

THE POTENTIAL FOR BIOLOGICAL CONTROL OF  
THE BLUE ALFALFA APHID

D. Gonzalez, W. White, R. Dickson  
and R. van den Bosch

The serious damage caused in the spring of 1975 by this new pest has prompted an intensive effort to search for biological control agents that may attack it. Our present efforts include the preliminary evaluation of available parasites that may potentially attack the blue alfalfa aphid, or Acyrtosiphum kondoi (Miyasaki 1971; Takahashi 1965; Shinji and Kondo 1938).

The stocks of parasites presently available for these evaluations are Aphidius ervi (tent. I.D.) and A. smithi. The former was recently introduced from Japan, and reflects a new biological record of its attack against A. kondoi, found in this case on yellow sweet clover (Melilotus officinalis) and on white clover (Trifolium repens). The parasite was also found on pea aphid on alfalfa (varieties Dupuis and Saranac), from which it had previously been reported (Takada 1968).

A summary of parasites collected from Japan is given in Table 1. Although a search widely ranging throughout Japan was carried out this fall for aphids, and parasites, parasites were only found attacking A. kondoi and pea aphid in Morioka, a city of approximately the same latitude as Yuba City, California. All collections were made from plants located within a 5 mile radius and presumably all plants were equally available to the parasites, the hyperparasites, and the aphids. If this was the case, then there appears to be some marked differences in host plant preference. Note that A. kondoi was only found parasitized on clovers, suggesting that either the aphid and/or the parasites may prefer this plant over alfalfa. If this is a true preference we may use such information to enhance parasite colonization by releasing parasites on clover adjacent to alfalfa. Although A. kondoi was found only parasitized on clovers, it does feed extensively on alfalfa, but primarily in the spring. In our search this fall, low numbers of non-parasitized A. kondoi were found from several areas in Japan, distant from one another and with marked climatic zones. It is noteworthy that the relationship reported on alfalfa in the spring in Japan between A. kondoi and pea aphid seems to be similar to that noted in California. That is, although both aphid types are present on spring alfalfa (Higuchi and Miyasaki 1969), A. kondoi seems to have a greater capacity for increasing in numbers, at least as known to date under cool spring conditions.

Table 1. Parasites from Japan.

HOST		# Primary parasites	# Hyper parasites	# NOT emerged	TOTAL
PLANT	INSECT				# cocoons parasitized
CLOVERS		39	28	28	
	Red (P.+ K. mixed)	(12)	( 0)	( 6)	(18)
	White (kondoi)	(27)	(28)	(22)	(77)
	Yellow sweet (kondoi)	8	39	45	92
ALFALFA		111	72	47	230
	var. Saranac (pea)	(89)	(57)	(38)	(184)
	var. Dupuis (pea)	(22)	(15)	( 9)	( 46)
TOTALS*		158	139	120	417

\*On 7 Oct. 1975

The other striking observation in Table 1 is the high ratio of hyperparasites (Kamijo and Takada 1973) to parasites, in all cases except one being nearly 1:1, and in the exception clearly being responsible for the very low survival of parasites. Thus, we have optimistic expectations that removal of these hyperparasites will greatly enhance the effectiveness of these parasites.

From limited laboratory observations to date, both A. ervi and A. smithi readily attack A. kondoi, but they also readily attack the pea aphid, as we report in Table 2. This behavior may be both for and against our efforts to establish effective parasites against A. kondoi. Obviously, if all parasites of pea aphid also attack A. kondoi, then we have a large number of candidates from which we may optimistically hope that one or more will effectively control the new aphid (Table 2). Likewise, there are certain to exist several biological races or ecotypes of each of these listed parasites as is indicated by the accompanying geographical range, which means that we may have at least several dozen potential parasite ecotypes to work with (Stary 1974). However, some of these parasites may also prefer pea aphid over A. kondoi, in which case introductions of those types may only further complicate an already difficult problem. The only certainty that we can state at this point is that there is, in our opinion, a great potential for controlling this aphid with parasites.

Table 2 Potential Parasites of A. kondoi.

Name	Origin	Insect hosts known	Attack <u>A. kondoi</u>	Develop on <u>A. kondoi</u>
<u>Evaluated in lab</u>				
<u>Aphidius ervi</u>	(Europe, No. Afr., Near & Far East, west USA)	pea aphid <u>A. kondoi</u> <u>A. caraganae</u>	yes	yes
<u>A. smithi</u>	(India, Canada)	pea aphid <u>A. kondoi</u>	yes	?
<u>Trioxys utilis</u>		spotted alfalfa aphid	no	no

Not evaluated

Native or already imported to North America:

Aphidius nigrips (Canada, USA; pea aphid)  
A. pulcher (USA & Canada; pea aphid)  
A. rosae (Wisconsin, Europe, USSR, Canada; pea aphid)  
A. urticae (Wash., Europe; pea aphid, A. caraganae)  
Ephedrus californicus (Calif.; pea aphid)  
E. plagiator (Calif., Europe, Asia; pea aphid, A. caraganae)  
Monoctonus paulensis (west Canada, USA; pea aphid)  
Praon aguti (No. Amer.; pea aphid)  
P. occidentale (Canada, USA; pea aphid)  
P. pequodorum (Ore., Wash.; pea aphid)  
P. simulans (Canada, USA; pea aphid)

Foreign

Aphidius picipes (Europe, Mongolia; pea aphid, A. caraganae)  
Binodoxys angelicae angelicae (Europe; A. caraganae)  
Praon barbatum (Europe; pea aphid)  
P. dorsale (Europe, Japan; pea aphid)  
Toxares deltiger (Europe, Canada; A. caraganae)

Our future plans include a continued search for parasites of A. kondoi in the spring in Japan, and in the middle east. We hope to return in Japan in the spring when there are high numbers of aphids, thus increasing our chances for finding either more parasite species and/or parasite races from the various climatic zones where the search will be conducted. For similar reasons, that is, to seek out more parasite species and/or

biological races or ecotypes, we also plan to search in the Middle East where the spring and summer climates in particular are very similar to the corresponding climatic zones found in California.

Our plans then are to colonize those parasites from the various climatic zones into their most corresponding climatic counterpart in California. As an example, our first colonization effort will take place this winter in the Sacramento Valley, with the releases of Aphidius ervi from Morioka, Japan.

Although we have only limited data on the new aphid's origin, host plant preference, behavior, and its seasonal distribution, those data clearly complement each other to give us a composite identity. With this frame of reference, we believe that we have a high probability for finding and establishing an effective parasite against the new aphid.

Table 3. List of Hyperparasites from Japan.

Host Aphid	Host Plant	(Tentative) Hyperparasite name
<u>A. kondoi</u>	Yellow sweet clover	<u>Charips</u> sp.
		<u>Aphidencyrthus</u> sp. (Encyrtidae)
		<u>Asaphes</u> sp. (Pteromalidae)
		<u>Lygocerus</u> sp. (Ceraphronidae)
		<u>Pachyneuron</u> sp. (Pteromalidae)
<u>A. kondoi</u>	White clover	<u>Asaphes</u> sp.
		<u>Lygocerus</u> sp.
Pea Aphid	Alfalfa (Dupuis)	<u>Lygocerus</u> sp.
	Alfalfa (Saranac)	<u>Lygocerus</u> sp. <u>Asaphes</u> sp.

## References

- Higuchi, Hiromichi, and Masahisa Miyasaki. 1969. A tentative catalog of host plants of Aphidoidea in Japan. *Insecta Matsumurana*. Supplement 5. 66 pp. Ent. Inst. Fac. Agric., Hokkaido Univ., Sapporo.
- Kamijo, Kazuaki, and Hajimu Takada. 1973. Studies on aphid hyperparasites of Japan; II aphid hyperparasites of the Pteromalidae occurring in Japan (Hymenoptera). *Insecta Matsumurana*. New Series 2: 39-76.
- Miyasaki, Masahisa. 1971. A revision of the Tribe Macrosiphini of Japan. *Insecta Matsumurana* 34 (pt. 1): 1-247.
- Shinji, O., and T. Kondo. 1938. Aphididae of Manchoukuo with the description of two new species. *Kontyū* 12(2): 55-69.
- Stary, Petr. 1974. Taxonomy, origin, distribution, and host range of Aphidius species (Hym., Aphidiidae) in relation to biological control of the pea aphid in Europe and North America. *Zeits. ang. Ent.* 77: 141-171.
- Takada, Hajimi. 1968. Aphidiidae of Japan (Hymenoptera). *Insecta Matsumurana* 30(2): 67-124.
- Takahashi, Ryoichi. 1965. Some new and little-known Aphididae from Japan. *Insecta Matsumurana* 28(1): 19-61.