, 50 cm long and 7.0 cm apart, were established between rows of culture plants so that each test row was adjacent to a culture row. Each of the two sections per cage comprised a complete replication of 48 rows to which 45 test entries were randomly assigned (three rows were unused). Each entry was replicated four times (two replications per cage) for each aphid.

During previous greenhouse studies, time required for germination and development of different plant species varied greatly. Synchrony of development of test plants to the unifoliate stage with growth of aphid colonies was insured in the field study by sowing test species at intervals predetermined from greenhouse germination records. Planting began March 4 and was completed March 26, 1978. Number of seeds sown varied from 10 to 100, depending on relative size of seedlings, percent germination, and quantity of seed available. Germination counts were taken 1 week after final planting when most seedlings had reached the unifoliate stage. Aphid culture plants were cut back at this time, and cuttings were left in place for 48 h to force aphids over to test plants.

Since direct sampling of aphid populations excessively disturbed the insects, visual estimation of aphid populations on test plants in field cages was made according to a six-category rating scale as follows:

Rating	Number of aphids
1	0
2	1-5
3	6-10
4	11-20
5	21-50
6	50

As a measure of aphid preference for host plants, numbers of plants per row supporting aphid populations in each category were counted 1 week after culture plants were cut back. These data were used to calculate for each test species a weighted mean population level rating, which assigned greatest weight to those ratings from rows (replications) that had lower variance and larger numbers of plants germinated. For each rating category, the proportion of plants in a given row assigned to that rating was determined according to the formula

$$p_i = n_i/N$$

where: i = rating category, 1 to 6

p_i = proportion of plants in category i
n_i = number of plants rated in category i
and N = total number of plants germinated in row.

Mean population levels were calculated as

$$\bar{a} = \sum_{i=1}^{6} (p_i \quad i)$$

with variance

$$v = \sum_{i=1}^{6} p_i (i - \bar{a})^2$$

Replications with all plants supporting aphid populations in a single category had mean population levels with variance of zero. These replications were arbitrarily assigned the relatively low variance of 0.10 to avoid division by zero in calculation of weights for each mean from the formula, $w = N/V$. Greater weight was thus assigned to population estimates from rows with larger numbers of plants and smaller variance in mean population level ratings. Weighted population levels were calculated as, $Y = \bar{a}\,W$, and used in subsequent analysis of variance, but unweighted population ratings were used in comparison with greenhouse data for the same plants.

Percent seedling mortality from aphid feeding on test plants was determined 2 weeks after culture plants were cut back. Percentages were transformed to arcsin values according to the formula

$$\arcsin x = \frac{y + 0.375}{100.375 - y,}$$

where y represents percent seedling survival and x is a value in radians.

Statistical Analyses

Data from greenhouse and field experiments were subjected to analysis of variance to determine whether experimental design had an effect on outcome of each study. Greenhouse experiments were done as randomized incomplete blocks, and data for aphid fecundity on two check plant species were analyzed to determine whether results varied with date of test. Further analyses of variance were then performed on data from each test block of host plants tested to determine whether differences existed between responses of BAA and PA. Separation of mean aphid fecundities on the different hosts was accomplished by calculation of least significant difference. Weighted population ratings and transformed percent mortality data from field experiments were subjected to analysis of variance for split-plot design to determine whether experimental design affected aphid behavior and to detect differences in responses of BAA and PA over the range of plants tested. Separation of means for these parameters was also accomplished by calculation of least significant difference.

Results and Discussion

Greenhouse Studies

Direct comparison of host plants on the basis of fecundity data from different test dates was precluded since aphid reproduction varied significantly with date of test ($p = 0.01$) and was subject to test date x aphid species interaction ($p = 0.01$) (table 1).[3] Significant variation in aphid fecundities on check plants was also attributable to aphid species ($p = 0.05$) and plant species ($p = 0.05$); however, absence of significant variation due to test date x check plant species interaction, aphid species x check plant species interaction, or test date x aphid species x check plant species interaction was interpreted as an indication that, while date of test influenced overall aphid fecundities, the relationship between aphid species, check plant species, and aphid reproduction remained statistically consistent over all test dates. Aphid reproduction on the economically important check plant species, *Medicago sativa*, 'Caliverde,' was chosen as a standard for comparison of data between aphid species and among host plant species tested on different dates.

Fecundities of BAA and PA on 84 plant species tested over five dates appear in tables 2 to 6. Analysis of variance for aphid fecundity data from various host plants, performed separately for each test date, indicated that significant variation ($p = 0.01$) was present in reproduction of both aphids at all test dates. Suitability of host plants varied greatly within the range of species tested on each date for each aphid, and the two aphid species differed in their responses to the same hosts tested on a single date; however, no distinct host plant genera or groups of species were separable on the basis of LSD between mean total fecundities for either aphid within each test date (tables 2 to 6). PA were generally capable of greater reproduction than BAA on the host plants tested. Fecundity of PA was significantly higher than that of BAA on 20 of 84 plant species. Conversely fecundity of BAA was significantly greater than PA fecundity on only 3 of 84 species tested. The genera *Lathyrus, Lupinus,* and *Vicia* were poor hosts for the BAA. Both aphids failed to reproduce only on *Lathyrus tingitanus* L. and *Phaseolus vulgaris* L. The PA also did not reproduce on *Vigna sinensis* (L.) Savi; however, Patch *(14)* and Essig *(5)* listed both *P. vulgaris* and *V. sinensis* as hosts for the PA.

Aphid fecundity on 'Caliverde' from each test date was assigned a relative fecundity of 1.00 and was used as a standard of comparison between host plants tested on the five different dates. Host plants were grouped by genera and plant type for comparisons in figures 1 to 4.

Both aphids were capable of reproduction on all 18 *Astragalus* species tested, except *A. mexicanus* DC., on which the BAA did not reproduce (fig. 1). Nine species of *Astragalus* were relatively better than 'Caliverde,' and nine were relatively poorer as reproductive hosts for

[3] All tables are grouped in the Appendix, beginning on p. 7.

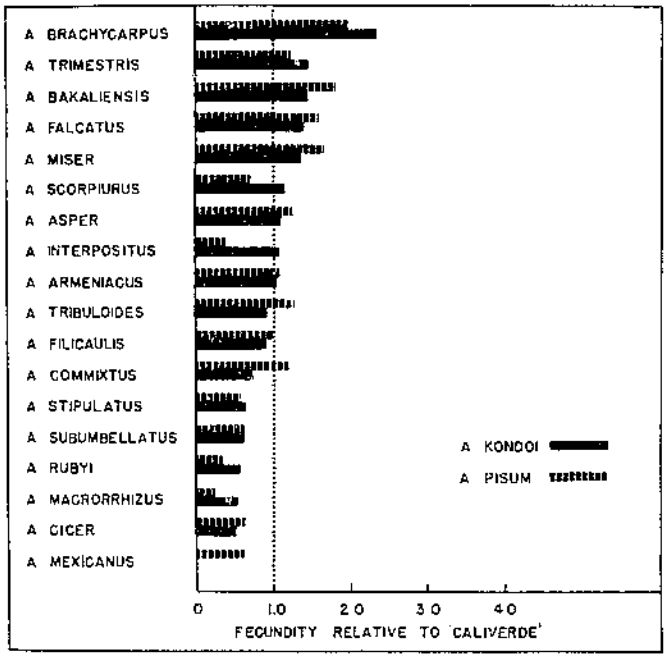

Figure 1.—Relative fecundity of blue alfalfa aphids *(Acyrthosiphon kondoi)* and pea aphids *(A. pisum)* on 18 species of the genus *Astragalus* in the greenhouse. Relative fecundity of aphids on 'Caliverde' alfalfa equals 1.00.

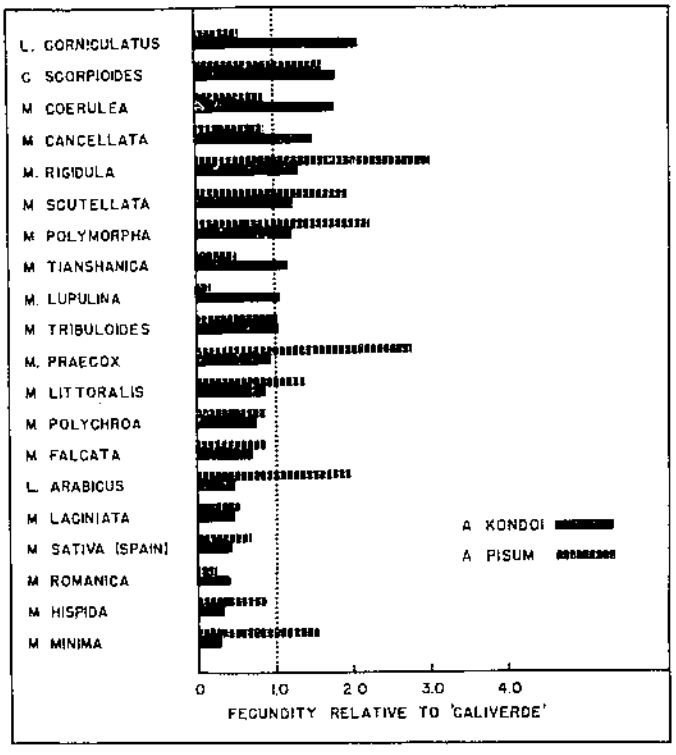

Figure 2.—Relative fecundity of blue alfalfa aphids *(Acyrthosiphon kondoi)* and pea aphids *(A. pisum)* on 20 species of the genera *Coronilla*, *Lotus*, and *Medicago* in the greenhouse. Relative fecundity of aphids on 'Caliverde' alfalfa equals 1.00.

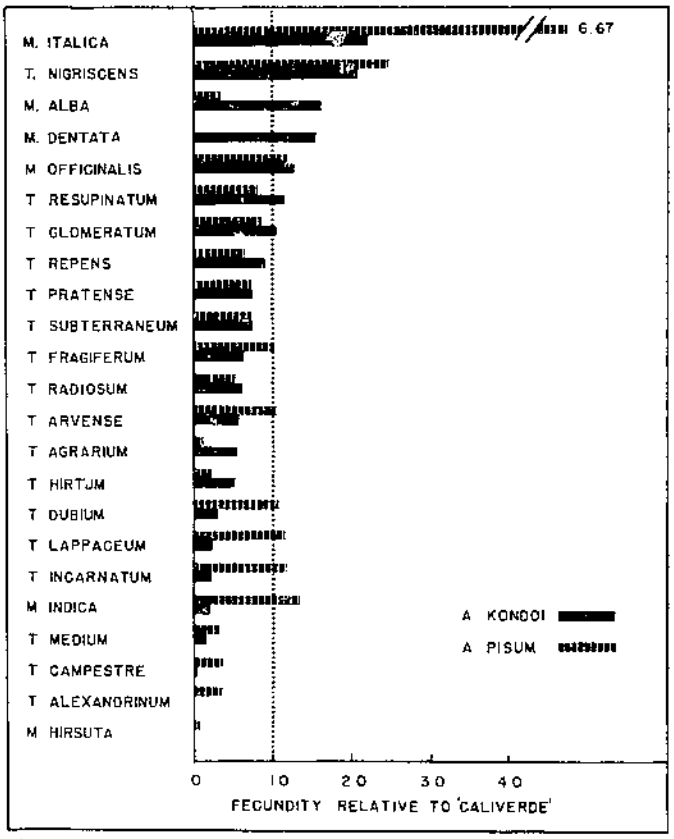

Figure 3.—Relative fecundity of blue alfalfa aphids *(Acyrthosiphon kondoi)* and pea aphids *(A. pisum)* on 23 species of the genera *Trifolium* and *Melilotus* in the greenhouse. Relative fecundity of aphid on 'Caliverde' alfalfa equals 1.00.

each aphid. Those hosts better or poorer than 'Caliverde' for BAA were also better or poorer for PA, with the exception of *A. scorpiurus* Bunge, *A. interpositus* Boriss., *A. tribuoloides* Delile, and *A. commixtus* Bunge. Both aphids were capable of utilizing a wide range of *Astragalus* species as hosts in the greenhouse.

All 20 species of *Coronilla*, *Lotus*, and *Medicago* were suitable as reproductive hosts for BAA and PA (fig. 2). Seven *Medicago* species were better hosts than 'Caliverde,' and 10 species were poorer than 'Caliverde,' although these were not the same species for each aphid. *Medicago tribuloides* Desr. was about equal to 'Caliverde' as a host for both aphids. *Lotus corniculatus* L. was relatively better than 'Caliverde' for PA. Both aphids reproduced well on *Coronilla scorpioides* Koch.

Clovers and sweetclovers, *Trifolium* spp. and *Melilotus* spp., respectively, have been grouped for comparison in figure 3. Four of six *Melilotus* species *(M. italica* Lam., *M. alba* Desr., *M. dentata* Pers., and *M. officinalis)* were better hosts than 'Caliverde' for BAA. The PA failed to reproduce on *M. dentata* but established colonies on *M. indica* (L.) All., on which BAA did not reproduce. *Melilotus italica* was the best host of this group for either aphid. Of the *Trifolium* species tested, only 3 of 17 and 6 of 17 were better hosts than 'Caliverde' for BAA

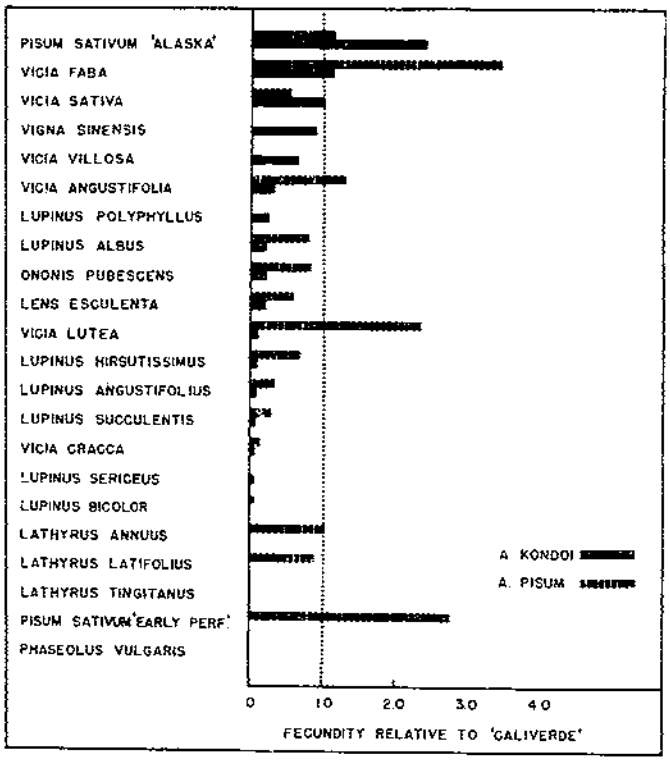

Figure 4.—Relative fecundity of blue alfalfa aphids *(Acyrthosiphon kondoi)* and pea aphids *(A. pisum)* on 23 species of the genera *Lathyrus, Lupinus, Pisum, Vicia,* and other species of economic importance in the greenhouse. Relative fecundity of aphids on 'Caliverde' alfalfa equals 1.00.

and PA, respectively. PA reproduced on all species of *Trifolium* examined, whereas BAA failed to survive on one species, *T. alexandrinum* L.

Fecundity of BAA and PA relative to that on 'Caliverde' was also compared for 23 species from the genera *Lathyrus, Lupinus, Pisum,* and *Vicia* as well as several other species of economic importance. BAA failed to reproduce on *Lathyrus* species and reproduced poorly or not at all on *Lupinus* species by comparison with 'Caliverde.' *Phaseolus vulgaris* and *Pisum sativum* L. 'Early Perfection' did not support reproduction by BAA. Species of economic importance that served as hosts for BAA included *Vigna sinensis* (cowpea), *Lens esculenta* Moench. (lentil), and 'Alaska' pea. Species of *Vicia* and *Ononis* also supported BAA and PA reproduction.

With few exceptions, both BAA and PA were able to reproduce on hosts from the genera *Medicago, Melilotus,* and *Trifolium*. Responses of the aphids to species of *Lathyrus, Lupinus,* and *Phaseolus* indicated that these should be considered poor hosts only for BAA. Responses to other genera, including *Coronilla, Lens, Lotus, Ononis, Pisum, Vicia,* and *Vigna,* were variable, and none of these was categorically eliminated as hosts for BAA.

Field Studies

Data from field plots subjected to uniform aphid infestations provided information about two additional facets of aphid-host plant relationships: (1) preference of aphids for a range of host plants offered simultaneously and (2) seedling mortality under inundative infestation as a measure of sensitivity of each plant species to aphid damage.

No significant effects from aphid species or cages within aphid species were apparent in weighted population levels or plant survival (table 7), indicating that overall populations of aphids were consistent from cage to cage and that results were not affected by split plot design of the experiments. Aphid population levels and plant survival were significantly ($p = 0.01$) influenced by host plant species and plant species x aphid species interaction.

Responses of aphids to the range of plants tested varied with type of plant and with aphid species on the same range of plants. Mean separation of weighted population levels (LSD = 4.750, $p = 0.05$) did not permit identification of genera or distinct groups of species supporting populations of BAA significantly different from those on other plants tested for this aphid (table 8); however, population levels of PA were significantly higher on three groups of plant species than on other species tested for PA. *Pisum sativum* 'Alaska' had the highest populations of PA; followed by *Trifolium arvense* Walt. and *T. nigriscens* Viv. in the second highest group; and *T. lappaceum* L., *T. campestre* Schreb., and *Lathyrus tingitanus* L. in the third highest group. Weighted population ratings on 18 host species were significantly higher ($p = 0.05$) for PA than for BAA, whereas populations of BAA were higher on only three hosts.

Plants were ranked from lowest to highest survival under BAA infestation (table 9). No distinct host plant genera or groups of species were evident in mean separation (LSD = 0.256 at the 0.05 level) of transformed percent seedling survival for either aphid. Survival of seedlings was significantly less for 13 species tested (LSD = 0.278 at the 0.10 level) in BAA infestations than in PA infestations (table 9). Percent seedling survival was significantly higher for five plant species (LSD = 0.278 at the 0.10 level) in BAA infestations than in PA infestations.

Classification of Hosts Studied in Field and Greenhouse Experiments

Quantitative comparison of PA and BAA data was difficult because of high variances in fecundity and aphid population levels. Excessive variance was possibly attributable to normal genetic variation in host plant material. Although means were separable on the basis of LSD, no district groups of means were apparent that corresponded to specific genera or plant types. Responses of plants and aphids were not always consistent from greenhouse to field, and hosts that had

high population ratings in the field often did not suffer proportionately high seedling mortality. Several plants that were poor reproductive hosts for BAA in greenhouse studies, including species of *Lathyrus, Lupinus, Trifolium,* and *Vicia,* supported relatively high populations of the aphid in field cages. Populations of PA were significantly higher than those of BAA on 18 of 45 species in the field cages, yet seedling survival for 11 of these 18 species was lower in cages infested with BAA.

To classify relative suitability of hosts on the basis of both field and greenhouse data, a composite susceptibility rating was arbitrarily adopted that would account for variability between field and greenhouse data and reflect trends in fecundity, population ratings, and seedling survival that were not always statistically significant. This system was modified from one used by Peters and Painter *(15)* in a host range study of the "yellow clover aphid complex." Abbreviations for each host class appear in table 10, followed by a designation and description of criteria for the class. Those hosts, which supported little or no reproduction of aphids in the greenhouse yet were infested in the field cages, were classified as possible nonhosts (PN). Tolerant hosts (ST) supported moderately high populations of aphids with high seedling survival in the field and also were good reproductive hosts in the greenhouse. Those classified as susceptible (S) were good reproductive hosts in the greenhouse but had moderate to low aphid populations and seedling mortality in field cage infestations. Aphid fecundity on very susceptible hosts (SS) were high with moderate to high populations and seedling mortality in field cages. Host plants that had very low seedling survival at relatively low aphid infestations were considered highly susceptible (SSS). Composite susceptibility ratings appear in table 11 for 44 plant species tested in both field and greenhouse experiments with BAA and PA.

Plants of the genus *Astragalus* were generally susceptible to both aphids. *Astragalus mexicanus* was a possible exception since it did not support reproduction of BAA in the greenhouse but had relatively high aphid populations in field cages. Species of *Lathyrus* and *Lupinus* were classified as possible hosts for the BAA since they also did not support aphid reproduction in the greenhouse but were observed to have aphid populations in field cages. *Lathyrus tingitanus* and *Lupinus polyphyllus* Lindl. also were classed as possible nonhosts for PA. Species of *Medicago* and *Lotus* were classified as susceptible to both BAA and PA. *Medicago* species were rated more susceptible to BAA than PA for 7 of 11 species tested in greenhouse and field experiments.

Clovers of the genera *Trifolium* and *Melilotus* were generally susceptible to both aphids. *Melilotus hirsuta* Lipski and *T. alexandrinum* were considered possible nonhosts for BAA. *Trifolium* species were rated more susceptible to PA than BAA for 9 of 15 species studied. A general trend was evident in classification of hosts on the basis of fecundity, percent seedling survival, and aphid population ratings for each plant species. Species of the genus *Medicago* were relatively more susceptible to BAA than PA, whereas species of *Trifolium* were more susceptible to PA than BAA.

Conclusions

Greenhouse and field studies comparing host plants of *A. kondoi* and *A. pisum* have shown a wide range of leguminous hosts for both aphids, which included most species tested from the genera *Astragalus, Lotus, Medicago, Melilotus, Trifolium,* and *Vicia.* Host ranges of the two aphids exhibited no well-defined differences since relatively few plant species served as hosts for one aphid to the exclusion of the other.

Among leguminous genera with value as forages, *Medicago* and *Melilotus* should be considered susceptible to BAA. Species of *Trifolium* are also potential hosts for BAA but should be considered generally less suitable than *Medicago* or *Melilotus.* Vetches and trefoils, also susceptible to BAA, will tolerate heavier infestations than species of *Medicago, Melilotus,* or *Trifolium.* BAA should be considered potential pests of several legumes of economic importance as food crops, including *Lens esculenta* (lentil), *Pisum sativum* 'Alaska' (pea), and *Vigna sinensis* (cowpea).

The broad range of plant species on which BAA reproduced provides many alternate hosts as sources of infestation and mechanisms of spread for this pest. Host availability should, therefore, not be considered a limiting factor for spread of this pest in areas where crops other than alfalfa are grown.

Literature Cited

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Appendix

Eighty-five plant species were examined in the course of experiments reported herein. Since each plant species was not utilized in all experiments, a summary of experiments in which each species was studied has been compiled below. Codes appearing in the right-hand column represent the following experiments: F — field experiment under caged controlled infestation, G — greenhouse experiment in dialysis tube cages. Full designations of seed sources are as follows:

GA — Regional Plant Introduction Station
Experiment, GA 30212

IA — Regional Plant Introduction Station
Ames, IA 50011

WA — Regional Plant Introduction Station
Pullman, WA 99164

NY — Regional Plant Introduction Station
Geneva, NY 14456

TPMC — Tucson Plant Materials Center
Tucson, AZ 85705

USDA — Forage Insects Research Laboratory
Tucson, AZ 85719

B — Burpee Seed Co.
Riverside, CA 92507

NK — Northrup King Seeds
Fresno, CA 93776

Plant species	Identification number	Origin	Source	Experimental utilization
Astragalus armeniacus Boiss.	PI 214095	Spain	WA	G
A. asper Jacq.	PI 314059	U.S.S.R.	WA	F, G
A. bakaliensis Bunge	PI 220158	Afghanistan	WA	F, G
A. brachycarpus Bieb.	PI 314414	U.S.S.R.	WA	G
A. cicer L.	PI 66515	Sweden	WA	F, G
A. commixtus Bunge	PI 200161	Afghanistan	WA	F, G
A. falcatus Lam	PI 314062	U.S.S.R.	WA	G
A. filicaulis Fisch. & Mey.	PI 314142	—do—	WA	G
A. interpositus Boriss.	PI 314064	—do—	WA	G
A. macrorrhizus Cav.	PI 287772	Spain	WA	G
A. mexicanus DC.	PI 214097	—do—	WA	G
A. miser Dougl.	PI 232545	Idaho	WA	G
A. rubyi Green & Morris	A-14693	Arizona	TPMC	G
A. scorpiurus Bunge	PI 222036	Afghanistan	WA	F, G
A. stiupulatus Jacq.	PI 214401	Spain	WA	G
A. submumbellatus Klotzsch.	PI 219572	Pakistan	WA	G
A. tribuloides Delile	PI 220155	Afghanistan	WA	G
A. trimestris Pall.	PI 214102	Spain	WA	G
Coronilla scorpioides Koch	PI 287794	—do—	IA	G
Lathyrus annuus L.	PI 268322	—do—	USDA	G
L. latifolius L.	PI 358889	Nebraska	IA	F, G
L. tingitanus L.	PI 292797	Sweden	IA	F, G
Lotus arabicus L.	A-15142	—do—	TPMC	F, G
L. corniculatus L.	A-14572	Turkey	TPMC	F, G
Lupinus albus L.	PI 287241	Germany	WA	F, G
L. angustifolius L.	PI 237721	—do—	WA	F, G
L. bicolor Lindl.	PI 284713	California	WA	G
L. hirsutissimus Benth.	PI 285719	—do—	WA	F, G
L. polyphyllus Lindl.	PI 232580	Oregon	WA	F, G
L. sericeus Pursh.	PI 356829	Utah	WA	G
L. succulentis Dougl.	A-14027	Arizona	TPMC	G
Medicago arabica All.	PI 212948	Spain	GA	F
M. cancellata Tenore	PI 315458	U.S.S.R.	IA	F, G
M. coerulea Less.	PI 325381	—do—	IA	F, G
M. falcata Lam.	PI 228152	—do—	IA	F, G
M. hispida Gaertn.	PI 17361	—do—	TPMC	G
M. laciniata Mill.	PI 319051	Spain	IA	G
M. littoralis Rhode	PI 255381	Yugoslavia	GA	F, G
M. lupulina L.	PI 223872	Afghanistan	GA	F, G
M. minima L.	PI 227032	Iran	GA	F, G
M. polychroa Grossheim	PI 346895	U.S.S.R.	IA	F, G
M. polymorpha L.	PI 193054	Australia	GA	G
M. praecox DC.	PI 212948	Spain	GA	F, G
M. rigidula Desr.	PI 233252	Israel	GA	G
M. romanica Prod.	PI 325396	U.S.S.R.	IA	F, G
M. sativa L.	PI 210763	Spain	GA	G
M. sativa L. 'Caliverde'	(1)	California	USDA	F, G
M. scutellata Mill.	PI 161415	Argentina	GA	G
M. tianshanica Vassilcz.	PI 270315	Sweden	IA	G
M. tribuoloides Desr.	PI 190089	Australia	GA	F, G
Melilotus alba Desr.	PI 342821	Canada	IA	F, G
M. dentata Pers.	PI 213324	U.S.S.R.	IA	G
M. hirsuta Lipski	PI 129697	Sweden	IA	F, G
M. indica (L.) All.	PI 294227	Israel	IA	F, G
M. italica Lam.	PI 193951	Italy	IA	F, G
M. officinalis (L.) Pall.	A-14809	—do—	TPMC	F, G
Ononis pubescens L.	PI 233262	Israel	WA	G
Trifolium agrarium L.	PI 289863	Greece	GA	F, G
T. alexandrinum L.	PI 209016	South Africa	GA	F, G
T. arvense Walt.	PI 120079	Turkey	GA	F, G
T. campestre Schreb.	PI 120074	—do—	GA	F, G
T. dubium Sibth.	PI 171869	—do—	GA	F, G
T. fragiferum L.	PI 315496	U.S.S.R.	GA	G

See footnote at end of table.

Plant species	Identification number	Origin	Source	Experimental utilization
T. glomeratum L.	PI 287970	Spain	GA	G
T. hirtum All.	PI 120230	Turkey	GA	F, G
T. incarnatum L.	PI 233812	Italy	GA	G
T. lappaceum L.	PI 120233	Turkey	GA	F, G
T. medium L.	PI 317338	Finland	NY	G
T. nigriscens Viv.	PI 129053	Turkey	GA	F, G
T. pratense L.	PI 191149	Sweden	GA	F
T. radiosum Wahlenb.	PI 206771	Turkey	GA	F, G
T. repens L.	PI 208730	Italy	GA	F, G
T. resupinatum L.	PI 110431	Afghanistan	GA	G
T. subterraneum L.	PI 190564	Australia	GA	F, G
Vicia angustifolia L.	PI 121275	Turkey	GA	G
V. cracca L.	PI 206494	—do—	GA	G
V. faba L.	(1)	California	B	F, G
V. lutea L.	A-17845	Arizona	TPMC	G
V. sativa L.	PI 173158	Turkey	GA	F, G
V. villosa Roth.	PI 201883	Iran	GA	F, G
Lens esculenta Moench	PI 212611	Afghanistan	WA	F, G
Phaseolus vulgaris L. 'Blue Lake'	(1)	Arizona	NK	G
Pisum sativum L. 'Alaska'	(1)	—do—	NK	F, G
P. sativum L. 'Early Perfection'	(1)	—do—	NK	G
Vigna sinensis (L.) Savi	(1)	—do—	NK	G

[1] Seed purchased locally.

Table 1—*Analysis of variance for fecundity of BAA and PA on 2 check plant species* (Medicago sativa *'Caliverde' and* Melilotus officinalis) *included in greenhouse studies on each of 5 test dates*

Source of variation	Degrees of freedom (d.f.)	Mean square	Test for significance (f)
Date of test	4	325.98	40.81**
Aphid species	1	52.30	6.55*
Plant species	1	37.81	4.73*
Interactions:			
Date x aphid species	4	32.96	4.12**
Date x plant species	1	7.69	.96
Aphid species x plant species	1	0	0
Date x aphid species x plant species	4	7.68	.96
Error	56	7.99	

[1] F-values followed by * and ** were significant at the 0.05 and 0.01 level, respectively.

Table 2—*Mean fecundity (nymphs per aphid per week) of blue alfalfa aphids (BAA) and pea aphids (PA) on leguminous plants of test group 1 (April 1976). Plants were ranked according to increasing fecundity of BAA*

Plant species[1]	Fecundity[2] PA[3]	BAA[3]
**Lathyrus tingitanus*	0 a	0 a
**Trifolium campestre*	3.30 abc	.56 a
**T. dubium*	+9.64 cdefg	.90 a
**Vicia lutea*	15.94 ghi	.98 a
**Trifolium hirtum*	2.30 ab	2.50 ab
**Vicia angustifolia*	+16.25 ghi	3.75 abc
**Trifolium fragiferum*	14.39 efghi	5.68 abcd
Astragalus cicer	9.65 cdefg	5.76 abcd
A. rubyi	5.03 abcd	6.41 abcd
Trifolium radiosum	7.61 bcde	6.80 abcd
**Astragalus stipulatus*	5.83 abcd	8.20 bcdef
Trifolium subterraneum	11.05 defgh	8.37 bcdef
**Lotus corniculatus*	4.95 abcd	8.72 bcdefg
**Medicago tribuloides*	10.10 cdefgh	9.65 cdefgh
Melilotus officinalis	+19.43 ijkl	10.32 cdefgh
**Astragalus commixtus*	+25.07 kl	10.71 cdefgh
Medicago sativa 'Caliverde'	14.77 fghi	11.15 defgh
**Trifolium glomeratum*	13.42 efghi	11.50 defgh
**Astragalus interpositus*	4.01 abcd	12.18 defgh
**A. filicaulis*	16.94 hij	12.25 defgh
**Trifolium nigriscens*	15.41 ghi	12.47 defgh
**Astragalus scorpiurus*	11.50 defgh	12.92 efgh
**Trifolium resupinatum*	7.74 bcdef	13.16 efgh
**Medicago scutellata*	+26.42 l	14.46 efgh
Astragalus falcatus	23.62 jkl	15.62 gh
A. trimestris	18.12 ijk	16.41 h

[1]Plant species preceded by * were tested on more than one date.
[2]Mean fecundities preceded by + were significantly greater for PA than for BAA (LSD = 8.55, p = 0.05).
[3]Means followed by the same letter were not significantly different from other means for the same aphid (LSD = 7.04, p = 0.05).

Table 3—*Mean fecundity (nymphs per aphid per week) of blue alfalfa aphids (BAA) and pea aphids (PA) on leguminous plants of test group 2 (October 1976). Plants were ranked according to increasing fecundity of BAA*

Plant species[1]	Fecundity[2] PA[3]	BAA[3]
**Lupinus angustifolius*	1.65 a	0 a
Trifolium alexandrinum	2.93 ab	0 a
Lathyrus annus	+8.29 cd	0 a
Lupinus albus	+6.55 bc	.66 abc
**Vicia angustifolia*	+11.92 d	1.02 abc
Lotus arabicus	+16.16 e	1.55 abcd
Trifolium agrarium	1.14 a	1.75 abcd
T. arvense	+8.58 cd	1.87 abcd
Vicia villosa	.03 a	1.97 abcd
Medicago falcata	7.11 c	2.25 abcd
**Trifolium hirtum*	2.18 a	2.35 abcd
Medicago sativa 'Caliverde'	8.19 cd	3.18 abcd
Astragalus armeniacus	8.99 cd	3.32 abcde

See footnotes at end of table.

Table 3—*Mean fecundity (nymphs per aphid per week) of blue alfalfa aphids (BAA) and pea aphids (PA) on leguminous plants of test group 2 (October 1976). Plants were ranked according to increasing fecundity of BAA*—continued

Plant species[1]	Fecundity[2] PA[3]	BAA[3]
A. asper	+10.43 cd	3.59 abcde
Melilotus officinalis	7.07 bc	4.37 bcde
Astragalus bakaliensis	+16.47 e	4.62 bcde
Medicago cancellata	7.32 c	4.77 cde
**Melilotus alba*	9.79 cd	5.34 de
Medicago coerulea	7.16 c	5.64 de
Astragalus brachycarpus	+16.19 e	7.48 e

[1]Plant species preceded by * were tested on more than one date.
[2]Mean fecundities preceded by + were significantly greater for PA than BAA (LSD = 5.88, p = 0.05).
[3]Means followed by the same letter were not significantly different from other means for the same aphid (LSD = 4.18, p = 0.05).

Table 4—*Mean fecundity (nymphs per aphid per week) of blue alfalfa aphids (BAA) and pea aphids (PA) on leguminous plants of test group 3 (February 1977). Plants were ranked according to increasing fecundity of BAA*

Plant species[1]	Fecundity[2] PA[3]	BAA[3]
Phaseolus vulgaris	0 a	0 a
Melilotus hirsuta	.09 a	0 a
Lupinus bicolor	.15 a	0 a
Astragalus mexicanus	3.58 a	0 a
Lathyrus latifolius	2.63 a	0 a
Lupinus hirsutissimus	2.09 a	.22 a
Vicia lutea	+9.97 b	.31 a
Melilotus indica	3.98 a	.45 a
Trifolium incarnatum	3.49 a	.65 a
Medicago minima	4.65 a	.75 a
Astragalus macrorrhizus	.71 a	1.43 a
Medicago polychroa	2.59 a	1.91 a
Vigna sinensis	0 a	2.27 a
Medicago sativa 'Caliverde'	2.99 a	2.49 a
M. lupulina	.54 a	2.70 a
**Astragalus interpositus*	1.29 a	2.72 ab
Melilotus officinalis	2.29 a	2.75 ab
Astragalus miser	5.05 a	3.40 ab
Melilotus italica	+19.94 c	5.57 abc
**Lotus corniculatus*	2.24 a	++7.69 bc

[1]Plant species preceded by * were tested on more than one date.
[2]Mean fecundities preceded by + were significantly greater for PA than for BAA, and those preceded by ++ were significantly greater for BAA than PA (LSD = 4.87, p = 0.05).
[3]Means followed by the same letter were not significantly different from other means for the same aphid (LSD = 3.47, p = 0.05).

Table 5—*Mean fecundity (nymphs per aphid per week) of blue alfalfa aphids (BAA) and pea aphids (PA) on leguminous plants of test group 4 (March 1977). Plants were ranked according to increasing fecundity of BAA*

Plant species[1]	Fecundity[2] PA[3]	BAA[3]
**Trifolium campestre*	1.37 abc	0 a
Pisum sativum 'Early Perf.'	+8.33 gh	0 a
Ononis pubescens	2.44 abcde	.70 ab
Lens esculenta	1.75 abcde	.73 ab
Lupinus polyphyllus	0 a	.86 ab
Trifolium lappaceum	3.46 bcde	.92 ab
Medicago romanica	.73 ab	1.44 abc
**Trifolium dubium*	4.10 cdef	1.59 abc
Medicago laciniata	1.60 abce	1.64 abc
**M. littoralis*	4.10 cdef	2.74 abcd
M. praecox	+8.27 gh	3.25 bcde
M. sativa 'Caliverde'	2.98 abcde	3.41 bcde
Vicia sativa	1.64 abcde	3.45 bcde
Medicago polymorpha	7.29 fg	4.23 cde
M. rigidula	+9.05 gh	4.44 cde
Melilotus officinalis	4.79 def	5.17 def
M. dentata	0 a	++5.31 def
Coronilla scorpioides	4.82 ef	6.12 ef
Pisum sativum 'Alaska'	3.49 bcde	++8.33 fg
**Trifolium nigriscens*	10.70 h	9.66 g

[1]Plant species preceded by * were tested on more than one date.
[2]Mean fecundities preceded by + were significantly greater for PA than for BAA, and those preceded by ++ were significantly greater for BAA than for PA (LSD = 4.51, p = 0.05).
[3]Means followed by the same letter were not significantly different from other means for the same aphid (LSD = 3.21, p = 0.05).

Table 6—*Mean fecundity (nymphs per aphid per week) of blue alfalfa aphids (BAA) and pea aphids (PA) on leguminous plants of test group 5 (April 1977). Plants were ranked according to increasing fecundity of BAA*

Plant species[1]	Fecundity[2] PA[3]	BAA[3]
**Lathyrus tingitanus*	0 a	0 a
Lupinus sericeus	0 a	0 a
Vicia cracca	1.19 ab	.54 a
Lupinus succulentis	2.73 abc	.79 a
**L. angustifolius*	4.44 abcd	1.52 ab
Trifolium medium	3.12 abc	1.66 ab
Medicago hispida	8.40 def	3.30 abc
M. sativa (Spain)	6.77 cde	4.17 abcd
**Astragalus stipulatus*	6.80 cde	5.51 bcde
**A. commixtus*	7.95 def	5.54 bcde
A. subumbellatus	6.06 cde	5.86 bcde
**Trifolium fragiferum*	9.99 efg	7.23 cdef
T. pratense	7.25 cde	7.34 cdef
**Astragalus filicaulis*	8.17 def	7.38 cdef
**Trifolium glomeratum*	8.04 def	8.14 def
Astragalus tribuloides	12.43 fg	8.72 def
Trifolium repens	6.39 cde	8.97 efg

See footnotes at end of table.

Table 6—*Mean fecundity (nymphs per aphid per week) of blue alfalfa aphids (BAA) and pea aphids (PA) on leguminous plants of test group 5 (April 1977). Plants were ranked according to increasing fecundity of BAA*—continued

Plant species[1]	Fecundity[2] PA[3]	BAA[3]
Medicago sativa 'Caliverde'	9.62 efg	9.49 efg
**M. tribuliodes*	12.10 fg	9.98 efg
Vicia faba	+33.60 i	10.89 fgh
**Trifolium resupinatum*	10.10 efg	10.89 fgh
Medicago tianshanica	4.90 bcd	11.34 fgh
**T. scutellata*	+23.26 h	11.40 fgh

[1]Plant species preceded by * were tested on more than one date.
[2]Mean total fecundities preceded by + are significantly greater for PA than for BAA (LSD = 6.62, p = 0.05).
[3]Means followed by the same letter were not significantly different from means for the same aphid (LSD = 4.70, p = 0.05).

Table 7—*Analysis of variance for arcsin transformation of percent seedling survival and weighted population levels of blue alfalfa aphids and pea aphids on 45 leguminous host plant species infested under field conditions in caged split plots during April 1978*

Source of variation	d.f.	Transformed percent survival Mean square	F[1]	Weighted populations levels Mean square	F[1]
Aphid species	1	.376	2.63	1915.57	11.03
Cages per aphid species	2	.143	1.81	173.60	4.35
Replications per cages per aphid species	4	.079		39.88	
Plant species	44	.540	15.89**	306.67	26.26**
Plant species × aphid species interaction	44	.315	9.26**	98.89	8.47**
Error	264	.034		11.68	

[1]F-values followed by ** are significant at the 0.01 level.

Table 8—*Mean population levels and mean weighted population levels of blue alfalfa aphids and pea aphids caged on 45 leguminous host plants under caged field conditions—plants ranked according to weighted population levels of blue alfalfa aphids*

Plant species[1] [2]	Blue alfalfa aphid		Pea aphid	
	Unweighted	Weighted	Unweighted	Weighted
Astragalus asper	1.96	9.704 a	2.45	15.792 abc
Lupinus hirsutissimus	2.07	11.541 ab	2.25	+21.324 defgh
Medicago cancellata	1.91	11.611 ab	2.58	17.152 abcd
Lupinus angustifolius	2.16	11.938 abc	3.02	17.290 bcde
L. polyphyllus	2.00	12.376 abc	3.66	+19.496 cdefg
Melilotus italica	2.24	12.453 abc	3.57	+23.153 ghijk
Astragalus commixtus	2.71	12.494 abc	3.49	+26.651 ijklm
Medicago romanica	2.12	12.499 abc	2.50	17.273 bcd
Lathyrus latifolius	3.33	12.706 abcd	3.63	15.798 abc
Astragalus scorpiurus	2.79	12.833 abcd	3.82	+21.145 defgh
Trifolium dubium	2.30	12.952 abcd	2.50	15.868 abc
T. hirtum	2.15	13.746 abcde	2.58	+20.702 defgh
Medicago arabica	2.10	14.095 abcde	2.52	+26.814 jklmn
Astragalus bakaliensis	2.59	14.598 bcdef	3.36	+25.109 ijkl
Medicago tribuloides	2.04	14.889 bcdef	3.08	+28.643 lmno
Lupinus albus	3.23	14.987 bcdef	4.36	18.356 cdef
Medicago coerulea	1.96	15.284 bcdefg	2.24	19.496 cdefg
Lathyrus tingitanus	3.23	16.423 cdefg	5.94	+40.121 p
Astragalus cicer	2.33	17.339 defgh	1.97	12.426 a
Medicago falcata	2.22	17.871 efghi	1.89	20.267 cdefg
Lens esculenta	3.50	17.880 efghi	4.50	+28.438 lmn
Astragalus mexicanus	2.54	18.431 efghi	1.64	19.587 cdefg
Medicago polychroa	2.33	19.135 fghij	2.43	23.316 ghijk
Melilotus officinalis	2.10	19.153 fghij	2.43	23.316 ghijk
Trifolium subterraneum	2.95	19.816 ghij	3.18	20.521 cdefgh
Vicia villosa	3.11	19.936 ghij	4.94	+27.880 klmn
Medicago littoralis	2.36	21.510 hijk	2.74	+31.351 mno
Trifolium radiosum	1.96	21.669 hijk	3.72	27.431 klmn
Medicago praecox	2.58	22.009 hijkl	2.65	27.871 klmn
M. minima	2.70	22.145 ijkl	2.48	22.097 fghij
Trifolium lappaceum	1.61	22.327 ijkl	3.72	+38.243 p
Melilotus hirsuta	2.21	23.370 jklm	1.98	22.045 efghi
Medicago sativa 'Caliv.'	1.92	23.698 jklmn	5.12	27.358 klmn
Trifolium alexandrinum	2.40	25.301 klmno	2.16	27.889 klmn
Melilotus alba	2.21	++25.337 klmno	1.98	17.776 cdef
M. indica	2.33	++25.576 klmno	2.54	13.001 ab
Trifolium agrarium	1.65	25.918 klmno	2.02	26.873 klmn
T. campestre	1.43	26.470 lmno	2.44	+39.985 p
Pisum sativum 'Alaska'	5.01	27.598 mno	6.00	+55.197 r
Vicia sativa	2.66	28.262 no	4.09	27.396 klmn
Trifolium nigriscens	2.22	28.674 op	2.94	+46.085 q
Lotus corniculatus	2.77	++29.132 op	2.04	19.964 cdefg
L. arabicus	2.19	29.775 op	2.42	31.497 no
Trifolium arvense	1.67	33.389 pq	1.98	+48.348 q
Medicago lupulina	2.69	36.291 pq	2.56	33.254 o

[1] + indicates that survival under pea aphid infestation was significantly less at the 0.05 level. + + indicates that survival under blue alfalfa aphid infestation was significantly less at the 0.05 level.

[2] Means followed by the same letter were not significantly different at the 0.05 level.

Table 9—*Mean percent survival and mean transformed percent survival of 45 leguminous host plant species exposed to caged field populations of blue alfalfa aphids and pea aphids*

Plant species[1] [2]	Blue alfalfa aphid		Pea aphid	
	Percent survival	Arcsin transformation	Percent survival	Arcsin transformation
Lotus corniculatus	7.26	++0.216 a	27.16	0.547 defg
Astragalus bakaliensis	7.16	++ .218 a	83.52	1.116 mnop
A. scorpiurus	10.18	.262 a	12.10	.321 bcd
Medicago cancellata	9.03	++ .276 ab	56.89	.857 hijkl
Lupinus polyphyllus	15.00	.309 abc	5.00	.162 ab
Medicago falcata	18.27	++ .403 abcd	64.57	.934 ijklm
M. polychroa	19.50	++ .437 abcde	63.65	.932 ijklm
M. praecox	21.56	++ .471 abcde	51.79	.813 hijk
Astragalus commixtus	31.37	++ .527 bcdef	72.98	1.026 jklmno
Trifolium hirtum	27.50	.551 cdef	19.00	.453 cde
Medicago romanica	29.92	.574 defg	38.26	.658 efgh
Astragalus mexicanus	31.89	++ .558 defgh	80.67	1.117 mnop
Melilotus italica	33.37	++ .612 defgh	74.21	1.052 klmnop
Medicago sativa 'Caliv.'	34.47	628 defgh	50.20	.788 ghij
M. littoralis	36.18	++ .635 defgh	64.86	.942 ijklm
Trifolium nigriscens	37.98	.663 efghi	53.86	.824 hijk
Astragalus asper	38.53	++ .668 efghi	75.30	1.058 klmnop
Trifolium alexandrinum	40.71	++ .602 efghi	78.02	1.112 lmnop
Astragalus cicer	45.91	.745 fghijk	49.29	.778 ghij
Medicago minima	46.70	.752 fghijk	63.16	.923 ijklm
M. coerulea	46.94	++ .754 fghijk	78.18	1.083 lmnop
Melilotus hirsuta	47.48	.758 fghijk	79.14	1.101 lmnop
M. officinalis	47.40	.759 fghijk	72.19	1.024 jklmno
Medicago arabica	53.40	.820 ghijkl	73.87	1.057 klmnop
Lathyrus tingitanus	54.58	.833 hijklm	70.07	1.012 jklmn
Medicago tribuloides	60.66	.917 ijklmn	74.21	1.050 klmno
Trifolium subterraneum	64.34	.936 jklmno	50.44	.788 ghij
T. radiosum	63.83	.939 jklmno	22.43	+ .483 def
Melilotus alba	63.58	.941 jklmno	49.45	.780 ghij
Medicago lupulina	70.22	.998 klmnop	74.36	1.052 klmnop
Melilotus indica	70.21	1.020 lmnop	21.18	+ .477 def
Trifolium dubium	72.74	1.026 lmnop	44.70	+ .731 fghi
Pisum sativum 'Alaska'	75.00	1.053 lmnopq	85.00	1.212 mopq
Lens esculenta	73.06	1.073 lmnopqr	90.23	1.279 opq
Lotus arabicus	77.84	1.083 mnopqr	74.77	1.048 klmno
Lathyrus latifolius	80.42	1.153 nopqr	8.33	+ .200 abc
Lupinus hirsutissimus	79.17	1.190 opqrs	43.33	+ .718 fghi
Vicia sativa	84.53	1.203 pqrs	50.51	+ .790 ghij
Trifolium lappaceum	88.48	1.229 pqrs	0.00	+ .061 a
T. campestre	88.75	1.229 qrs	83.61	1.155 mnop
T. arvense	92.58	1.291 qrs	84.00	1.157 mnop
T. agrarium	93.42	1.314 rs	89.57	1.269 nopq
Lupinus angustifollus	90.97	1.323 rs	79.80	1.108 lmnop
Vicia villosa	96.43	1.427 s	90.00	1.307 pq
Lupinus albus	96.43	1.427 s	96.43	1.427 q

[1] + indicates that survival under pea aphid infestation was significantly less at the 0.05 level. ++ indicates that survival under blue alfalfa aphid infestation was significantly less at the 0.05 level.

[2] Means followed by the same letter were not significantly different at the 0.05 level.

Table 10—*Susceptibility ratings for comparison of host plants on the basis of composite data from study of blue alfalfa and pea aphids in greenhouse and field experiments*

Classification	Fecundity relative to fecundity on 'Caliverde'	Seedling survival in field study	Population rating in field study
Possible nonhost	≤ 0.5	variable	≥ 1.0
Susceptible but tolerant	≅ or > 2.0	>85%	≥ 2.0
Susceptible	≅ or > 1.0	40 to 85%	≤ 3.5
Very susceptible	≅ or > 1.0	30 to 75%	≥ 2.0
Highly susceptible	> 0.5	≤ 30%	≥ 1.0

Table 11—*Host suitability classification of 44 plant species tested under greenhouse and field conditions for blue alfalfa aphids and pea aphids [Key to abbreviations: SSS = highly susceptible, SS = very susceptible, S = susceptible, ST = susceptible but tolerant, PN = possible nonhost]*

Plant species	Blue alfalfa aphid	Pea aphid
Astragalus asper	SS	SS
A. bakaliensis	SSS	ST
A. cicer	S	S
A. commixtus	SS	SS
A. mexicanus	PN	S
A. scorpiurus	SSS	SSS
Lathyrus tingitanus	PN	PN
L. latifolius	PN	SSS
Lens esculenta	S	ST
Lotus arabicus	S	SS
L. corniculatus	SSS	SS
Lupinus albus	PN	ST
L. angustifolius	PN	SSS
L. polyphyllus	PN	PN

Table 11—*Host suitability classification of 44 plant species tested under greenhouse and field conditions for blue alfalfa aphids and pea aphids [Key to abbreviations: SSS = highly susceptible, SS = very susceptible, S = susceptible, ST = susceptible but tolerant, PN = possible nonhost]*—continued

Plant species	Blue alfalfa aphid	Pea aphid
L. hirsutissimus	PN	SS
Medicago sativa 'Caliverde'	SS	SS
M. cancellata	SSS	SS
M. coerulea	SS	S
M. falcata	SSS	SS
M. minima	S	SS
M. littoralis	SS	SS
M. lupulina	SS	S
M. polychroa	SSS	SS
M. praecox	SSS	SS
M. romanica	SSS	SS
M. tribuloides	S	S
Melilotus alba	SS	S
M. hirsuta	PN	S
M. indica	S	SSS
M. italica	SS	SS
M. officinalis	SS	SS
Trifolium agrarium	ST	S
T. alexandrinum	PN	ST
T. arvense	ST	ST
T. campestre	S	SS
T. dubium	SS	SS
T. hirtum	SS	SSS
T. lappaceum	ST	SSS
T. nigriscens	SS	SS
T. radiosum	S	SSS
T. subterraneum	S	SS
Vicia sativa	ST	SS
Vicia villosa	ST	ST
Pisum sativum 'Alaska'	SS	ST

END