Chemical Control/New Products

EFFECT OF CHLORONICOTINYL INSECTICIDES ON PHYTOPHAGOUS AND PREDATORY MITE POPULATIONS IN A COVER SPRAY PROGRAM

Elizabeth H. Beers and Peter D. Himmel
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: Assail, acetimiprid, Calypso, thiacloprid, Actara, thiamethoxam, Provado, imidacloprid, Asana, esfenvalerate, Imidan, phosmet, twospotted spider mite, *Tetranychus urticae*, European red mite, *Panonychus ulmi*, western predatory mite, *Typhlodromus* [*Galendromus*] *occidentalis*, apple rust mite, *Aculus schlechtendali*

Abstract: This study provides a reasonably clear indication that the use of Assail for codling moth may be problematic in terms of integrated mite control. This product is currently the most likely non-IGR OP replacement for control of Washington's key apple pest. While the mechanism is not clear from this field trial, both toxicity to predatory mites and stimulation of tetranychid mite reproduction may be contributory. The pest mite populations resulting from a 4-spray Assail program were moderate, although the small scale of these plots may influence the degree of immigration, and the effect may be more severe in larger plots. The other chloronicotinyls Calypso and Actara appear to have some effect on either predatory or tetranychid mites, but not to the same extent as Assail. Provado was not statistically different from either Imidan or the check in this regard. Asana suppressed predatory mites, but did not cause a mite flareup during the current growing season. Imidan has no apparent effect on either predatory or phytophagous mites. Assail, Calypso, Asana and Imidan provided the best codling moth control; Assail also appears to suppress San Jose scale. All the chloronicotinyls controlled white apple leafhopper, as did Imidan and Asana in 4-spray cover programs.

The purpose of this test was to determine if the nicotinoids (imidacloprid/Provado; thiamethoxam/Actara; acetamiprid/Assail; thiacloprid/Calypso) have an effect on phytophagous mite populations, either direct, or indirectly through an effect on predatory mites. Provado has been registered for several years, and Actara was registered early in 2001. The other two materials are not yet registered on tree fruits.

There is some anecdotal evidence over the years that Provado has caused an increase in mite populations where it is used on pear for psylla. Although hormolygosis has been proposed as a possible mechanism, there has been no confirmation of this. There is also published information by James et al. that imidacloprid can effect the fecundity of predatory phytoseiid mites. Work earlier this year by John Dunley's laboratory (fecundity bioassays with twospotted spider mite) indicates that some of theses materials may stimulate egg production of this species. As part of the Areawide 2 project (see Exp. 0108) my laboratory group will work on fecundity of Washington's primary predatory mite, *Typhlodromus occidentalis*, with the nicotinoids and other compounds.

The format used in this experiment was a field trial using a 4 cover spray program timed for codling moth (2 applications/generation), which is the proposed label usage for Assail. This timing and schedule is not necessarily appropriate for all the materials (e.g., the Actara label only allows 8 oz/acre/season, thus the 4 5.5 oz-treatments applied here are well over the label). While the Provado label only limits the rate/application, but this material is not used against codling moth. However, in order to examine the general principal, it was necessary to test the material in a similar fashion (high label rate, 4 cover sprays). One additional treatment was added (Assail, 1st and 2nd cover spray only) to see if this use pattern might mitigate any potential effects. There was evidence of both suppression of predatory mites and a concurrent increase in phytophagous mite populations in the 2000 field trial with this product (Exp. 0014). Two other registered materials were included for purposes of comparison; Asana, as the standard material for flaring mite populations; and Imidan, an organophosphate generally held not to affect mite populations.

Materials and Methods

This experiment was conducted in an apple block composed of 'Oregon Spur Delicious' with 'Golden Delicious' pollenizers at the WSU-TFREC's Columbia View Farm south of Orondo, WA. The experimental design was a randomized complete block with 8 treatments and 4 replicates. Each replicate consisted of five trees in a single row with a minimum of one buffer row between rows containing treatment trees. Treatments were randomized on the basis of a pre-treatment count of *Typhlodromus* populations on 22 May. Twenty leaves/tree were collected and kept cool during transportation and storage. The mites were brushed from the leaves with a Leedom mite brushing machine and collected on a revolving sticky glass plate. The composite sample on the plate was counted using a stereoscopic microscope. All stages and species of phytophagous and predatory mites were recorded, including the eggs and motile stages of European red mite (ERM), *Panonychus ulmi* (Koch); twospotted spider mite (TSM), *Tetranychus* urticae Koch; McDaniel spider mite (MCD), *Tetranychus mcdanieli* McGregor [the eggs of TSM and MCD could not be distinguished, and were recorded as a group]; western predatory mite, *Typhlodromus* (=*Galendromus*) *occidentalis* (Nesbitt); a stigmaeid predatory mite, *Zetzellia mali* Ewing, and motile stages of apple rust mite (ARM), *Aculus schlechtendali* (Nalepa).

Fruit damage was assessed just prior to commercial harvest by examining in situ 25 fruits from the upper canopy and 25 fruits from the lower canopy of 1 tree/replicate. Damage by codling moth, San Jose scale, thrips were recorded. In addition, fruit calyces were examined using a 10× OptiVisor (Donegan Optical Co., Inc.) for infestation with diapausing eggs of European red mite or diapausing females of the *Tetranychus* spp.

Each treatment received four applications (two in the case of one of the Assail treatments) of the appropriate material and timed for codling moth cover sprays. The four applications were as follows: 1st cover, 24 May; 2nd cover 28 June; 3rd cover 19 July, 4th cover 9 Aug, 2001. All applications were made with an airblast sprayer (Rears Pak-Blast, Eugene, OR) calibrated to deliver 200 gpa.

Data were analyzed using the Statistical Analysis System (SAS 1988). Prior to analysis data were tested for homogeneity of variance using Levene's (1960) test. Variances found to be non-homogeneous were transformed [ln(*y*+0.5)] before analysis. PROC GLM was used to conduct an analysis of variance, and treatment means were separated using the Waller-Duncan *k*-ratio *t*-test. Cumulative mite days were calculated according to the following formula (Beers & Brunner 1999):

$$CMD=\sum 0.5(P_a + P_b)D_{a-b}$$

Results and Discussion

Mite populations were low in the check throughout the season, never exceeding 0.3 mites/leaf, typical of minimally sprayed apple orchards in Washington. There was a noticeable increase in mite populations after the first cover application in several treatments, including Assail 4x and Actara (Table 1), although statistical differences among treatments did not occur until mid-June. There appeared to be stepwise increases in the mite population in the Assail 4x treatment (Fig. 1), each increase following a cover spray. Interestingly, the Assail 2x treatment had generally lower mite populations, even though these two treatments were identical through the second cover spray. Despite the initial increase, the mite populations in the Actara treatment were moderate, only increasing substantially toward the end of the season, along with a number of other treatments.

The standard treatment for suppressing *T. occidentalis* and causing rebound of mite populations (Asana) provoked only the most minor increase in tetranychid populations late in the season, barely exceeding 1 mite/leaf. Past experience indicates that in some cases, there is a delayed effect with this material that is not expressed until the following season (Beers & Brunner 1999). The standard non-flaring OP treatment, Imidan, had low mite populations that were never different from the check.

The seasonal cumulative mite days(Table 1, Fig. 4) reflected the elevated levels of mites in the Assail 4x treatment, which were ca. 3.7x higher than the next highest treatment (Calypso). The Assail 2x treatment had substantially lower amounts of cumulative mite populations than the Assail 4x, however, it was still higher than the check. Provado, Asana and Imidan had cumulative mite populations that were not different than the check.

The Assail 4x treatment also had one of the lower populations of predatory mites, indicating that direct toxicity may play a role in the increase in tetranychid mites. Overall, Asana and the 2 Assail treatments had the lowest cumulative level of predatory mites (Table 2, Fig. 1, 4). While the Calypso treatment had a slightly elevated phytophagous mite population, the predatory mite population was only slightly lower than the check. The predatory mite population in the Imidan, Actara and Provado treatments were not different than the check.

The rust mite populations were highest on the average in the Assail 2x, Assail 4x, Provado, and Asana treatments (Table 3, Fig. 3, 4). However, these differences were not of great magnitude, and rust mite populations are sufficiently variable as to make these data inconclusive. None of the materials tested are known to be acutely toxic to rust mites. The primary interest in rust mites is their ability to serve as an alternate food source for predatory mites. Without consistent differences, there is no reason to suppose that the predatory or tetranychid mite population fluctuations were mediated by the availability of an alternate prey source.

The two hypotheses regarding increasing mite populations following applications of various pesticides (toxicity to biological control agents and hormolygosis) cannot be adequately explored in a field trial of this type. However, these data do provide some indication of what mechanisms might be at work. In the case of Assail, it is possible that both mechanisms may be operative. The predatory mite populations were suppressed by the Assail treatments, but to roughly the same extent as the Asana applications. The mite populations, however, were higher in the Assail treatments than the Asana treatments, indicating that there may have been stimulation of mite reproduction in addition.

While not the primary objective of this study, data were taken on other direct and indirect pests present in the orchard. White apple leafhopper populations were moderate prior to the first cover spray (Table 4, Fig. 4) and were suppressed by all of the materials tested; Imidan was the weakest in this regard, but all the nicotinoids provided excellent control. Second generation populations were higher in the check, but were suppressed by all materials.

Fruit damage by codling moth was assessed prior to harvest since this was nominally the target pest of this program (Table 5, Fig. 5). Pressure in the block was substantial, reaching nearly 50% in the check. Actara and Provado did not reduce codling moth fruit damage in relation to the check. The Assail 2x program also failed to provide control, however, this is not unexpected since there were no cover sprays in the second generation. Imidan, Calypso, Asana and Assail 4x provided the best control.

This block has been experiencing an increased level of San Jose scale damage over the past 5 years, and this population has finally reached a serious level. The population distribution is still not uniform, most likely accounting for the inability to detect statistical differences in the fruit damage (Table 5, Fig. 5). Although none of the treatments were specifically timed for scale, the timing for codling moth 2nd cover is generally regarded as providing 1st generation crawler suppression. Similarly, the 2nd generation of crawlers is prolonged enough to be affected by the 2nd generation codling moth cover sprays. Despite the lack of statistical differences, if appears that Assail and Provado may have some effect on scale.

The tetranychid mite population averaged ca. 63% European red mite, with the remainder composed of twospotted spider mites, and a trace level of McDaniel mites. Mite eggs and diapausing females in apple calyces are potentially export problems to some countries, and thus the tolerance for mites may be lower than would be indicated by the foliar damage. In general, it has always been assumed that calyx infestation is only a problem with very high mite populations (>20 mites/leaf). In this case, all infestations observed consisted of European red mite eggs, thus the relationship between cumulative European red mite days and calyx egg infestation was examined using regression (Fig. 6). In general, the seasonal mite population was moderately predictive of calyx infestation. However, the rate of calyx infestation much higher than expected, with several plots exceeding 80% infested fruit, even though mite populations in the block never exceeded 6 mites/leaf. Even at very low average seasonal populations (as indicated by cumulative ERM-days), calyx infestations frequently exceeded 40%. The method used (examination with 10x magnification) most likely is responsible for a higher detection rate than is usual (i.e., inspection with the unaided eye).

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Table 1. Seasonal tetranychid mite populations in a 2- or 4-cover-spray program of insecticides, CV-11, 2001

Compound	Rate fm/ acre	CM Cover Sprays	Tetranychid mites/leaf 22-May	28-May	6-Jun[x]	13-Jun[x]	19-Jun	29-Jun[x]	6-Jul[x]	11-Jul
Assail 70WP	3.45 oz	1,2,3,4	0.00 a	0.16 a	0.51 a	0.86 a	0.40 a	2.20 a	3.34 a	2.25 a
Calypso 480SC	4 fl oz	1,2,3,4	0.01 a	0.00 a	0.13 a	0.00 b	0.10 a	0.18 ab	0.19 ab	0.10 ab
Actara 25WDG	5.5 oz	1,2,3,4	0.00 a	0.58 a	0.25 a	0.15 ab	0.16 a	0.08 b	0.78 ab	0.30 ab
Provado 1.6F	8 fl oz	1,2,3,4	0.01 a	0.06 a	0.08 a	0.06 b	0.36 a	0.14 b	0.43 ab	0.75 ab
Assail 70WP	3.45 oz	1,2	0.00 a	0.01 a	0.10 a	0.01 b	0.00 a	0.43 ab	1.26 ab	0.89 ab
Asana 0.66EC	14.5 fl oz	1,2,3,4	0.00 a	0.00 a	0.00 a	0.01 b	0.00 a	0.01 b	0.01 b	0.01 b
Imidan 70WP	5.33 lb	1,2,3,4	0.00 a	0.00 a	0.00 a	0.04 b	0.00 a	0.05 b	0.05 b	0.08 ab
Check	---	---	0.00 a	0.00 a	0.03 a	0.03 b	0.01 a	0.03 b	0.03 b	0.04 b

Compound	Rate fm/ acre	CM Cover Sprays	Tetranychid mites/leaf 19-Jul	25-Jul[x]	1-Aug[x]	7-Aug[x]	15-Aug[x]	20-Aug[x]	27-Aug	Cum. Mite Days 27-Augx
Assail 70WP	3.45 oz	1,2,3,4	2.31 a	5.03 a	3.83 a	3.43 a	4.16 a	3.96 a	5.18 a	234.11 a
Calypso 480SC	4 fl oz	1,2,3,4	0.24 b	0.61 bc	0.86 bc	1.78 b	1.34 b	2.10 b	3.41 b	61.86 bc
Actara 25WDG	5.5 oz	1,2,3,4	0.06 b	0.29 bc	0.19 bcd	0.36 bc	0.33 bc	0.35 c	1.20 bc	29.80 bc
Provado 1.6F	8 fl oz	1,2,3,4	0.23 b	0.35 bc	0.19 bcd	0.74 bc	0.11 c	0.10 c	0.08 c	24.88 cd
Assail 70WP	3.45 oz	1,2	0.28 b	1.19 b	0.71 b	0.86 bc	0.50 bc	0.78 bc	2.05 b	53.12 b
Asana 0.66EC	14.5 fl oz	1,2,3,4	0.08 b	0.23 bc	0.18 bcd	0.58 bc	0.45 bc	0.49 c	1.10 bc	17.19 cd
Imidan 70WP	5.33 lb	1,2,3,4	0.04 b	0.03 c	0.03 d	0.11 c	0.01 c	0.03 c	0.14 c	3.54 d
Check	---	---	0.01 b	0.16 c	0.08 cd	0.16 c	0.21 bc	0.26 c	0.21 c	7.54 d

[x]Data transformed ln(y+0.5) due to nonhomogeneity of variances

Application Dates: C1: 24 May ; C2: 28 June; C3: 19 July; C4: 9 Aug 2001

Table 2. Seasonal predatory mite populations in a 2- or 4-cover-spray program of insecticides, CV-11, 2001

Compound	Rate fm/ acre	CM Cover Sprays	Predatory mites/leaf 22-May	28-May	6-Jun	13-Jun	19-Jun[x]	29-Jun[x]	6-Jul[x]	11-Jul
Assail 70WP	3.45 oz	1,2,3,4	0.21 a	0.01 a	0.06	0.14 ab	0.08 b	0.24 cd	0.15 b	0.20 b
Calypso 480SC	4 fl oz	1,2,3,4	0.15 a	0.09 a	0.17	0.60 a	0.88 a	0.88 bc	1.51 a	1.71 ab
Actara 25WDG	5.5 oz	1,2,3,4	0.18 a	0.23 a	0.18	0.39 ab	1.20 a	1.78 ab	1.20 a	1.20 ab
Provado 1.6F	8 fl oz	1,2,3,4	0.10 a	0.04 a	0.10	0.41 ab	0.55 ab	0.91 bcd	1.95 a	2.06 a
Assail 70WP	3.45 oz	1,2	0.04 a	0.04 a	0.07	0.00 b	0.03 b	0.13 d	0.13 b	0.33 b
Asana 0.66EC	14.5 fl oz	1,2,3,4	0.05 a	0.01 a	0.00	0.06 b	0.05 b	0.11 d	0.06 b	0.33 b
Imidan 70WP	5.33 lb	1,2,3,4	0.04 a	0.03 a	0.03	0.19 ab	0.18 b	1.18 b	1.25 a	1.51 ab
Check	---	---	0.06 a	0.06 a	0.21	0.61 a	0.39 ab	2.59 a	1.81 a	2.10 a

Compound	Rate fm/ acre	CM Cover Sprays	Predatory mites/leaf 19-Jul	25-Jul	1-Aug	7-Aug	15-Aug	20-Aug	27-Aug	Cum. Mite Days 27-Aug
Assail 70WP	3.45 oz	1,2,3,4	0.18 c	0.38 c	0.36 a	0.69 ab	0.71 a	0.43 a	0.95 a	29.03 c
Calypso 480SC	4 fl oz	1,2,3,4	1.43 a	0.28 c	0.58 a	0.78 ab	0.58 a	0.40 a	0.94 a	72.06 b
Actara 25WDG	5.5 oz	1,2,3,4	1.11 ab	0.86 bc	0.96 a	1.80 ab	1.80 a	0.74 a	1.18 a	98.62 ab
Provado 1.6F	8 fl oz	1,2,3,4	1.13 ab	1.35 ab	1.38 a	1.89 a	1.61 a	0.84 a	1.38 a	100.79 ab
Assail 70WP	3.45 oz	1,2	0.25 bc	0.33 c	0.71 a	0.71 ab	0.66 a	0.44 a	1.20 a	29.66 c
Asana 0.66EC	14.5 fl oz	1,2,3,4	0.13 c	0.31 c	0.36 a	0.59 b	0.35 a	0.15 a	0.58 a	19.23 c
Imidan 70WP	5.33 lb	1,2,3,4	1.75 a	1.71 a	0.85 a	1.79 ab	1.16 a	0.58 a	1.00 a	86.49 ab
Check	---	---	1.30 a	1.26 ab	0.54 a	1.50 ab	1.03 a	0.94 a	1.64 a	105.49 a

[x]Data transformed ln(y+0.5) due to nonhomogeneity of variances
Application Dates: C1: 24 May ; C2: 28 June; C3: 19 July; C4: 9 Aug 2001

Table 3. Seasonal rust mite populations in a 2- or 4-cover-spray program of insecticides, CV-11, 2001

Compound	Rate fm/ Rate fm/acre	CM Cover CM Covers	22-May	28-May	6-Jun	13-Jun	19-Jun	29-Jun	6-Jul	11-Jul
			Rust mites/leaf							
Assail 70WP	3.45 oz	1,2,3,4	59 a	70 a	466	310 a	206 a	406 a	908 a	743 a
Calypso 480SC	4 fl oz	1,2,3,4	65 a	44 a	115	71 b	220 a	300 a	648 a	395 a
Actara 25WDG	5.5 oz	1,2,3,4	3 a	87 a	152	48 b	116 a	283 a	408 a	443 a
Provado 1.6F	8 fl oz	1,2,3,4	3 a	118 a	196	230 ab	200 a	278 a	350 a	605 a
Assail 70WP	3.45 oz	1,2	3 a	6 a	202	116 ab	146 a	427 a	809 a	565 a
Asana 0.66EC	14.5 fl oz	1,2,3,4	1 a	17 a	24	42 b	99 a	243 a	765 a	553 a
Imidan 70WP	5.33 lb	1,2,3,4	1 a	14 a	44	94 b	87 a	327 a	500 a	648 a
Check	---	---	6 a	33 a	176	237 ab	162 a	361 a	435 a	480 a

Compound	Rate fm/ acre	CM Cover Sprays	19-Jul	25-Jul	1-Aug	7-Aug	15-Aug	20-Aug	27-Aug	Cum. Mite Days 27-Aug
			Rust mites/leaf							
Assail 70WP	3.45 oz	1,2,3,4	428 a	336 a	470 a	173 abc	85 a	208 a	113 a	33,650 a
Calypso 480SC	4 fl oz	1,2,3,4	305 a	403 a	151 b	106 bc	62 a	123 a	118 a	20,916 bc
Actara 25WDG	5.5 oz	1,2,3,4	201 a	249 a	273 ab	93 bc	53 a	218 a	99 a	18,008 c
Provado 1.6F	8 fl oz	1,2,3,4	405 a	270 a	318 ab	70 bc	75 a	260 a	110 a	23,532 abc
Assail 70WP	3.45 oz	1,2	464 a	460 a	303 ab	400 a	68 a	268 a	113 a	28,981 ab
Asana 0.66EC	14.5 fl oz	1,2,3,4	500 a	730 a	283 ab	298 ab	88 a	273 a	110 a	26,376 abc
Imidan 70WP	5.33 lb	1,2,3,4	332 a	283 a	125 b	175 abc	98 a	213 a	100 a	20,200 bc
Check	---	---	390 a	365 a	257 ab	34 c	95 a	128 a	93 a	22,035 bc

[x]Data transformed ln(y+0.5) due to nonhomogenity of variances

Application Dates: C1: 24 May ; C2: 28 June; C3: 19 July; C4: 9 Aug 2001

Table 4. Seasonal white apple leafhopper nymph populations in a 2- or 4-cover-spray program of insecticides, CV-11, 2001

	Rate fm/	CM Cover	Leafhopper nymphs/leaf						
Compound	acre	Sprays	18-May	29-May[x]	5-Jun[x]	7-Aug	15-Aug[x]	20-Aug[x]	27-Aug[x]
Assail 70WP	3.45 oz	1,2,3,4	0.06 a	0.00 c	0.00 c	0.00 b	0.00 b	0.00 b	0.00 b
Calypso 480SC	4 fl oz	1,2,3,4	0.61 a	0.01 c	0.03 bc	0.00 b	0.01 b	0.01 b	0.00 b
Actara 25WDG	5.5 oz	1,2,3,4	0.28 a	0.05 c	0.00 c	0.00 b	0.00 b	0.01 b	0.00 b
Provado 1.6F	8 fl oz	1,2,3,4	0.33 a	0.01 c	0.03 bc	0.00 b	0.00 b	0.00 b	0.03 b
Assail 70WP	3.45 oz	1,2	0.40 a	0.03 c	0.00 c	0.00 b	0.00 b	0.00 b	0.01 b
Asana 0.66EC	14.5 fl oz	1,2,3,4	0.55 a	0.09 bc	0.00 c	0.01 b	0.00 b	0.00 b	0.00 b
Imidan 70WP	5.33 lb	1,2,3,4	0.18 a	0.19 b	0.14 ab	0.03 b	0.00 b	0.04 b	0.03 b
Check	---	---	0.39 a	0.55 a	0.29 a	0.16 a	1.00 a	1.09 a	0.95 a

[x] Data transformed log(y+0.5) due to non-homogenity of variances
Application Dates: C1: 24 May ; C2: 28 June; C3: 19 July; C4: 9 Aug 2001

Table 5. Fruit damage at harvest in a 2- or 4-cover-spray program of insecticides, CV-11, 2001

	Rate fm/	CM Cover		% Fruit Injury by					
Compound	acre	Sprays	n	CM	CM Sting	CM Entry	Thrips	SJS	Mites
Assail 70WP	3.45 oz	1,2,3,4	4	8.6 bc	1.5	7.1	0.0	6.7 a	77.2 a
Calypso 480SC	4 fl oz	1,2,3,4	4	6.5 c	0.5	6.0	0.0	45.0 a	52.0 ab
Actara 25WDG	5.5 oz	1,2,3,4	4	46.3 a	2.0	44.3	0.0	32.8 a	22.8 bc
Provado 1.6F	8 fl oz	1,2,3,4	4	49.5 a	2.0	47.5	0.0	15.0 a	7.5 c
Assail 70WP	3.45 oz	1,2	4	25.0 b	2.5	22.5	0.0	13.5 a	23.5 bc
Asana 0.66EC	14.5 fl oz	1,2,3,4	4	5.0 c	0.5	4.5	0.0	32.0 a	25.0 bc
Imidan 70WP	5.33 lb	1,2,3,4	4	3.5 c	1.0	2.5	0.0	33.5 a	13.0 c
Check	---	---	4	48.0 a	2.0	46.0	0.0	35.5 a	9.0 c

Application Dates: C1: 24 May ; C2: 28 June; C3: 19 July; C4: 9 Aug 2001.

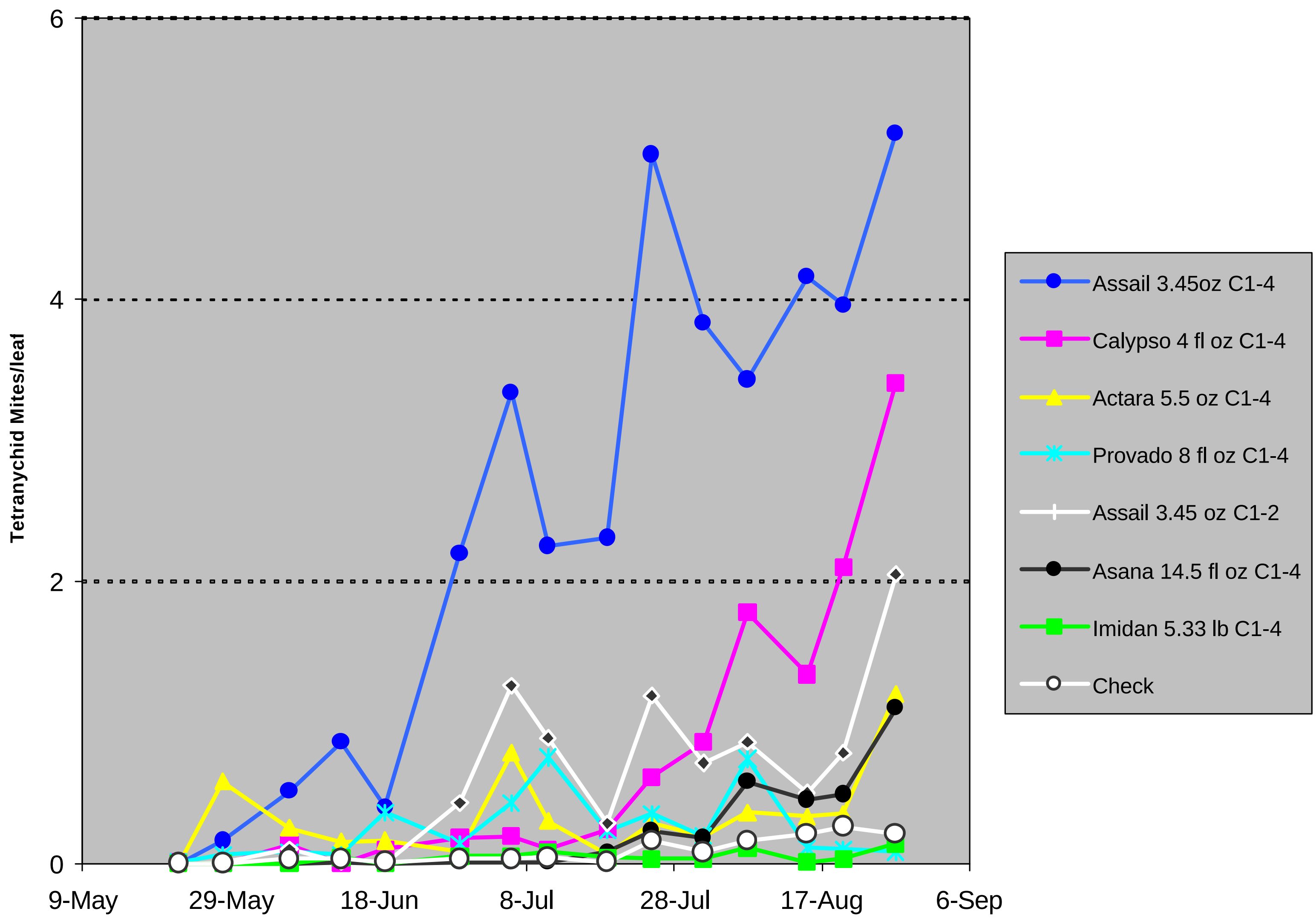

Fig. 1. Seasonal tetranychid mite populations in a 2- or 4-spray cover program of insecticides, CV-11, 2001.

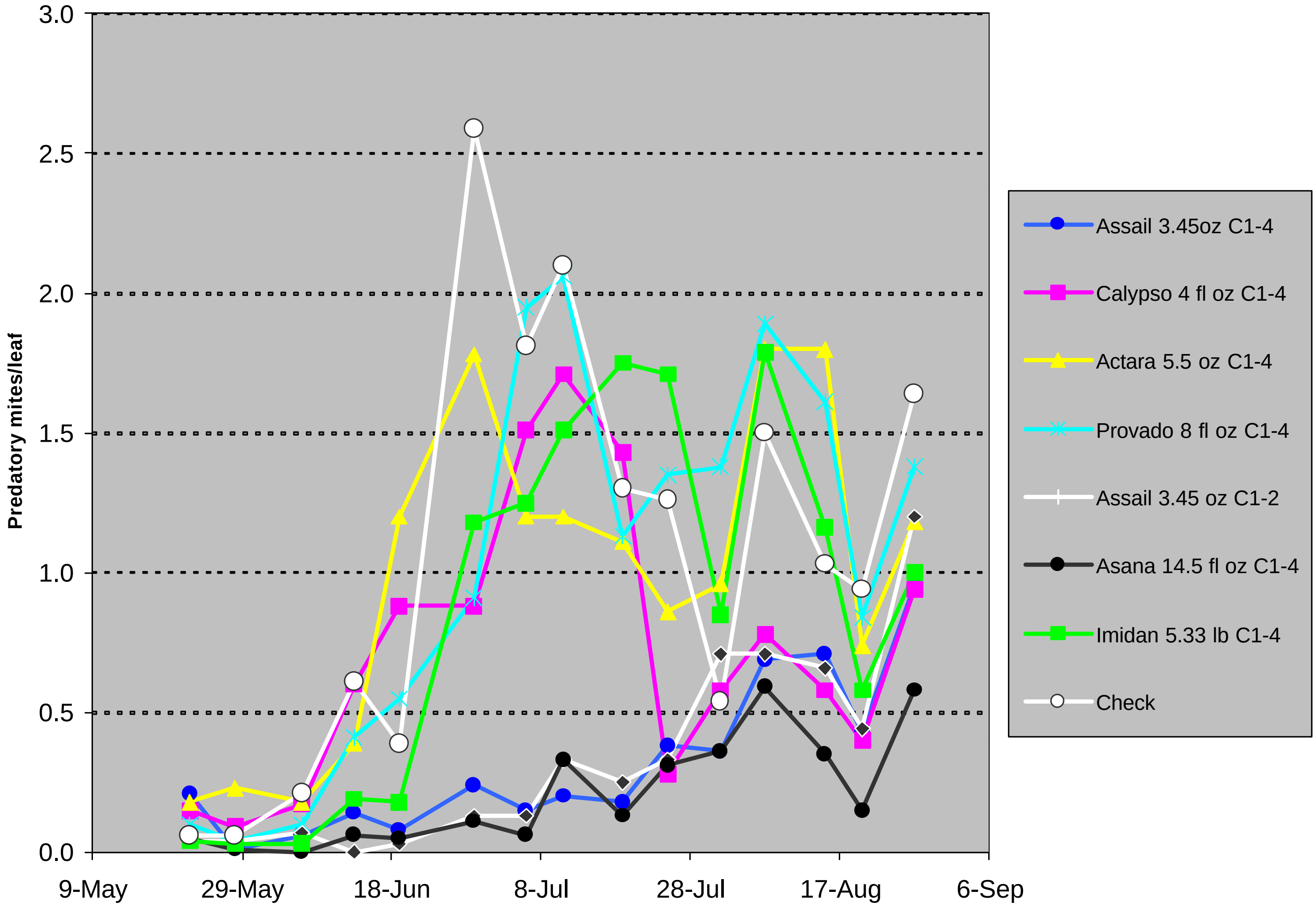

Fig. 2. Seasonal predatory mite populations in a 2- or 4-spray cover program of insecticides, CV-11, 2001.

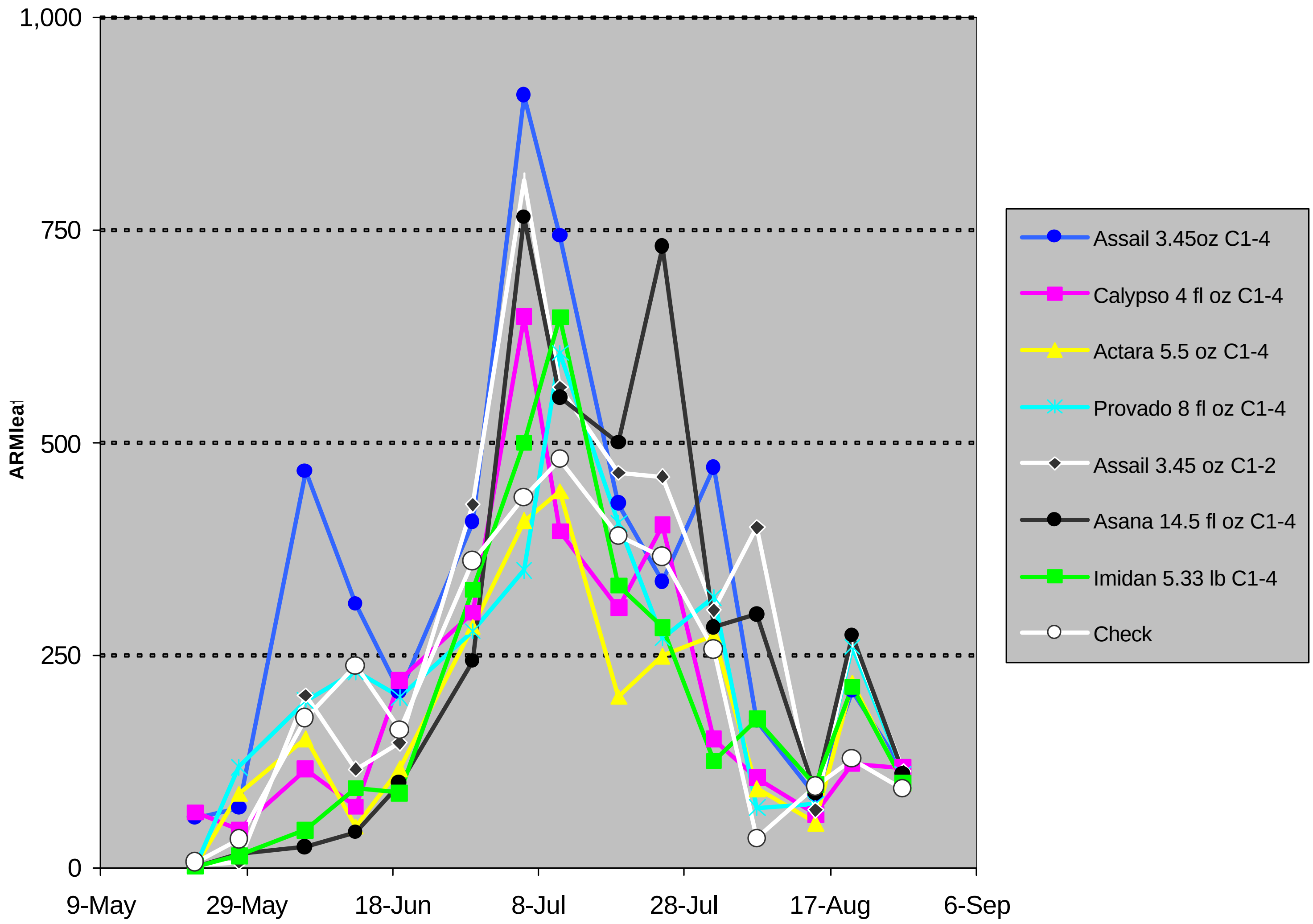

Fig. 3. Seasonal rust mite populations in a 2- or 4-spray cover program of insecticides, CV-11, 2001.

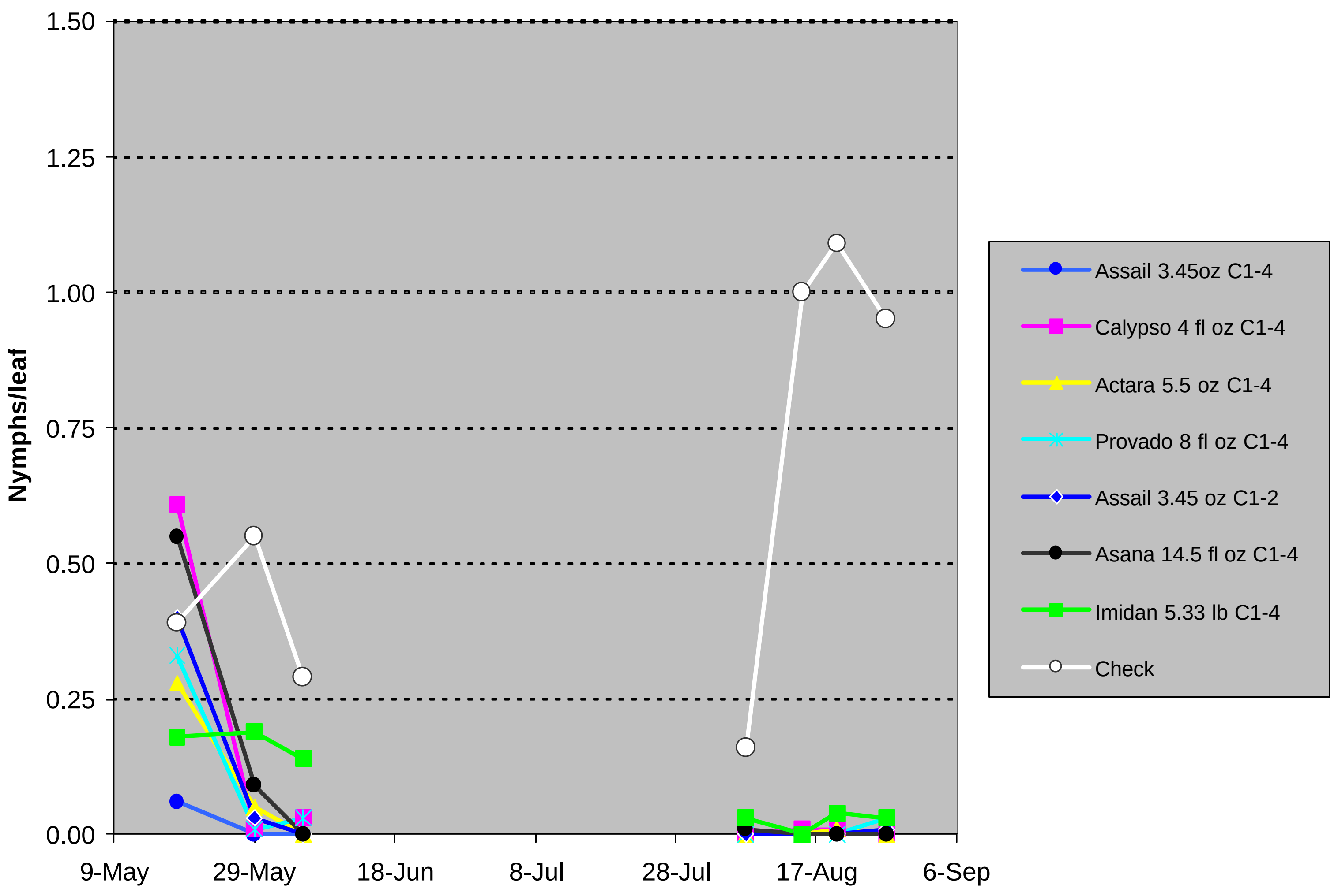

Fig. 4. White apple leafhopper nymph populations in a 2- or 4-spray cover program, CV-11, 2001.

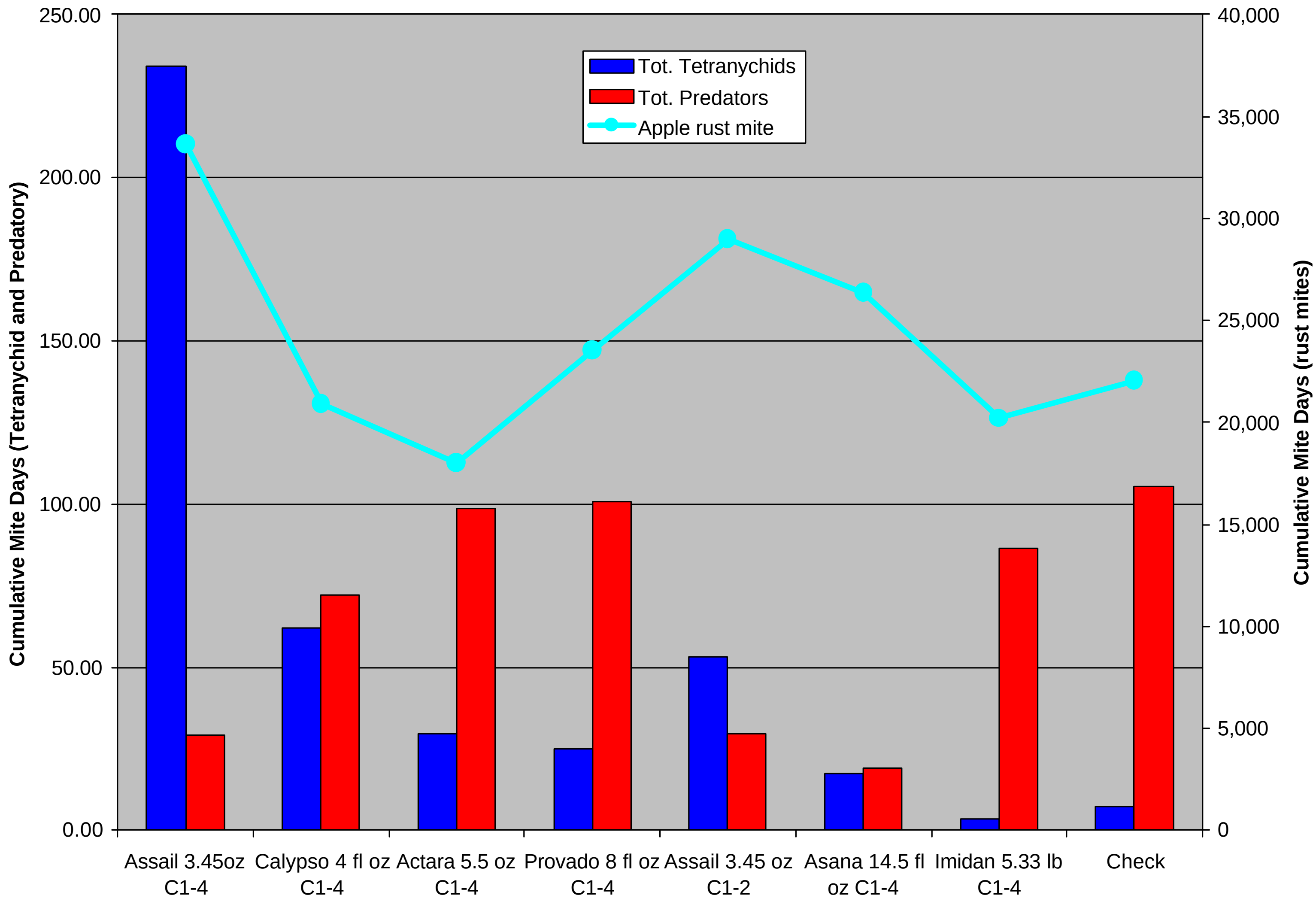

Fig. 5. Cumulative mite days (tetranychid, predatory and rust) in a 2- or 4-spray cover program of insecticides, CV-11, 2001.

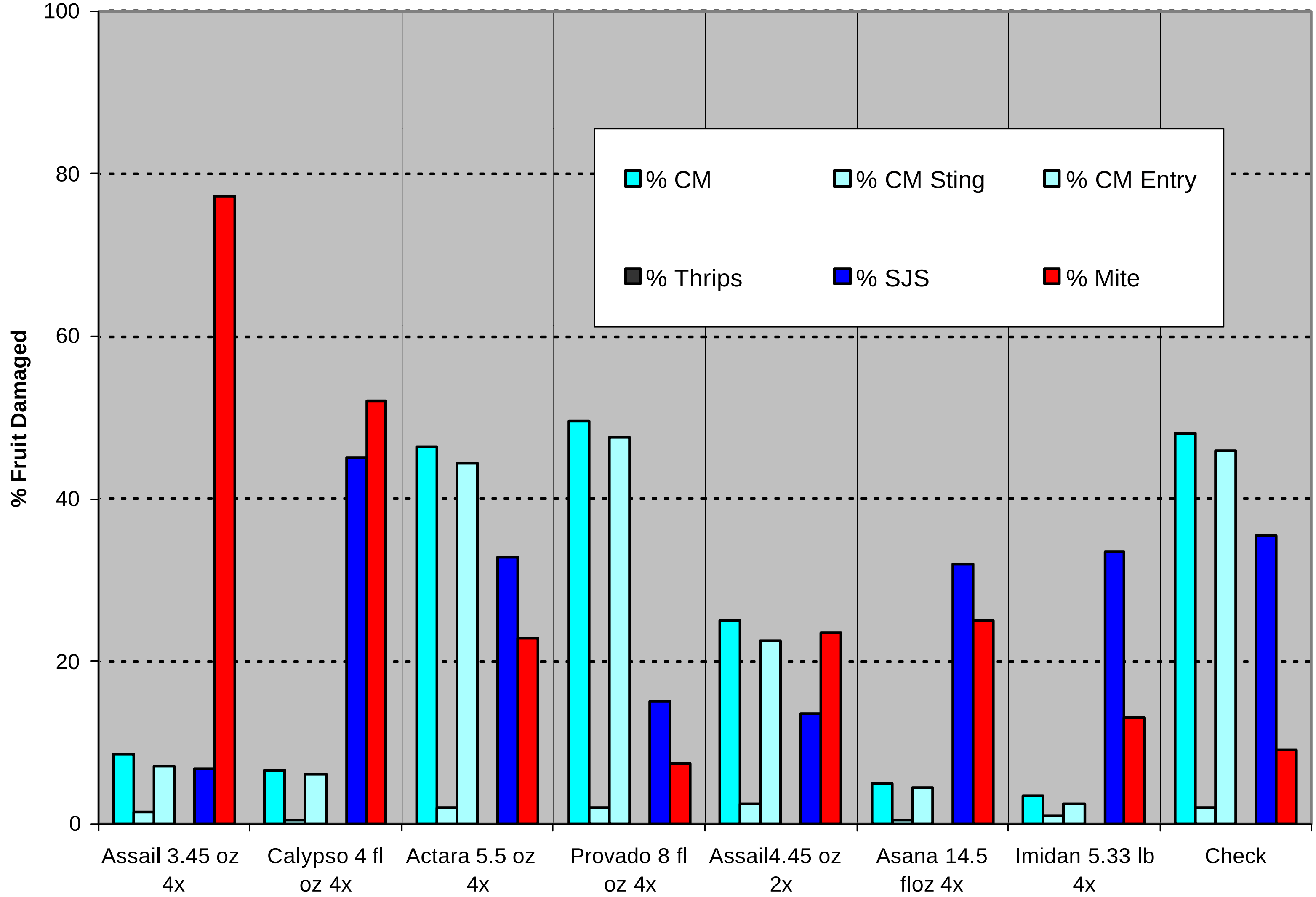

Fig. 6. Fruit damage at harvest in a 2- or 4-spray cover program of insecticides, CV-11, 2001.

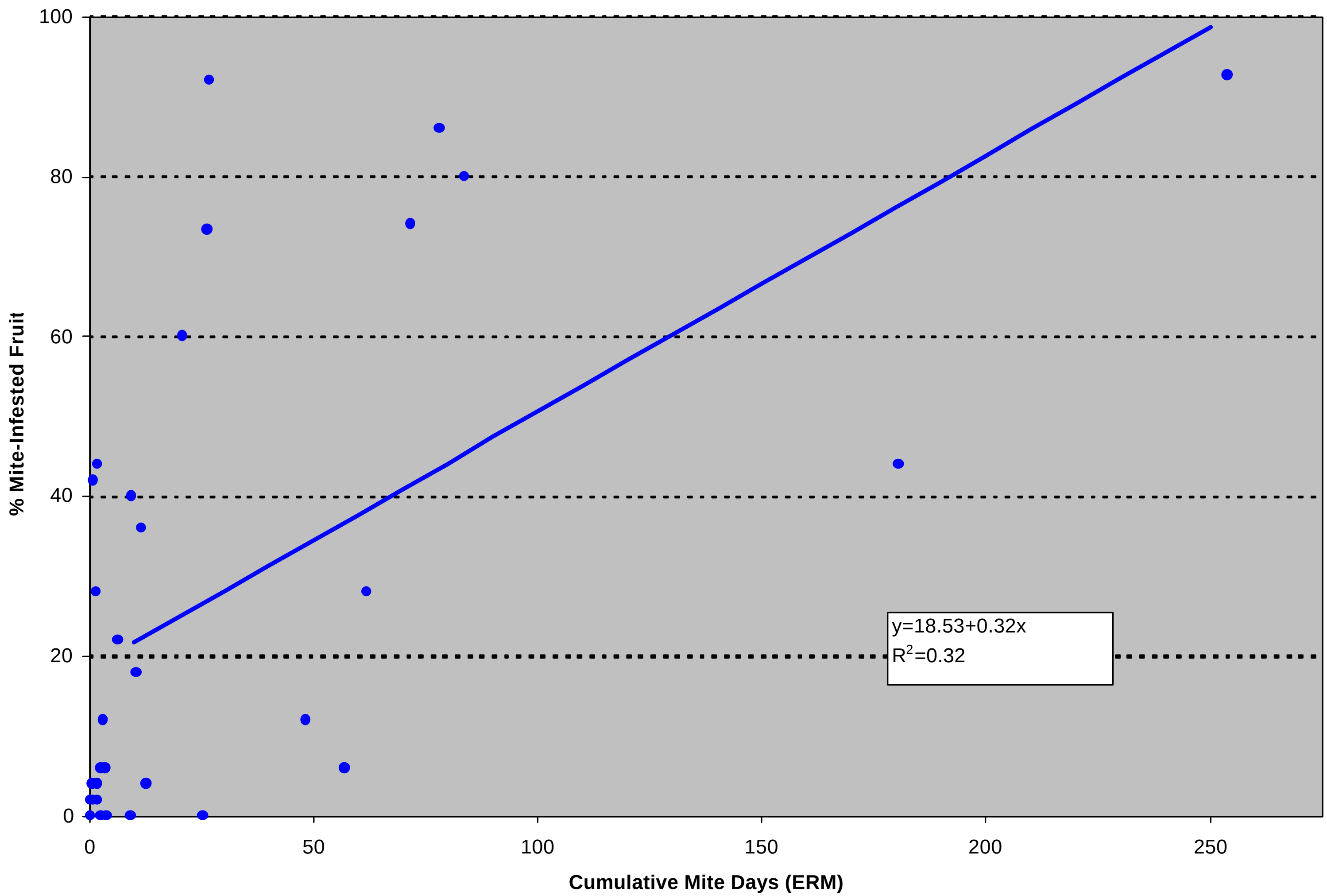

Fig. 7. Regression of cumulative mite day and percentage fruit infested with European red mite eggs at harvest, CV-11, 2001.