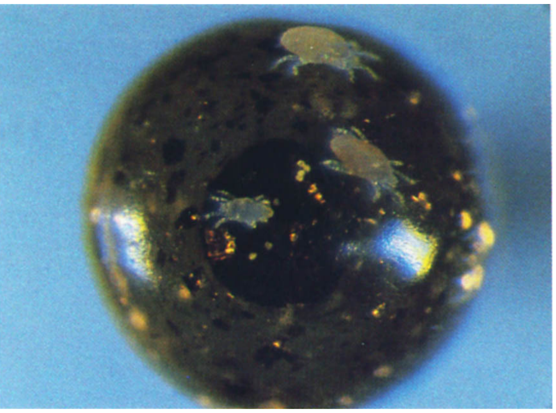


Two adult female and one adult male tydeid mite on the head of an insect pin.

Tydeid mites in vineyards

Nancy Fike Knop □ Marjorie A. Hoy

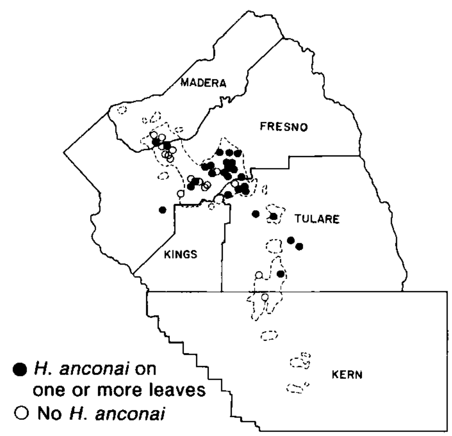
This beneficial mite serves as alternate prey for a spider mite predator

Better understanding of the biology and interactions of mite species occurring in vineyards will make it easier to manage spider mite pests. A predatory mite, if present early in the season in sufficient numbers, can control the Pacific spider mite. Populations of the predator, in turn, are affected by availability of another mite, a tiny pollen-feeding tydeid that serves as alternate prey in the absence of spider mites.

The tydeid, *Homeopronematus anconai* (Baker) (formerly identified as *Pronematus anconai*), also overwinters in grape buds with the predatory mite, *Metaseiulus (Typhlodromus) occidentalis* (Nesbitt), where it may continue to serve as food for the predator. High numbers of the tydeid in vineyards late in the growing season will increase overwintering predator populations and make control of the Pacific spider mite, *Tetranychus pacificus* (McGregor), more likely the following year (*California Agriculture*, November 1971).

This tydeid has been collected in San Joaquin Valley vineyards throughout the year but may be rare or absent in midsummer. To learn more about its biology, we conducted studies examining summer weather conditions and pesticides used in vineyards as factors that might limit the tydeid's numbers. We also evaluated pesticides of potential interest for vineyard pest management for their effect on this mite.

Although two tydeid species were previously reported in San Joaquin Valley vineyards, we collected only *H. anconai* in sites sampled between 1979 and 1981. This species was present in the major Valley grape-growing areas. We found *H. anconai* in 22 of 34 vineyards sampled on April 9 to 11, 1980, in Madera, Fresno, and Tulare counties.



The tydeid was found in most San Joaquin Valley grape-growing areas (dotted lines).

Life history

Females of this tydeid species deposit single-stalked eggs, often at the tips of leaf hairs, in vein crotches on the undersides of grape leaves. There are four immature stages. A six-legged larva hatches from the egg, and is followed by three eight-legged nymphal stages (protonymph, deutonymph, and tritonymph), the last of which molts to an adult. During each molt, the mite is inactive.

Adult females are about 1/100 inch (1/4 mm) long, and males are two-thirds that size. These mites can move very fast both backward and forward. Active and inactive stages occur singly or in clumps, most often along leaf veins and in vein crotches.

Development from egg to active adult (in laboratory constant-temperature cabinets) took about 13 days, and mean generation time was 21 days at 75°F. At 90°F, development took about 8 days, and mean generation time was 12 days.

To see whether San Joaquin Valley temperature might be too high for summer survival or might halt reproduction, we also reared the tydeid in a temperature cabinet set to cycle between 72° and 105°F, the average high and low temperatures in Fresno between July 28 and August 2, 1978-80. All cabinets were set for 18 hours of light and 6 hours of dark. Cyclic high temperatures and long days did not have any observable detrimental effects. Mites reached adulthood in 12 days and began egg production at 12½ days. Thus, high temperatures probably do not limit numbers of this mite during the summer.

Female *H. anconai* can produce eggs without mating, but only males develop from unfertilized eggs. Laboratory tests confirmed that females are only able to mate successfully during the first day of active adult life. This short interval for mating may be one reason why these mites are often found in groups on foliage in vineyards, since males must be nearby to ensure fertilization soon after females become adult.

Almost all the tydeids overwintering in grape buds are mated adult females. To learn if these females are in a reproductive dormancy (diapause) and, if so, what daylength and temperatures would induce diapause, we conducted a series of rearing experiments in field cages and in the laboratory. Females maturing during October in field cages did enter a reproductive diapause, seeking a sheltered spot where they remained for the winter. Diapausing females did not deposit eggs, even when ample food was available, and they were much less active than non-diapausing mites. The laboratory experiments showed that diapause was induced by short daylength and cool temperatures. This tydeid is well adapted for winter survival in the San Joaquin Valley.

H. anconai is not a pest. It may derive moisture, some essential nutrient(s), or both, from leaf tissue, but it causes no detectable feeding damage. It can be reared in the laboratory on grape or blackberry leaf discs laid underside up on moist cotton with one or more types of pollen added every day or two as food. We have reared *H. anconai* on pollens as diverse as cattail (*Typha*), iceplant (*Carpobrotus*), California poppy (*Eschscholzia*), and *Magnolia*, but we were not able to rear it on pine (*Pinus*), *Dahlia*, or *Cosmos* pollen. Although primarily a pollen feeder, this mite also feeds on fungus, can cannibalize its own eggs, and occasionally preys on Pacific or Willamette spider mite eggs. Females do not continue to deposit eggs on leaves unless pollen or other food is present, so we know it is not primarily a plant-feeding species. However, we have not succeeded in rearing this tydeid with pollen as the sole food on artificial substrates, so we suspect that leaves or microorganisms on the leaves offer something essential.

Tydeids appear to be more abundant in weedy vineyards, and local pollen counts may reveal a relationship between pollen availability and population size. Pollen counts in the San Joaquin Valley are usually lower during June, July, and August than in spring or fall.

Chemical selectivity

To investigate possible pesticide effects on early- and midsummer tydeid numbers, we screened pesticides commonly used on grapes, as well as a few registered for other crops (see table). Adult females were placed on pesticide-treated leaf discs in the laboratory at 78° to 80°F with 16 hours of light. After 48 hours, we counted and removed the surviving females, counted the number of eggs laid, and kept the discs to record egg hatch and larval development.

The results suggest that pesticide use may be a major reason why *H. anconai* populations drop during the summer. Of the fungicides tested, sulfur dust and microsulf (wettable powder sulfur) were the most toxic, particularly to larvae. Sulfur is the dominant pesticide (in pounds applied) used in San Joaquin Valley vineyards, and probably has a major effect on tydeid populations. Benlate (benomyl) reduced egg production somewhat and sharply reduced egg hatch. Bayleton was the least toxic fungicide tested, although it decreased egg production.

Among the acaricides, Omite (propargite) was toxic to this mite at field rates and probably reduces tydeid populations in vineyards when it is applied. Although most females survived field rates of Vendex, this material was a potent larvicide. Plictran (cyhexatin, unregistered for use in grapes) was more toxic than Omite to both females and larvae.

Five of the six insecticides tested are registered for use in grapes. The laboratory results suggest that commercial rates of Kryocide (cryolite) and Cygon (dimethoate) do not reduce tydeid populations. Sevin (carbaryl) and Naled (dibrom) reduced egg production but were not toxic otherwise. Lannate (methomyl) is toxic to this tydeid, but it is even more toxic to *M. occidentalis*, so that surviving tydeids would be released from predation. Although higher tydeid numbers might result, predator populations would be at least temporarily reduced. Permethrin (Ambush/Pounce), which is not registered for use in grapes, was the most toxic of the pesticides tested: although some females survived for 48 hours, very few eggs were laid and none hatched.

Integrated control potential

An integrated program of vineyard pest control should include insecticides, fungicides, and acaricides that are least toxic to both *H. anconai* and *M. occidentalis*.

Of of the insecticides tested, Kryocide, which can be used to control western grapeleaf skeletonizer, *Harrisina brillians* Barnes and McDunnough, and the omnivorous leafroller, *Platynolta stultana* Walsingham, is the only one not toxic to existing vineyard populations of the tydeid and the predator (*California Agriculture*, May-June 1981). Low rates of Cygon might be used in

Laboratory evaluation of pesticide effects on tydeid *Homeopronematus anconai*

			Survival of females after 48 hr				Egg production by survivors after 48 hr				Egg hatch				Larval development to protonymph			
			Percent of untreated control‡ at field rate times:															
Pesticide formulation*	Field rate†	Number females tested	2	1	½	¼	2	1	½	¼	2	1	½	¼	2	1	½	¼
Insecticides	*lb*		%															
Kryocide 96W (cryolite)	3.84	220	106	106	93	103	71	90	91	102	90	97	95	100	101	89	107	99
Cygon 25WP (dimethoate)	0.50	202	93	100	93	104	95	109	-	-	99	105	-	-	105	98	-	-
Sevin 80S (carbaryl)	2.00	200	100	100	100	100	73	75	73	83	111	105	108	102	118	117	98	108
Naled 8EC (dibrom)	0.08	200	95	97	97	100	67	88	87	87	100	93	100	108	100	81	76	107
Lannate 24EC (methomyl)	0.45	100	19	25	50	94	17	25	29	71	117	88	100	111	55	83	110	94
Pounce 3.2EC (permethrin)§	0.10	100	0	32	58	63	-	3	5	4	-	0	0	0	-	-	-	-
Acaricides																		
Omite 30W (propargite)	0.45	199	-	27	63	112	-	14	30	72	-	94	93	88	-	65	29	94
Vendex 50WP (hexakis)§	0.25	200	46	76	86	92	78	78	51	59	94	95	94	87	0	0	0	8
Plictran 50W (cyhexatin)§	0.19	180	12	3	6	24	8	15	62	31	0	0	45	25	-	-	0	0
Fungicides																		
Bayleton 50WP§	0.13	260	78	102	97	96	59	60	71	78	117	101	109	96	81	105	84	94
Benlate 50WP (benomyl)	0.37	200	100	92	89	95	79	68	93	101	16	26	38	59	82	94	89	121
Cosan 80 microsulf)	3.20	220	92	96	87	-	96	109	107	-	87	80	88	-	7	15	36	-
Sulfur dust	15 lbs./acre	200	-	72	-	-	-	72	-	-	-	45	-	-	-	0	-	-

*Listed under each category from least toxic to most toxic.
†Pounds active ingredient per 100 gallons. Field rate = highest labeled field dose using recommended dilute spray, or 200 gallons per acre if unspecified. Solutions prepared in distilled water. Leaf discs dipped in solutions or solutions sprayed on with aerosol spray can. Sulfur dust applied with hand duster at a rate estimated by comparing sulfur weight on discs with weight on freshly treated leaves from vineyard.
‡Abbott's correction × 100.
§Not currently registered for use in grapes.

vineyards where *M. occidentalis* has developed a modest level of Cygon resistance. Unfortunately, no truly selective insecticide is available that is effective against the grape leafhopper, *Erythroneura elegantula* Osborn, but has low toxicity to most field populations of the two beneficial mites. Laboratory-selected strains of *M. occidentalis* are resistant to Sevin, organophosphates, and sulfur, and their release would offer greater flexibility in pesticide use.

The situation is somewhat better with regard to fungicides. Populations of *M. occidentalis* tested in previous studies are tolerant to Bayleton, and the Sevin-resistant strain is cross-resistant to Benlate. Use of these materials to control powdery mildew, *Uncinula necator* (Schw.), could conserve both the predator and the tydeid.

If lower than label rates of Omite are used to assist *M. occidentalis* in controlling spider mites, then this acaricide might be used without excessive detriment to the tydeid populations.

Integrated pest management built around biological control of Pacific spider mites by *M. occidentalis* may have to make pollen available to support populations of the tydeid as alternate prey and include control of insect pests with biological agents or with pesticides that conserve both beneficial mites as key components in the program.

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Lettuce efficiency in using fertilizer nitrogen

Norman C. Welch □ Kent B. Tyler □ David Ririe □ Francis Broadbent

The crop has a low efficiency in using fertilizer nitrogen but needs adequate nitrogen just before harvest to produce heads of acceptable size and color

Head lettuce typically needs an abundant supply of soil nitrogen close to harvest time to attain maximum yield and quality required by the fresh market. The lettuce plant produces two-thirds of its fresh weight during the last 30 percent of its growing period. More than 60 percent of the nutrients are absorbed during this period.

Management of nitrogen fertilizer for maximum nutrient uptake efficiency by this shallow-rooted crop presents a challenge to vegetable growers. In 1980, we conducted a field experiment on a Watsonville loam soil in the Pajaro Valley using ^{15}nitrogen-depleted ammonium sulfate to measure fertilizer uptake efficiency and to distinguish between soil and fertilizer nitrogen utilized by the crop. In the previous year, two lettuce crops had been grown with the same nitrogen rates and the same location of treatments to help deplete the soil nitrogen in the untreated check and low-nitrogen-fertilizer areas.

The variety 'Salinas' was planted on 40-inch beds with two rows per bed on April 24 and sprinkle-irrigated the following day. After seedling emergence and stand establishment, two furrow irrigations were applied using less than 6 inches of water to grow the crop. All plots received 400 pounds of 0-20-20 fertilizer banded into the soil as the beds were listed up for planting. The first nitrogen fertilizer was applied five days before planting. The rates were 0, 60, 120, 180, and 240 pounds per acre in single or split applications. One each of the treatments of 60, 120, and 180 pounds nitrogen also received nitrapyrin, applied at the rate of 1 quart per acre by injection of a solution of one part nitrapyrin to nine parts water onto the dry ammonium sulfate band. In split nitrogen treatments, the second application was banded into the bed after thinning, about six weeks after planting.

Preplant and post-harvest soil samples were taken from each of the 10 treatments and five replications in 1-foot increments to a depth of 3 feet. Leaf midribs sampled at approximately two-week intervals after thinning were analyzed for nitrate nitrogen. Whole-top samples were taken during the season and analyzed for total nitrogen and ratios of isotopic nitrogen. Measurement of the isotopic composition of these forms of nitrogen in whole-top samples permitted calculation of the amount of fertilizer-derived nitrogen present.

The spring lettuce crop was harvested on June 26; a 10-foot length of bed was used to obtain 24 heads, or one carton. Each head was trimmed to a uniform number of wrapper leaves before weighing.

Leaf midrib analyses

Nitrate (NO_3) levels in the midribs provided a basis for differentiating between part of the fertilizer treatments (see table). Nitrate levels in plots receiving no fertilizer nitrogen were significantly lower than in all other treatments