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Attempted Dispersal of the Twospotted Spider Mite, *Tetranychus urticae*, on Greenhouse-grown Peanut Leaves in Response to Pesticides and Irrigation[1,2,3]

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ABSTRACT

The relationship of the factors irrigation (both overhead and seep) and pesticide residues (and their interaction) on attempted dispersal of spider mite on greenhouse-grown peanuts was determined. Pesticide residue had no measurable effect on mite movement; however, irrigation method had a marked influence on mite attempted dispersal. Mites moved more on leaves of plants receiving seep irrigation than those receiving overhead irrigation.

Key Words: Twospotted spider mite, *Tetranychus urticae* Koch, Peanut, Groundnut, *Arachis hypogaea*, Pesticide effect on mite dispersal, Irrigation effect on mite dispersal, Mite dispersal.

Pest outbreaks following applications of certain agricultural pesticides has been well established (2, 14, 16). Campbell (5) reported outbreaks of the twospotted spider mite, *Tetranychus urticae* Koch, on peanut, *Arachis hypogaea* L., following certain fungicide and fungicide-insecticide applications. This was especially true during hot, dry weather. Boykin (4) demonstrated that one cause of twospotted spider mite numerical variations on peanut leaves was the effect of these fungicides and fungicide-insecticide combinations on the mite's intrinsic rate of increase. Another factor which influences mite population increases following pesticide applications is the reduction of the intraspecific competition for food and space which occurs when the pesticides irritate or repel or kill mites (3, 12, 13). This irritation or repellancy causes increased dispersal of mites which results in a greater number of colonies being able to utilize ample food and space than occurs in the absence of pesticides. Increased dispersal also decreases the effects of any density dependent limiting factors (1, 8, 10). More efficient use of food and space and less efficient response of density dependent limiting factors can result in increased mite reproductive ability and mite outbreaks (16). The objective of this research was to determine if some pesticides or method of irrigation increased attempted dispersal of the twospotted spider mite on greenhouse-grown peanut.

Materials and Methods

The peanut variety NC 2 was planted three seeds to a pot in the greenhouse on March 1, 1979 in 20 cm diameter clay pots using a mixture of 2 parts sterile soil to 1 part sterile sand. After germination plant density was thinned to one plant per pot, and 15 gm of a slow-release full NPK fertilizer (14-14-14) was added to each pot. Six weeks later, pesticide applications were begun and continued at two-week intervals. The following pesticides and concentrations (all fungicides except for carbaryl) were applied five times: ammonical copper (Copper Count®), 4.68 L per hectare; fentin hydroxide (Du-Ter®), .42 kg per hectare; mancozeb (Manzate 200®), 1.68 kg per hectare; benomyl (Benlate®), .56 kg per hectare; carbaryl (Sevin®), 1.40 kg per hectare; mancozeb + carbaryl and benomyl + mancozeb + carbaryl (at above rates). Nontreated peanut plants served as a check. One potted plant was a replication, and each treatment was replicated 4 times in a completely randomized design. Half the plants were watered by seep irrigation and the other half by overhead irrigation one time per week using a water hose and spray nozzle until soil saturation.

Ten days after the fifth pesticide application, one fully expanded quadrifoliate leaf was excised from each plant. All such leaves were approximately the same age. The excised leaf with its petiole wrapped in water-saturated cotton was placed in an open 150 x 25mm petri dish. The two apical leaflets, adaxial side up, were pinned down flat on a small piece of cardboard, and the leaflet edges were surrounded with 'Stikem'® (Michel & Pelton Co., Emeryville, VA). Thus, these two leaflets constituted an experimental unit to which one of the eight pesticides x two irrigation methods x four replications were assigned according to a completely randomized design. Five active, gravid female mites were randomly transferred from bean leaves to each peanut leaflet using a camel hair brush (5 mites x 2 apical leaflets x 8 treatments x 2 irrigation methods x 4 reps = 640 mites). Twospotted spider mite females usually actively walk over the leaf surface for the first hour after release. Thereafter, these mites become less active and spend most of their time feeding and resting (15). For this reason, all mites caught in 'Stikem' during the first hour after release were replaced. Less than 5% of the mites were replaced. Dabrowski et al. (7) stated that mites which refused to settle got stuck in a sticky barrier because the host plant was nonacceptable. After twenty-four hours, observations were made on mite attempted dispersal which was determined by the numbers of mites caught per leaflet in the 'Stikem'. The test was conducted in a continuously lighted room where the temperature averaged 26.7 C and the relative humidity 50%.

Mites for this test were collected from North Carolina peanut fields in October 1978 and maintained for ten months on 'Fordhook 242' lima bean (*Phaseolus lunatus* L.) in a rearing room kept at 27 C and 60% RH. The mites were identified as *T. urticae* Koch by E. W. Baker (USDA, ARC, Beltsville, MD).

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[2]Portion of a thesis submitted for partial fulfillment of the M. S. degree in Entomology at North Carolina State University.

[3]The use of trade names in this publication does not imply endorsement of the products named or criticisms of similar ones not mentioned.

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A two way analysis of variance was conducted to test for irrigation and pesticide main effects and the interaction between these two factors. To facilitate interpretation in case of interaction, a Waller-Duncan Bayesian LSD (k ratio = 100) was obtained for comparing the pesticide means within each irrigation treatment.

Results and Discussion

There was no consistent difference in the pattern of attempted mite dispersal shown by the pesticide treatments for the various irrigation treatments (Table 1, columns 1,2). Thus, we did not consider it improper procedure to study main effect mean patterns for irrigation and pesticides even though interaction was significant. From comparison of pesticide main effect means it was concluded that pesticides did not cause the mites to attempt dispersal more than mites on the nontreated check (Table 1, column 4). Pielou (11) also found in a similar test that carbaryl did not repel mites more than the check.

Table 1. Effect of pesticides and irrigation methods applied to peanut foliage on the dispersal of female twospotted spider mites.

Pesticide	Mean number of adult female mites caught in 'Stikem' on edge of peanut leaves[1]			
	Overhead irrigation[2]	Seep irrigation[2]	Seep minus overhead[3]	Pesticide main effect means[2]
Check	4.25 a	5.25 ab	1.00	4.75 a
Benomyl + Mancozeb + Carbaryl	4.25 a	5.25 ab	1.00	4.75 a
Benomyl	3.75 ab	5.75 ab	2.00	4.75 a
Fentin hydroxide	3.25 ab	7.00 a	3.75**	5.13 a
Mancozeb + Carbaryl	3.00 ab	3.00 b	0.00	3.00 ab
Mancozeb	2.75 ab	5.25 ab	2.50*	4.00 ab
Carbaryl	2.75 ab	4.00 ab	1.25	3.38 ab
Ammonical copper	1.00 b	4.00 ab	3.00*	2.50 b
Irrigation method main effect means	3.13	4.94	1.81***	

[1]40 adult female mites released per pesticide - irrigation combination (5 mites/apical leaflet/replication).

[2]Values in a column with the same letter are not significantly different (P > .05) according to the Waller-Duncan t-test assuming a k-ratio of 100.

[3]Differences between irrigation x pesticide means and irrigation main effect means tested using t-tests. Significant at the (*) 5%, (**) 1%, or (***) .1% level.

A sizeable portion of the interaction was due to large seep irrigation means for the fentin hydroxide, mancozeb and ammonical copper pesticides which were significantly different from their overhead counterparts (Table 1, column 3). This suggests that these three pesticides can cause increased mite dispersal in peanut fields during dry weather. Seep irrigated greenhouse plants and field plants during dry weather are similar in that both will accumulate pesticide residue, inert materials, and dust. These materials can cause increased mite dispersal. Increased mite dispersal can lead to mite population increase due to more efficient use of food and space and less efficient response of density dependent limiting factors.

However, mite populations have not been observed to increase when exposed to fentin hydroxide and ammonical copper in the field (5). Lack of increase in field populations can be partially explained by the fact that both fentin hydroxide and ammonical copper also suppress the reproductive potential of the twospotted spider mite (4,6).

Irrigation main effect means were highly significant ($P < .001$). Fentin hydroxide, ammonical copper and mancozeb accounted for much of the irrigation main effect differences. However, even if these pesticides are omitted from the analysis, there is still a significant irrigation effect ($P < .05$). The seep irrigation mean is larger than the mean for overhead irrigation.

We feel seep irrigated leaves are similar to dry weather leaves in residue and dust accumulation. If the dispersal hypothesis proposed by David (7), Kuenen and Post (9), and Attiah and Boudreaux (1) is correct, we suggest that a substantial increase in dispersal can occur during hot, dry weather, resulting in mite population increases. Campbell (5) stated that mite increase and the most severe damage to peanut occurs during hot, dry weather. An increase in dispersal activity may result from such factors as an accumulation of pesticide residue, inert materials, or dust on leaves. This accumulation may irritate or repel mites. Fleschner (8) suggested that these accumulated substances may change the leaf morphology or physiology, resulting in a plant which may be more susceptible to mite injury.

From the pesticide main effect mean comparisons, we conclude that the pesticides tested did not increase mite attempted dispersal on peanut over that occurring on the nontreated check. However, the twospotted spider mite may be naturally more active on nontreated peanut and may exhibit high dispersal regardless of treatment when peanut is compared to other host plants. Also, mite dispersal was substantially increased if leaves received seep irrigation and were not periodically washed as with overhead irrigation. Reduced leaf washing would also occur during hot, dry weather conditions and can result in increased dispersal and mite populations.

There are many other factors and interactions not examined in this research that contribute to mite population increases in peanut fields. These areas are still in need of investigation. Each aspect of this very complex system must be examined independently before the entire system of mite-peanut-pesticide interactions can be understood.

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