Summary

Most separations involve single causes, although a summary of terminations in general involves many different reasons. Of all terminations, about 82 percent were employee-initiated. Those not worker-initiated were the result of economic problems of dairies (11 percent) and firings (7 percent).

About 80 percent of the turnover was under some degree of dairy operator control. Terminations not under the operator's control included workers' personal and family problems and relationships with other employees.

Results of this study don't point to one area of personnel management that dairy operators need to address to reduce turnover. Instead, many aspects of management are implicated. Management, for example, can give employees "exit interviews" to find out whether a pattern of problems exists. Such interviews would contain information from those who leave dairies for other lines of work.

Divisions of some categories into various degrees of employer control are arbitrary. Each dairy operator makes policies as to how far he or she will go to avoid turnover problems and to categorize the turnover that occurs as avoidable or not avoidable. For instance, most cases revolving around unsatisfactory relationships with co-workers are listed as unavoidable. An employer, however, has several tools available to improve relationships among workers (such as offering group incentive pay and stressing to workers the importance of teamwork). On the other hand, turnover listed as controllable by management is not always so. For example, while most employers would like to pay their workers well, compensation and benefits are limited by the dairy's profitability.

Turnover is a symptom of other problems, especially dissatisfaction with work or working conditions. Measures taken to prevent turnover are bound to improve other operating results as well. The dissatisfaction that precedes turnover can greatly affect the dairy's productivity. Turnover in itself is also costly, since it is expensive to replace workers.

It is not good to prevent turnover at all costs; some worker departures will benefit the dairy. This is not to say that a rancher should promote dissatisfaction of workers to make them leave. There are far better methods for terminating employment.

Turnover seems to be decreasing, suggesting a need for research on the causes of this stability. Information is needed on not only the effect of the economy (including the looseness of the labor market), but also the effect of specific personnel management techniques on turnover. For example, do more productive workers stay longer? What are the effects of different methods of compensation (including the use of incentives) on turnover? What do individual dairies with low separation rates do differently than their less successful neighbors? Of course, before many of these questions can be answered, dairy operators need to keep accurate records of their workers' lengths of employment and reasons for leaving.

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Improved sampling for spider mites on Imperial Valley cotton

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In sampling for spider mites on cotton, time limitations are important, especially when *Tetranychus cinnabarinus* (Boisduval) populations can reach levels exceeding tens of thousands per plant. Counting all *Tetranychus* spp. on a single cotton leaf often requires an hour or more. Consequently, few researchers or pest control advisors take the time for careful sampling.

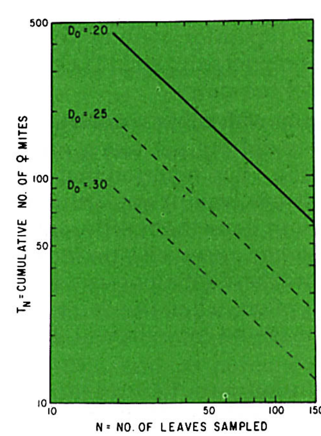
Sampling studies of spider mites on cotton had been made in California's San Joaquin Valley, where they are a primary pest, but a separate sampling study was needed for Imperial Valley cotton because of differences in climate, variety, and growth patterns. Also, in the San Joaquin Valley, there exists a complex of mites consisting of *T. urticae* Koch, *T. pacificus* McGregor, and *T. turkestani* (Ugarov and Nikolski). *Tetranycus cinnabarinus*, a mite closely related to *T. urticae*, is prevalent in Imperial Valley cotton. Because of such differences, research findings in the San Joaquin may not be applicable to the Imperial Valley.

The pink bollworm *Pectinophora gossypiella* (Saunders) is the main cotton pest in California's lower desert valleys (Imperial, Coachella, and Palo Verde), with *Heliothis zea* (Boddie) and *H. virescens* (Fabricius) also key pests. Multiple pesticide applications are needed each season to keep their populations below damaging levels. Spider mites are considered secondary cotton pests; however, during some years their populations increase to damaging levels. There is a need, therefore, to monitor mite populations compatibly with current control practices for key pests in Imperial Valley cotton.

Field research during 1982 and 1983 was directed to determining whether pesticides applied to control key pests would affect the within-plant distribution of *T. cinnabarinus* on mainstem node leaves, whether this distribution would change over the course of the season, and whether from this information a reliable, less time-consuming method for sampling field populations of *T. cinnabarinus* could be developed.

Data collection

Tests were conducted on DPL-61 cotton at the Imperial Valley Field Station near El Centro. In 1982, treatments were replicated four times in a randomized block design. In 1983, treatments were replicated eight times in a randomized block design.



When the plot of a sample unit of mites in cotton falls above the desired precision line, sampling is stopped and the mean density is calculated.

Pesticides were applied weekly when cotton bolls susceptible to pink bollworm were present. In 1982, there were six treatments: an organophosphate, a carbamate, three pyrethroids, and an untreated control. Only three treatments were compared in 1983: the pyrethroids cypermethrin and FMC-54800 and an untreated control. In both years, treatments were assessed by sampling 96 plants per week: four plants per plot in 1982, three plants per plot in 1983.

During much of the season, most mites are found on mainstem node leaves. Because the numbers of mites on these leaves can be related to the number of mites per plant, only mainstem node leaves were sampled. This was more convenient than sampling the whole plant, and the relative age of these leaves is obvious from their position on the stem. Leaf age is important in mite population dynamics, because tetranychid mites tend to be more reproductive on young leaves. As the number of adult *Tetranychus* spp. female mites has been shown to be highly correlated to the total mite population, only adult female mites were assessed, thereby saving time and providing a reliable population index. The upper 16 mainstem node leaves on each plant were sampled and the number of adult females was recorded. The mainstem node leaf at the top of the plant was considered the first such leaf, and the count progressed down the plant. In all cases an observation was considered a mainstem node leaf.

TABLE 1. Effect of pesticide treatments on within-plant distribution of *Tetranychus cinnabarinus* on cotton, Imperial Valley, 1982*

			Mainstem nodes on plant† (1 = top of plant)															
Treatment	Observations	Females/leaf	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Control	256	0.62			X	$\bar{X}$	X	X	X	X	X	X						
Organophosphate (monocrotophos 5E, 0.56 kg ai/ha)	256	0.86		X	X	X	X	$\bar{X}$	X	X	X	X	X	X	X	X	X	
Carbamate (U-56295 85WP, 0.73 kg ai/ha	256	0.59		X	$\bar{X}$	X	X	X	X	X	X		X	X				
Pyrethroid (cypermethrin, 2.5E, 0.04 kg ai/ha)	256	6.00		X	X	$\bar{X}$	X	X	X	X	X	X	X					
Pyrethroid (FMC-54800, 0.8EC, 0.04 kg ai/ha)	256	0.13	X	X	X	$\bar{X}$	X	X	X	X	X	X	X	X	X	X	X	X
Pyrethroid (FCR-1272 1.67EC, 0.04 kg ai/ha)	256	4.19		X	X	$\bar{X}$	X	X	X	X								
Total	1,536	2.07			X	$\bar{X}$	X	X										

*Observations from August 2, 1982 — two weeks after first treatment; one week after second treatment.
†$\bar{X}$ = node with highest mean mite population.
X = nodes with mean mite populations not significantly different from highest (Duncan's New Multiple Range Test, $p < 0.05$).

TABLE 2. Within-plant distribution of *Tetranychus cinnabarinus* on cotton, Imperial Valley, 1982

			Mainstem node*															
Date	Total no. nodes	Mean no. females	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Jun 29	13.74	0.14	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Jul 6	15.25	0.15	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Jul 13	16.48	0.19			X	X	X	X	X	X	X							
Jul 20	17.83	0.46			X	X	X	X	X	X								
Jul 26	17.47	0.82			X	X	X											
Aug 2	18.15	2.07			X	X	X	X										
Aug 9	20.04	6.30			X	X	X	X										
Aug 16	22.33	2.07		X	X	X	X	X	X									
Aug 23	25.10	0.49	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Aug 30	29.28	0.34			X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sep 6	32.43	0.59			X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sep 13	33.91	0.33			X	X	X	X	X									
Sep 20	34.52	1.26			X	X	X	X										
Sep 28	35.24	1.31			X	X	X											
Oct 3	35.56	2.29			X	X	X	X										
Oct 10	35.80	3.80			X	X	X	X										
Oct 19	38.08	6.25			X	X	X	X	X	X	X	X	X	X				

*X = node with highest mean mite population and nodes with mean populations not significantly differing from highest (Duncan's New Multiple Range Test $P < 0.05$).

Chemical effects

Pesticide treatments did not greatly affect distribution of *T. cinnabarinus* on mainstem node leaves of cotton plants on any dates examined (see data from August 2, 1982, in table 1).

The mean number of females per leaf (pooled over mainstem node leaves) varied from a high of 6.0 to a low of 0.1. The specific leaf with the highest mite density varied slightly among treatments. When Duncan's New Multiple Range Test was used to compare node leaves within treatments, a range was produced within which one could sample mites and have an estimate of the most infested leaves ($P<0.05$).

Analyzing the data in the same way, but pooling all data for the date, without regard to treatment, a narrower range of mainstem node leaves 3 to 6 was produced. Extending this range through the ranges produced by individual treatment analysis showed that sampling any leaves in the 3-to-6 range would give an accurate estimate of the mite infestation, regardless of pesticide treatment. Analysis of data from other sampling dates in 1982 and 1983 gave similar results. Although ranges changed throughout the season, sampling within those produced by pooling all data at a date would always give an accurate estimate of mite infestation. Chemical treatments incorporated in this study affected mite population densities; however, distribution of mites within the plant was not changed, suggesting that a sampling plan based on within-plant distribution could be practical in a cotton integrated pest management program that includes other arthropod pests.

This is of special importance relative to the pyrethroids, which have been shown in laboratory tests to not only repel mites but to affect distribution of *T. urticae* on beans. Therefore, mites might be expected to be more numerous in lower portions of pyrethroid-treated plants, where pesticide sprays may not penetrate effectively. This did not occur in our study; any repellency to compounds in table 1 was not evident from the within-plant distribution.

Season-long distribution

Following determination that chemicals applied for pink bollworm control did not affect within-plant distribution of mites, populations on mainstem node leaves were compared to determine which node would be most suitable for sampling throughout the season. In both seasons, the number of nodes averaged about 40 by the time of defoliation. In 1982, the mean number of mites per leaf started from 0.1, rapidly increased to 6.3 per leaf and then decreased (table 2). Another increase started in mid-September with mite populations again averaging 6.3 per leaf. These increases and decreases were independent of chemical treatments and are perhaps tied to the crop's physiology or climatic

TABLE 3. Within-plant distribution of *Tetranychus cinnabarinus* on cotton, Imperial Valley, 1983

Date	Total no. nodes	Mean no. females	Mainstem node*															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Jun 6	9.53	0.06				X	X	X	X	X	X	X						
Jun 13	11.95	0.01					X	X			X		X	X				
Jun 20	14.07	0.00											X		X			
Jun 27	17.50	0.01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Jul 4	18.39	0.02	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Jul 11	19.81	0.01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Jul 18	22.24	0.01				X	X	X			X	X				X		X
Jul 25	23.67	0.04	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Aug 1	25.24	0.03	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Aug 8	25.77	0.05		X	X	X	X	X	X	X	X	X	X		X	X		X
Aug 15	27.39	0.11			X	X	X	X	X	X	X	X	X	X	X	X	X	X
Aug 22	30.30	0.23			X	X	X	X	X		X	X		X	X	X	X	X
Aug 29	30.13	0.37			X	X	X					X	X	X			X	X
Sep 5	32.26	0.57					X	X	X	X			X		X	X		
Sep 12	36.32	1.04				X	X	X	X	X							X	X
Sep 19	38.51	1.94				X	X	X										
Sep 26	38.84	1.21				X	X											
Oct 3	40.64	2.84				X	X											

*X = Node with highest mean mite population and nodes with mean mite populations not significantly different from highest (Duncan's New Multiple Range Test $P < 0.05$).

conditions.

During the 1983 season, mite populations were lower (table 3). The early-season population peak seen in 1982 did not occur in 1983. In late 1983, populations increased to an average of 2.8 per leaf, which was considerably lower than the intensity recorded in 1982.

Because previous analysis showed no effect on within-plant distribution due to chemical treatment, analysis for each date was based on data pooled among treatments (tables 2 and 3). When individual dates were considered, a large range of mainstem node leaves did not significantly differ ($P<0.05$) from the most heavily infested node leaf.

In 1982, sampling in the range of nodes 3 to 5, and in most cases 6, would have always given an accurate indication of mite infestation; this range however, did not occur in 1983. Possibly because of low mite populations in 1983, only node 5 was consistent as the best place to sample for mite infestations. Therefore, throughout both seasons, node 5 was consistent in not significantly differing from the most heavily infested node.

In 1983, early-season mite populations were at times so low that, of the 1,536 leaves sampled weekly, even one mite on one leaf would make that node the most infested, or not significantly different from the most infested nodes; this occurred on June 13, June 20, and July 18. In such cases, leaves at node 5 were sometimes significantly different from the mainstem node leaves with the highest mean mite population. However, when sampling populations to determine the need for chemical control, this situation would not lead to an unacceptable decision, inasmuch as the conclusion not to treat would be reached by sampling node 5 leaves. Therefore, node 5 provides the most reliable choice of sampling unit for detecting damaging levels of *T. cinnabarinus*. Furthermore, this sampling unit is independent of chemical treatment.

The sampling scheme

Using data collected from node 5 leaves, a method for sampling field populations of *T. cinnabarinus* was developed.

A person sampling mites in cotton would use the graph (p. 28) by plotting Tn and n after each sample unit is counted. When the plot falls above the line of the desired precision level, sampling is stopped and the mean density is calculated as $m = Tn/n$. The precision of this estimate will be approximately that of the line on the graph. As the precision level (D_0) increases, the accuracy of the estimate of population intensity decreases and less sampling is required to reach the stop line.

Conclusion

Although binomial and sequential sampling plans for spider mites have been developed for cotton grown in the San Joaquin Valley, the necessary economic thresholds for *T. cinnabarinus* on cotton had not been established, mainly because accurate less time-consuming sampling methods were not available. Using our sampling scheme, researchers can now determine the economic thresholds required to develop a sequential sampling program for spider mites in Imperial Valley cotton. This technique will ultimately generate treatment decisions by cotton growers and pest control advisors

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The citrus red mite, *Panonychus citri*, is the most important mite pest of citrus in California. It attacks leaves and fruit of lemon, orange, and grapefruit. Heavy infestations during times of plant water stress can cause leaf and fruit drop, twig dieback, and even death of large branches. In 1977, the last year for which data are available, estimated loss statewide due to the citrus red mite totaled $15.9 million.

Despite the importance of this mite, little progress has been made in two aspects important to instituting a pest management program: (1) development of sampling plans that allow rapid assessment of population levels and (2) establishment of the relationship between citrus red mite feeding damage and yield reductions. Lack of statistically adequate sampling plans has hindered attempts of pest control advisors to direct control measures on the basis of population levels, because of the time and effort needed to take a census of mite populations. This has also handicapped researchers attempting to quantify the relationship between mite feeding and yield reductions.

We have devised a sampling plan to enable rapid estimation of within-tree mite population levels based on the presence or absence of adult female citrus red mites. This plan is effective in conjunction with a sequential sampling plan to estimate the number of trees necessary to provide an accurate estimate of the areawide population level. Together, the plans will enable researchers and pest control advisors to obtain the maximum amount of information on citrus red mite populations with a minimum outlay of time and effort.

Infested-leaf index

Because citrus trees can have more than 100,000 leaves per tree, an accurate estimate of the mite population within a tree must be determined before an areawide mean can be calculated. Previous work by Dr. J. A. McMurtry, University of California, Riverside, has shown that a greater proportion of the citrus red mite population is found on leaves at the tree's outer periphery. With this in mind, we randomly selected 30 leaves from the tree's outer canopy between 2 and 6 feet from the ground. They were placed in a large wire basket and both leaf surfaces were immediately sprayed with hairspray to stop all mite movement.

The samples were taken to the laboratory, and the number of adult females, adult males, and active (nonquiescent)