Damaging populations of spider mites in Delta field corn are most effectively controlled when acaricides are applied before injury occurs to leaves above the 3-foot level on the plants. Premature drying of the corn foliage, caused by mite infestations, reduces grain yields by increasing stalk breakage, lowering moisture content of grain at harvest and causing kernel shrinkage. Mite control has increased grain yields by 100 to 2,500 pounds per acre in recent tests. This is a progress report of experimental work and growers should contact their farm advisors or read current pesticide control bulletins for specific recommendations on mite control.

Control of Spider Mites on Dent Corn

In the Sacramento-San Joaquin Delta

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DENT CORN grown on the San Joaquin Delta in central California is frequently infested with the two-spotted spider mite, *Tetranychus telarius* (L.), the Pacific spider mite, *Tetranychus pacificus* McGregor, and the Banks grass mite, *Oligonychus pratensis* (Banks). The two-spotted spider mite is predominant and has been found to occur in mixed populations at a ratio of about 4 to 1 of the Pacific spider mite. Banks grass mite may be abundant in some fields but not in others.

Mite infestations are first observed on the under surface of lower leaves of young corn plants, frequently where these leaves are in contact with the soil. Initially, the colonies are small, consisting in some cases of single females and a few eggs. As the populations increase, the lower leaves are severely damaged by feeding, and the mites gradually move upward on the plants, webbing and drying the leaves as they go. By mid-August, severely damaged leaves may be observed high on the plants and, by early September, heavy infestations frequently reach the tops.

Experiments conducted in 1960 on Staten Island, San Joaquin County, and previously reported, showed that heavy mite infestations seriously affected yields of dent corn. Investigations in greater detail were conducted in 1961 and 1962.

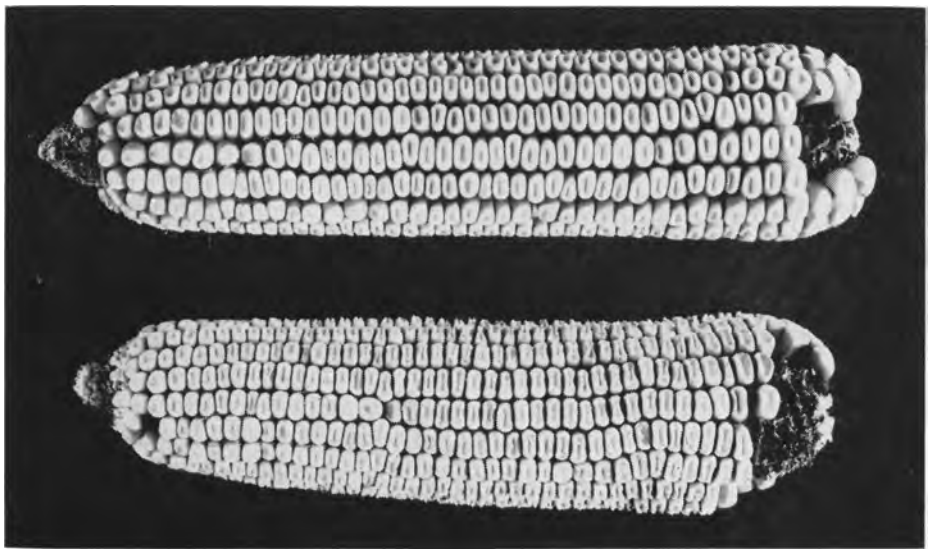
An experimental field of PAG 323 was planted on May 22, 1961. Six pairs of plots were used, with each plot four rows wide and 50 feet long. Untreated checks were alternated with treated plots and a check plot was always placed opposite a treated plot. Only one acaricide (ethion) was used since the purpose of the experiment was to study the effect of mite damage on corn yields. Applications were made with a knapsack sprayer at the rate of 1 pound of actual ethion per acre on July 28, August 9 and August 29. At the time of the first application the corn was beginning to silk. A moderate mite infestation consisting almost entirely of the two-spotted spider mite had developed on the plants.

Mite populations

Mite populations were determined prior to treatment and three times during the period of applications. Mites were counted in areas one-half inch in diameter marked on the undersides of infested leaves and an estimate was made of the percentage of the leaf surface damaged by mite feeding. Thirty leaves were examined from each plot on each sampling date, 10 each from plant levels 1 foot, 3 feet, and 6 feet above the ground.

Percentages of plants with broken stalks and plants infected with stalk rot were determined prior to harvest. On October 17, the two center rows of each plot were harvested by hand. The corn was shelled, and samples were drawn for determinations of moisture, kernel weight, quality, and chemical residue.

Shorter, dried stalks, to left, from mite-damaged check plots contrast with healthy green plants from treated plots, to right.



Well-filled ear of corn in top part of photo above was taken from an acaricide-treated plot for comparison with shriveled ear, below, from a mite-damaged, untreated plot.

Pretreatment counts on July 28 revealed that greater numbers of mites were present on lower than on upper leaves. Succeeding counts in the checks showed that the mites gradually moved upward on the plants. While ethion did not eliminate the mites, it reduced the populations to very low levels and the repeated applications prevented further increases. Striking differences in the appearance of plants in treated and untreated plots were apparent. On September 18, the final sampling date, lower leaves and leaves up to 4 feet high on the plants in the check plots were almost completely dry as a result of severe mite damage. Comparable leaves on plants in the treated plots were succulent and green.

Field weights

Although similar numbers of ears were harvested from the checks and treatments, the field weights of the ear corn from treated plots were significantly higher than those from checks. The moisture content of shelled corn from the check plots was 15.4% and for corn from the treated plots 18.9%. The yields of shelled corn for checks and treatments were calculated on a basis of 15% moisture content. On this basis, the average yield of corn per acre from the checks was 5,420 pounds and from the treated plots, 7,979 pounds or approximately 47% gain.

Samples of shelled corn were analyzed for dry matter, nitrogen, protein, mineral matter, fiber and fat. The only differences between treated and untreated corn were in protein and fat contents, and these were slight. Corn from the checks contained 10% protein while corn from the treated plots contained 10.6% protein. The percentage of ether-extractable fat in corn from the checks was 4.3% and from the treatments was 4.8%.

The premature drying of the foliage in the checks appeared to affect the stalks, making them more susceptible to breakage by wind and perhaps other factors. Numbers of broken stalks were significantly higher in checks than in treated plots. The breakage factor alone can reduce yield more than shown here because ears on many of the broken stalks are not recovered by mechanical harvesters.

Numbers of plants infected with stalk rot were significantly higher in checks than in treated plots. The apparent association of mite infestations with the incidence of stalk rot is not fully understood. Specific causal organisms of stalk rot are as yet unknown, but several fungi have been associated with the disease. Heavy mite infestations reduce plant vigor and it appears that such weakened plants may be more susceptible to stalk rot organisms.

Systemic insecticides

Trials were also conducted in 1961 to evaluate the effectiveness of two systemic insecticides, phorate (Thimet) and Di-Syston for control of mites on dent corn. The experiments were conducted in one field of young corn and in another field of older corn. When the insecticides were applied, on June 28, plants in the young field were 1½ feet tall and only a few mites were present on the lowest leaves. Plants in the older field were 6 feet tall and were heavily infested with mites.

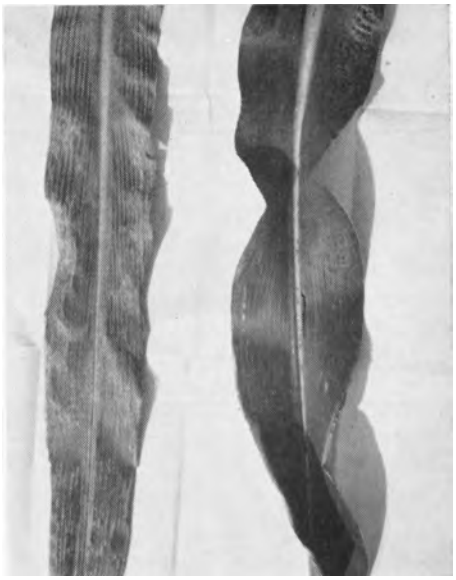
The insecticides were formulated as granules and were applied topically to the plants by pouring one gram of granules into the whorl of leaves at the top of each stalk. The application rates ranged from 2 to 2.4 pounds of active ingredient per acre. In addition to topical applications, the insecticides were applied to the soil as a side dressing 7 inches from the row and 6 inches deep in the younger field. The application rate in this test for each material was from 3 to 3.2 pounds of active ingredient per acre. Each treatment was replicated four times in 50-foot, single-row, plots.

Results were evaluated by posttreatment mite counts, and by estimates of the amount of leaf surface damaged by mites. In the younger field, there was a slight reduction in numbers of mites and in leaf damage where the granules were applied topically. Phorate appeared to be slightly more effective than Di-Syston. In the older field, leaf drying at the 3-foot level was delayed slightly by the phorate treatment. The soil applications appeared to have had no effect on mite control. Although there was a slight reduction in mite infestation with the topical applications, the results obtained with these materials do not appear promising for control of mites on dent corn in the Delta area.

Acaricide evaluation

Experiments completed during 1962 were designed to evaluate several other acaricides and different application timing. A field of PAG 323 variety dent corn planted on June 1 (Staten Island) was chosen for the experiments. The acaricides used were emulsifiable formulations of Kelthane, Tedion, ethion, and Delnav. Kelthane MF (an experimental formula-

Close-up of leaf sections show damage from mites on dried leaf to left as compared with green healthy leaf from treated plots to right.



tion), Kelthane MF plus Volck Supreme oil and ethion 67 (a special formulation containing 0.67 lb. ethion per gallon plus oil) were also applied.

Essentially, three experiments were organized. In the first experiment, Kelthane, Tedion and ethion were applied at three stages of plant growth to replicated plots with a specially built, commercial, ground spray rig. Single applications were made on July 2 when the plant heights were approximately 1 foot, July 16 at 2½ feet and July 23 at 4 feet. In the second experiment, Kelthane MF, Kelthane MF plus oil, and Delnav were applied to unreplicated plots with the ground rig on these three dates. In the third experiment, sprays containing Kelthane, Kelthane MF, ethion and ethion 67 were applied to large unreplicated plots by aircraft on July 23, when the plants were 4 to 5 feet tall.

Pre- and post-treatment estimates were made of the percentage of the leaf surfaces damaged by mites on leaves collected 6 inches, 3 feet, and 6 feet above the ground. The two center rows of the plots treated with ground equipment were harvested with a standard two-row harvester. The shelled corn was weighed and samples were drawn for moisture determinations and Kelthane residue analyses. Yields were not measured for the plots treated by aircraft. Results of these experiments are shown in the table.

Mite populations in the 1962 experiments were not as heavy as those in 1960 and 1961. The acaricides applied when the plants were approximately 1 foot tall reduced mite populations temporarily, but these plants later became reinfested. Much less reinfestation occurred with treatments applied when the plants were 2½ feet and 4 feet tall. Estimates of mite damage on the foliage did not show any appreciable differences between the two later applications. However, observations based on the overall appearance of the plants indicated that the latest application, when the plants were 4 feet tall, was the most effective.

Summary

The following generalizations can be made regarding the relative effectiveness of the acaricides tested during 1962. There were no appreciable differences in mite control with materials applied in the replicated experiment on July 2. In treatments applied on July 16 and 23, however, Kelthane appeared to be slightly more effective than Tedion or ethion and there was little difference between the latter two acaricides. In experiment 2, Kelthane MF appeared to be slightly less effective than Kelthane in experiment 1. The addition of oil to Kelthane MF did not appreciably improve control over that obtained with Kelthane MF alone. Delnav was about equal to ethion in effectiveness.

Of the materials applied by aircraft, Kelthane and ethion were about equal in effectiveness. The data shown in the table indicate that Kelthane MF may have been slightly more effective than Kelthane shortly after application. However, other mite counts at the 6-foot level (not shown in the table) revealed no differences between Kelthane and Kelthane MF.

Ethion 67 was much less effective than ethion, probably because the application rate of actual toxicant was one-third less with the 67 formulation.

The corn yields shown in the table are calculated on the basis of a moisture content of 15%. The data in experiment 1 show differences in yields according to time of application, increasing with the later treatments. Yields from plots treated with the acaricides were greater than from untreated checks, but because of variations between replications, differences between treatments could not be demonstrated statistically for the July 2 and July 16 applications. Yields from plots treated on July 23 were significantly higher than the check. Kelthane resulted in yield increases of 1,088 pounds of shelled corn per acre and Tedion, 904 pounds over the checks. Ethion resulted in a yield increase of 614 pounds per acre over the check.

Harvest data from the unreplicated treatments in the second experiment could not be analyzed statistically but indicated that, with the possible exception of Delnav, these treatments did not result in increased yields.

Residue tests for Kelthane on corn treated by ground application on July 23 and harvested on November 11 showed no residues when analyzed by the Agricultural Toxicology and Residue Research Laboratory at Davis.

SPIDER MITE CONTROL AND YIELDS OF DENT CORN OBTAINED WITH VARIOUS ACARICIDES, STATEN ISLAND, 1962

Date Applied and Plant Height	Treatment		Average % of Leaf Surface Damaged at 3' Level			Shelled Corn Lbs./A at 15% Moisture	Yield Increase Over Check	LSD 5% (Lbs.)
	Material	Lb/A	Aug. 8	Sept. 4	Sept. 26			
EXPERIMENT 1: GROUND APPLICATION—4 REPLICATIONS								
July 2 1 Ft.	Kelthane	1.0	0.19	38.0	87.7	5547	105	
	Tedion	0.5	0.19	42.6	87.4	5811	369	NS
	Ethion	1.0	0.20	44.9	93.1	5547	105	
	Check	..	3.95	79.6	98.5	5442	...	
July 16 2½ Ft.	Kelthane	1.0	0.03	6.6	37.3	5703	428	
	Tedion	0.5	0.12	17.2	60.8	5934	659	NS
	Ethion	1.0	0.14	22.7	74.1	5670	395	
	Check	..	4.93	76.4	98.4	5275	...	
July 23 4 Ft.	Kelthane	1.0	0.16	5.8	22.6	6337	1088	
	Tedion	0.5	0.47	20.6	59.4	6153	904	452
	Ethion	1.0	0.07	16.7	66.2	5863	614	
	Check	..	3.37	84.4	99.3	5249	...	
EXPERIMENT 2: GROUND APPLICATION—NOT REPLICATED								
July 2 1 Ft.	Kelthane MF	1.0	0.45	58.3	92.6	5618		
	Check	..	6.04	82.4	98.9	5442		
	Kelthane MF + Oil	1.0 21.6 oz	0.20	63.7	97.1	4880		
	Check	..	1.86	76.8	98.0	5442		
July 16 2½ Ft.	Kelthane MF	1.0	0.02	10.2	42.6	4617		
	Check	..	9.66	85.9	99.0	5442		
	Kelthane MF + Oil	1.0 21.6 oz	0.01	3.9	33.5	5143		
	Check	..	0.21	66.8	97.8	5275		
July 23 4 Ft.	Delnav	1.0	0.23	20.5	53.9	5758		
	Check	..	3.37	84.4	99.3	5249		
EXPERIMENT 3: AIR APPLICATION—NOT REPLICATED								
July 23 4 Ft.	Kelthane	1.62	0.08	8.0	24.6			
	Ethion	1.0	0.13	8.9	39.3			
	Ethion 67	0.67	0.32	50.8	95.9			
	Check	..	0.38	78.7	98.6			
July 23 5 Ft.	Kelthane MF	1.8	0.01	0.5	2.9			
	Check	..	0.31	70.5	84.2			

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