

POSSIBILITIES FOR VARIETAL RESISTANCE TO THE
BLUE ALFALFA APHID (Acyrtosiphon kondoi)

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The blue alfalfa aphid was first identified in the spring of 1975 in the Imperial Valley of California. During this period, most fields in this low desert valley area were infested with the blue alfalfa aphid and it was very common through a two or three month period to see severely infested and damaged fields.

In addition to the typical symptoms such as yellowing and stunting caused by the blue alfalfa aphid, the affected fields also appeared very ragged in appearance. That is, some plants were tall and growing vigorously while other plants were shorter and definitely less vigorous. To a plant breeder this was a good sign because this indicated the plants in the field had a variable reaction to the blue alfalfa aphid and that some of the better looking plants might be resistant to it. This was the first strong indication that it would be possible to develop resistant varieties and, probably, rapidly.

When variety trials and a large number of fields were surveyed, it appeared all varieties seemed to exhibit some variability. Since most varieties exhibited this character, it seemed it might be possible to obtain resistance with almost any variety background. However, research will be needed to determine if this is correct and, if so, what degree of resistance might be found in the plants selected from the various variety backgrounds.

Since the first observations were made on the variability in infested fields, more information has been developed on varieties and the possibilities of developing resistant varieties. Data were obtained at El Centro, California, on the reaction of alfalfa varieties to the blue alfalfa aphid in three alfalfa experiments (Table 1). Two of these experiments were established yield trials and one was a seedling trial designed to obtain data on the alfalfa weevil. The older alfalfa plots and fields seemed more severely damaged than the younger. One of the experiments damaged (Test 23) was a seedling field which was about one month old when infested. Severe losses occurred before the problem was identified.

The varieties shown in Table 1 were listed roughly from the lower to the higher values (less susceptible to more susceptible). Since many varieties have essentially the same reaction to the blue alfalfa aphid, the listing of one variety higher in the table than another does not mean the higher variety is better. The LSD (least significant difference) should be used to indicate differences and, if possible, this should be double checked by using more than one test. The level of precision as indicated by a high CV (coefficient of variability) was low in Test 23, and, therefore, it is least reliable.

All varieties were judged as being susceptible to the blue alfalfa aphid. However, there appeared to be differences in the degree of susceptibility. For example, Niagara N 71 Brand, El Camino Brand WL 508, Diablo Verde, UC Salton, and UC Cargo appear less susceptible than Caliente, Sonora 70, Hayden, Sonora, and Mesa Sirsa. This latter group might be called highly susceptible. The reaction of Moapa 69 appears to be located between these two susceptibility groups. Varieties from central and eastern United States such as Arc, Saranac, and Team appeared to have a poorer reaction than most of the western varieties mentioned above.

When the reaction to the blue alfalfa aphid was compared with tests for resistance

to the pea aphid (Table 2), the reactions appeared to have some similarity. To obtain an estimate of this relationship, correlation coefficients were calculated using data in Tables 1 and 2. The following results were obtained:

Blue alfalfa aphid, Test 60 x pea aphid, FP (N=5), $r = 0.98$
Blue alfalfa aphid, Test 60 x pea aphid, El C (N=4), $r = 0.99$
Blue alfalfa aphid, Test 11 x pea aphid, FP (N=4), $r = 0.78$
Blue alfalfa aphid, Test 11 x pea aphid, El C (N=3), $r = 0.76$

This very limited data indicates there is a fairly strong relationship between these two aphids for varietal reaction in alfalfa. However, the resistance reaction to the pea aphid in a specific variety is higher than the reaction to the blue alfalfa aphid where we appear to be dealing with only levels of susceptibility. This indicates that selecting for resistance to the blue alfalfa aphid might produce higher levels of resistance to the pea aphid. On the other hand, it appears the levels of resistance to the blue alfalfa aphid that can be obtained by selecting for high resistance to the pea aphid would probably be too low to be of much value.

In greenhouse work at Reno, Nevada, on the Washo, Moapa, and Lahontan types of germplasm, a similar relationship between resistance factors in the blue alfalfa aphid and the pea aphid have been observed.

Culturing the blue alfalfa aphid under controlled or greenhouse conditions is another important factor in a resistance program. Good techniques will greatly speed the development of resistant varieties because populations of a desired size could be produced as needed. At Reno the blue alfalfa aphid was maintained and increased on alfalfa clones growing in the greenhouse. Difficulty was experienced on clones resistant to the pea aphid. High summer temperatures also appeared to interfere with reproduction and predictable rearing results. However, the blue alfalfa aphid was maintained through the summer with reasonably good results. As more experience and information and, perhaps, better hosts are obtained, it is expected that routine predictable rearing will be possible.

On the basis of limited work it appears selections can be made under artificial or caged conditions and field conditions. At Reno, greenhouse flats have been seeded and infested with the blue alfalfa aphid in the seedling stage. Sustained pressure from large populations of aphids appeared to be needed, but it was difficult to maintain a sufficient number of aphids on most seedling flats during the hot summer because a dependable supply of aphids could not be reared. In one test where a good supply of aphids was available, excellent elimination of seedling plants was obtained and, therefore, apparently reliable selections were made using this method. Selections at Reno are being made primarily in the Moapa germplasm because this variety has received wide acceptance through the Southwest.

Infestation of individual alfalfa plants using small cages has not been used as yet, but it appears this important test should be successful.

Field selections are another important way of obtaining resistant germplasm. Variability found in fields attacked by this aphid indicate this method will be useable if the aphid attack can be sustained long enough to obtain a good differential reaction. Many such fields could be found in the Imperial Valley during the spring of 1975. One three-year-old field of the new variety UC Cargo was found near El Centro which had been infested with the blue alfalfa aphid for about one month. Most plants showed symptoms of the attack by the blue alfalfa aphid, but a few plants appeared bright green and unaffected (Figure 1).

Plants appearing resistant to the aphid were examined closely for aphids, discoloration, misshapen leaves, and stunting. About 93 plants were saved from the 20 acre field and placed in a seed production cage where seed was produced during the summer of 1975. The resulting experimental variety was called CUF 101 because it is being developed by the cooperative efforts of the University of California, the USDA, and farmers interested in the work. No tests have been made on this seed as yet.

On the basis of the information obtained on the blue alfalfa aphid since it was discovered in the spring of 1975, we feel the following conclusions can be made: (1) Good sources of resistance appear available. (2) Most testing procedures used in the

development of resistance to the pea and spotted alfalfa aphids will probably be effective. (3) It appears populations of the blue alfalfa aphid can be cultured under controlled conditions. (4) Development of varieties with resistance to the blue alfalfa aphid may also provide varieties with high levels of resistance to the pea aphid. From this it appears rapid development of resistant varieties in various germplasm backgrounds is possible.

Table 1. Reaction of alfalfa varieties to the blue alfalfa aphid (*Acyrtosiphon kondoi*) growing in variety trials on the University of California Imperial Valley Field Station during the spring of 1975.

Variety or brand	Average plot score ^{1/}		Average percent
	Test 60 ^{3/} 4-28-75	Test 11 ^{4/} 4-28-75	plants ^{2/} remaining Test 23 ^{5/} 4-29-75
Niagara N 71 Brand	7.11	-	-
El Camino Brand WL 508	-	7.00	-
Diablo Verde	-	7.00	0
UC 76*	7.22	7.33	-
UC Salton	7.44	7.17	38.3
UC Cargo	7.33	7.50	-
UC 62 (SM 3)*	-	7.33	-
UC 81 (Hunt 44)*	-	7.33	-
Moapa 69	7.89	7.83	-
Lew	-	-	-
Washoe	-	-	31.3
Kanza	-	-	31.3
UC 77 (weevil)*	-	8.00	27.9
UC 73 (weevil)*	8.11	8.17	21.9
Caliente	8.44	-	-
Sonora 70	-	8.17	-
Hayden	8.56	8.33	-
Sonora	8.89	8.50	-
Mesa Sirsa	9.00	8.67	27.9
Arc	-	-	21.7
Saranac	-	-	20.4
Weevichek	-	-	20.4
Team	-	-	19.2
Gladiator	-	-	19.2
LSD .05	.48	0.58	10.9
LSD .01	.65	0.76	14.3
Coefficient of variation (CV)	3.5	6.6	-

*Experimental varieties; no commercial seed available.

^{1/} Score of 1 = highly resistant, 2.5 = resistant, 5 = intermediate, 7.5 = susceptible, 9 = highly susceptible.

^{2/} Estimate of the number of seedling plants remaining after an infestation of *A. kondoi*.

^{3/} Planted October 6, 1972 in a hay production field, plot size = 20' x 60'.

^{4/} Planted February 8, 1974, plot size = 3.3' x 12'.

^{5/} Planted February 28, 1975, plot size = 1' x 16'.

Table 2. Damage scores of alfalfa varieties evaluated for resistance to field populations of pea aphid at Five Points and El Centro, California.

Variety	Score ^{1/} _{2/}	
	Five Points (FP)	El Centro (El C)
UC Cargo	3.2	2.0
UC Salton	2.7	2.0
Moapa 69	4.0	-
Hayden	5.7	-
Sonora 70	5.7	-
Niagara N 71	2.0	.7
Mesa Sirsa		2.8
LSD (.05)		0.69

^{1/} Data from Dr. V. L. Marble, Cooperative Extension Service, Davis

^{2/} Score of 1 = no damage, 5 = heavy damage.



Figure 1. Alfalfa plants susceptible (left) and resistant (right) to the blue alfalfa aphid. The susceptible plant is stunted, with small curled leaves while the resistant plant is almost twice as tall as the susceptible with fully expanded, normal appearing leaves.