INFLUENCE OF HOST PLANT PHYSIOLOGY ON POPULATIONS OF *TETRANYCHUS URTICAE* (ACARINA: TETRANYCHIDAE) INFESTING STRAWBERRY PLANTS IN PENINSULAR FLORIDA[1]

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ABSTRACT

Differences in *Tetranychus urticae* Koch populations on fruiting and non-fruiting strawberry (*Fragariae* × *ananassa*) plants indicated that mites are influenced by host plant physiology. Leaf samples from fruiting plants had large populations of spider mites, but samples taken from vegetatively growing, non-fruiting plants had few or no mites. Analysis of leaves from fruiting plants showed higher levels of sucrose than leaves from non-fruiting plants. Phorate treated vegetative plants showed increased mite density. These data suggest that important feeding components, perhaps sugars in strawberry leaves, are influenced by host plant physiology and in turn affect the spider mite populations.

Spider mites have long been a major problem for strawberry growers. Even prior to use of synthetic organic pesticides, red spiders caused severe damage to plants particularly during the fruiting season. Strawberry plants are usually set in the field during late September or October in Florida and begin to flower in late December and January. Spider mites are usually not a problem for the first 2 or 3 months but begin to build up in early spring, thrive throughout the berry producing period, then disappear from the summer nurseries.

Several researchers classed spider mites as the most serious arthropod pest of strawberries in Florida (Brooks et al. 1932; Brooks and Kelsheimer 1951, 1961) and in Virginia (Brittingham 1956). Brooks et al. (1932) observed large populations on fruiting plants but not on nursery plants. The decline and absence of mites in nursery plantings were attributed to effects of frequent, heavy, summer rains or overhead irrigation. The possibility of physiologically different plants was not considered.

The influence of nutrient levels on plants and subsequent influence on spider mite development has been demonstrated. Rodriguez (1954, 1960), Rodriguez et al. (1960), Henneberry (1962a,b) and others have contributed to knowledge relating influences of phosphorus, nitrogen and other elements within plant cells, sugars, and gibberellin to mite fecundity and population development. Rodriguez and Campbell (1961) found that total sugars were reduced by the hormone gibberellin and suggested that an optimal level of sugar was necessary for mite population development, although reducing sugar was not significantly correlated with mite population in their experiments.

Chaplin et al. (1968) experienced difficulty in infesting seedlings with mites in a greenhouse during April and August but not in November. They believed the difficulty was due to physiological growth conditions of the seedlings.

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Methods and Materials

Two plantings were made, 1 in a fruiting field, the second in a nursery for plant production. In the first, 'Florida 90' plants were set 15 October 1969 on black plastic mulch in raised beds of Leon fine sand. Fertilizer at 1,000 lb/acre of 18-0-25 was applied in a center band atop the beds prior to mulching. Seep irrigation was used. Plots consisted of 20 plants in double rows of 10 plants each set on 12 inch centers. Experimental design was a random block with 3 replications. Acaricides were applied with a hand sprayer. Samples of 10 leaves were taken from each plot at irregular intervals and brushed with a Henderson and McBurnie (1943) mite brushing machine. Counts were made of eggs and mites under 15x magnification. Notes concerning condition of plants were taken at the time of sampling.

Weather records of daily temperature and rainfall were kept throughout the growing season on a hygrothermograph recorder maintained by the U. S. Weather Bureau on the experimental farm where the work was conducted.

Leaf samples for analysis were taken during fruiting (10 March 1970), and post-harvest (21 April 1970) periods. Sugars were extracted in 80% alcohol, chromatographed with a solvent of butanol, acetic acid and water and developed with p-Anisidine hydrochloride.

The second planting was 'Solana' seedlings without leaves set into a nursery 20 April 1970. Plots treated included soil applications of Zinophos® (0,0-diethyl-0-2-pyrazinyl phosphorothionate) + phorate covered with various mulches. Leaf samples and counts were made during the summer to ascertain population levels of mites in the nursery.

Results and Discussion

Scattered populations appeared in the fruiting field in early February. To obtain uniform infestation, 1 field collected strawberry leaflet with 50 or more mites was placed in every clone of each plot. Subsequent samples yielded different numbers but consistent populations. After an initial decrease, average population density of mites and eggs increased rapidly for an extended period, then suddenly decreased to a very low level (Fig. 1).

Average and maximum temperatures (Fig. 1) for the week preceding each sample gave no clue or reason for the sudden population decline. Rainfall was an unlikely factor since the spring dry season was in progress and only 0.12 inches rain fell during April, the time of the population decline. Natural enemy populations were minimal and absent on treated foliage. Host plant foliage was abundant and not severely damaged by mites since many of the plots received chemical treatments.

Population development differed on chemically treated and untreated plots. On untreated checks (Fig. 1) adult population decline was preceded by a decline in egg population. Host plant nutrition is a key factor in mite fecundity (Henneberry 1962a) and untreated plots severely damaged by large populations were inadequate to sustain egg production. In contrast, chemically treated plots had low but consistent mite densities (Fig. 1) and egg density declined only after the population of adults had declined. Untreated plots showed population build up, exhaustion of food

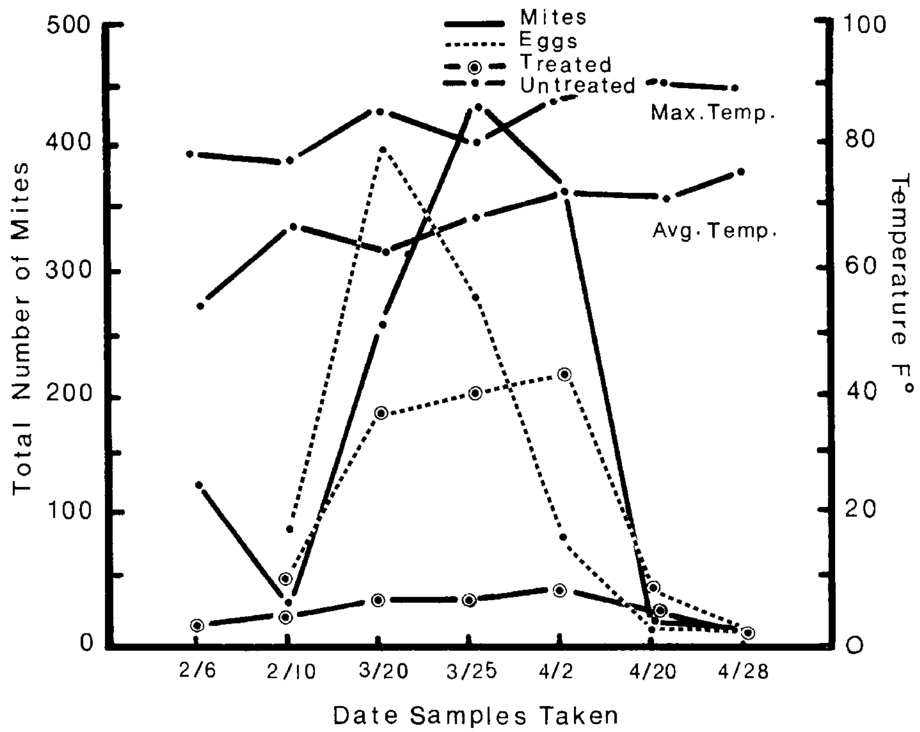

Fig. 1. Seasonal spider mite density on treated and untreated "Florida 90" strawberry plants.

supply, then population decline beginning with reduced fecundity. Chemically treated plants, on the other hand, were not exhausted since plants remained healthy and egg density was greater than adult density.

Concentration of sucrose was greater in leaves taken from fruiting plants than in leaves taken from post-harvest, non-fruiting plants. The physiological change in the host plant evidenced by cessation of fruiting and by the beginning of vegetative growth corresponded to the decline in sugar level and the decline in mite density. These data indicate that fruiting plants are more suitable hosts for mites than vegetatively propagating plants. One difference between fruiting and non-fruiting plants was sugar content, however, other leaf constituents of the physiologically altered plant might also influence feeding of spider mites.

Only the first leaf sample taken from the nursery plants had mites. Samples taken 16 days after setting the field showed populations of spider mites on plots treated with Zinophos+phorate but not on check plots (Table 1). Silver polyethylene plastic mulched plots had higher mite densities than unmulched plots or plots with black paper mulch. Larger numbers of mites than eggs on check plots and plots receiving low rates of Zinophos+phorate indicated a declining population. The converse was true of treatments with higher rates of Zinophos+phorate, and egg density exceeded mite density. This suggests that Zinophos+phorate altered the plant to a more suitable host for mite population development. The effect of Zinophos+phorate on strawberry is not known but Hackaylo

TABLE 1. *Tetranychus urticas* KOCH POPULATIONS IN 'SOLANA' STRAWBERRY NURSERY PLANTS, 1970.

Treatment	Form	Rate lb act./A	Type Mulch	Total number/4 replications* Eggs	Mites
Control	—	—	—	2	18
Control	—	—	Black paper	0	0
Control	—	—	Silver poly	2	8
Zinophos + phorate	15G	4.5	—	2	8
Zinophos + phorate	15G	9.0	—	36	24
Zinophos + phorate	15G	4.5	Black paper	18	44
Zinophos + phorate	15G	9.0	Silver poly	102	74

*1 sample of 15 leaflets per replication.

(1957) demonstrated increased carbohydrate levels in leaves of seedling cotton plants treated with phorate.

Data from fruiting and from non-fruiting plants, from leaf analyses for sugar, and from effects of Zinophos+phorate suggest that host plant physiology is critical in the development of spider mite populations on strawberries. The population density of mites on this crop appears to respond positively to sugar level. Sugar levels were low in non-fruiting plants and mite populations were not sustained in summer nurseries.

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