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Effect of Barren Soil Borders and Weed Border Treatments on Movement of the Twospotted Spider Mite into Peanut Fields[1,2,3]

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ABSTRACT

Barren soil borders, weed border treatments, and caged barren soil were evaluated for their effect on movement of the twospotted spider mite, *Tetranychus urticae* Koch, into peanut *(Arachis hypogaea* L.) fields. In field cage tests when a 3, 4.5, or 6 m strip of barren soil separated a source of mite-infestation from initially mite-free peanut, mite damage to peanut was inversely related to the distance of barren soil crossed. In uncaged field tests, similar barren soil borders did not prevent mite movement into peanut fields, however, the number of mites were inversely related to the distance from the field border. There were no significant differences among weed border treatments and total numbers of mites entering peanut fields over time. There were, however, differences among weed border treatments on early mite movement and establishment trends into peanut fields. Mowing weed borders significantly increased the number of aerially dispersing twospotted spider mites within the adjacent peanut field.

Key Words: Twospotted spider mite, *Tetranychus urticae* Koch, Peanut, *Arachis hypogaea* L., Groundnut, Cultural control, Movement, Dispersal, Wind dispersal.

Cultural practices have been reported as an effective means of reducing mite problems in cultivated crops. Flaherty et al. (6) found that grape vineyards bordering oil sprayed roads had fewer mite problems than vineyards adjacent to nonsprayed roads. *Eotetranychus willamettei* Ewing and *Tetranychus pacificus* McGregor problems were encouraged by dusty conditions near roads not sprayed with oil. They also reported that vineyard row middles with grass culture had fewer mite problems that those with cultivated row middles. Dosse (5) reported that good weed control helped reduce *Tetranychus cinnabarinus* (Boisduval) problems in citrus plantations of Lebanon.

In North Carolina the twospotted spider mite, *Tetranychus urticae* Koch, is a pest of many cultivated crops which often causes economic damage to peanut. Canerday et al. (4) suggested that spider mite problems in Alabama cotton fields could be reduced by clearing weeds and other host plants from areas adjacent to fields before planting and by keeping a 3 m barren barrier of broken soil around fields. They also warned that weeds and brush should not be cleared during the growing season as removal of vegetation may force mites to move into fields. Similar methods have been suggested and used for North Carolina peanut fields.

The purpose of this research was to evaluate the effectiveness of barren field borders and weed border treatments on reducing or delaying twospotted spider mite movement into peanut fields.

Materials and Methods

Field Tests

In the spring of 1978 tests were established in 3 fields of ca. 0.8 - 1.2 ha each. In 1979 the experiment was confined to one field. The peanut variety NC 2 was planted at the seeding rate of ca. 70 kg per ha both years, and no systemic insecticides or nematicides were applied at planting. Four weeks after planting in 1978, each field border was subdivided into 3 replicated 6 m wide plots of check, mowed, or herbicide-treated weed borders (Figure 1). The field in 1979 had 4 replications. Each weed border treatment had some combination of a 3, 4.5, and 6 m barren soil border or no barren soil border. In 2 fields during 1978, 8-row (90 cm spacing) peanut plots were treated with a tank mix of mancozeb, 1.34 kg ai/ha and carbaryl, 1.12 kg ai/ha using a tractor mounted sprayer. This treatment was applied at 2-week intervals beginning 22 June and ending 24 August for a total of 5 applications. Mancozeb + carbaryl increases the propensity of twospotted spider mite establishment (3). Each peanut plot was separated by 4 rows of nontreated peanut to decrease the propensity of interplot mite movement. Twospotted spider mites do not easily establish in nontreated peanut (3). The third field used in 1978 was similar but had 4-row treated peanut plots and 4-row nontreated peanut buffers. The one field in 1979 had 8-row treated peanut plots, 8-row nontreated peanut buffers and no herbicide treated weed border.

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[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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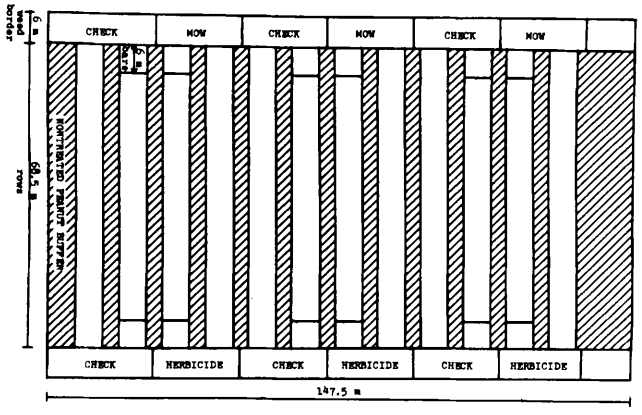

Fig. 1. Basic schematic diagram of the field design used to determine the effect of barren soil borders and weed border treatments on movement of the twospotted spider mite into peanut fields.

Twospotted spider mites were released at 0.3, 1.5, and 3 m into weed borders from the center point where each plot joined the weed border. The mites were reared and released as described by Campbell (3). Mites were released at 2-week intervals beginning 23 June and ending 25 August for a total of 5 releases.

Mow plots were mowed using a standard 55 cm blade gasoline powered push-type mower. Mowing was oriented so refuse was discharged into the weed border away from the peanut field. Herbicide plots were sprayed with paraquat using a 11.4 L garden-type hand-pump sprayer. Paraquat was diluted 8 mL/L of water, and 10 mL liquid soap was added to each tank of solution. The sprayer was calibrated to deliver the solution at a rate of 238 L/ha. Mow and herbicide-treatments were made on 11 July and 11 August in 1978. Field borders were mowed on 9 and 25 August in 1979. Barren borders were maintained by periodically spraying emerging weeds with glyphosate at 15 mL/L of water and at a rate of 238 L/ha.

Beginning 22 August and at weekly intervals thereafter, the number of mites were counted on 10 quadrifoliate leaves at 0.3, 3, 6, 9, and 12 m into the middle 2 rows of each treated peanut plot. Each field was sampled 3 to 5 times to determine patterns of *T. urticae* entry and establishment into peanut fields. The statistical design used was a split-plot with a 2 x 2 factorial (weed edge x barren border) as the whole plot factor and distance into the field as the subplot factor.

To sample mites dispersing by wind, the field used in 1979 had one sticky trap placed 6 m from and facing the weed border in one of the center two rows of each peanut plot. The sticky trap was constructed from one 75 cm long .5 x 5.5 cm lattice strip nailed 60 cm above the ground to a 2 x 4 cm board. Fourteen no. 2 binder clips (Charles Leonard, Inc., Glendale, NY) were stapled to each lattice strip. Each clip held perpendicular to the ground a 75 x 25 mm microscope slide coated with a thin layer of 'Stikem'® (Michel & Pelton Co., Emeryville, CA). All vegetation was removed from around the base of traps. The base of the traps was treated with a 20 cm band of Stikem so only wind dispersing mites could be caught on sticky slides. Slides were placed on traps on 1 August and replaced every 2 weeks (15 and 29 August) until 12 September. On 9 and 25 August old slides were removed from traps placed in slide boxes and replaced by fresh slides during 1 hr. of weed border mowing. After mowing, the fresh slides were removed and the old slides were put back on the traps. Only soft bodied *T. urticae* were counted on each slide with the aid of a stereoscopic microscope. Earlier laboratory experimentation indicated that hard bodied *T. urticae* found on slides were dead before being blown onto slides.

Cage Tests

Cage tests were used to more accurately determine the ability of T. urticae to cross barren borders. Tests were established on 8 August 1978 in the center of a large area of nontreated peanut. Three replications of cages were built over rogued rows leaving 3, 4.5, or 6 m strips of barren soil with one NC 2 peanut plant within 15 cm of the east end of each cage. Each of the 9 cages was 90 cm wide x 45 cm high and constructed using 2.5 x 5 cm boards covered by a 32 x 32 lines/2.5 cm^2 mesh of 'Lumite'® screen (Chicopee Manufacturing Co., Cornelia, GA). Caged peanut plants were sprayed with a tank mix of mancozeb + carbaryl (rates previously stated) on August 8 and 16 to increase the probability of mite establishment. On August 16 and 25 heavily mite-infested beans (reared as previously described, Campbell (3)) were placed at the west end of each cage. After August 8, all cages remained completely sealed except during treatments and releases. Caged peanut plants were visually rated for percent chlorosis on 8 September 1978 using a 0-100% scale (0 = no chlorsis; 100 = complete chlorosis).

Data were analyzed using a 2-way analysis of variance. Mites used in these tests were identified as *T. urticae* Koch by E. W. Baker (USDA, ARC, Beltsville, MD). Voucher specimens were placed in the North Carolina State University Insect Collection.

Results

Field Tests

Data analysis showed there were no consistent differences between the main effect means of barren borders, weed borders, or sample distance into the field over time. This was true of all locations whether or not complete randomization could be practiced. Also, there were no consistent differences between any interaction means over time. On the first and second sample dates, however, there was a consistent and significant trend ($P \leq .05$) in mite numbers relative to sample distance into the field. Figure 2 shows the predicted mean number of mites per 10 quadrifoliate leaves based on data collected from the first two sampling dates at various distances into the peanut fields opposite weedy borders that were either mowed, herbicide-treated or left natural (Check). More mites were found at 0.3 m into peanut plots bordering natural weed borders ($P \leq .05$) than were found at 0.3 m into peanut plots bordering mowed or herbicide-treated weed borders. Mite numbers decreased as the distance from the mowed or herbicide-treated border increased. Also, as samples were taken further into the field, numbers of mites in plots bordering natural weeds became less than mite numbers in plots bordering mowed and herbicide-treated weed borders. At 10.5 to 12.0 m into the field, mite numbers were the same in all plots regardless of weed border treatment.

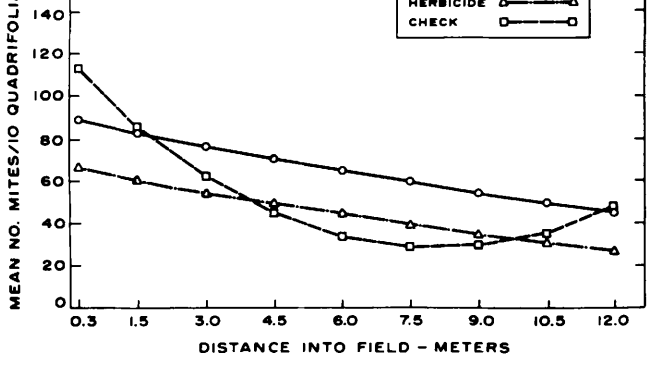

Fig. 2. Effect of sample distance into the peanut field from mowed, herbicide-treated, or check week borders on the predicted mean number of *T. urticae* per 10 quadrifoliate leaves based on data collected from the first two sampling dates of each field experiment. Martin, Halifax and Northampton Co., NC, 1978 and 1979.

Mowing of weed borders significantly increased the number of aerially dispersing twospotted spider mites within the adjacent peanut field (Table 1). As many mites were caught on slides exposed only during 1 hr. of

mowing as were caught on slides exposed during two weeks of non-mowing.

Table 1. Effect of 1 hour mowing and 2 weeks nonmowing on the number of mites caught on wind dispersal sticky slides. Halifax Co., NC, 1979.

Date collected	No. Mites Caught[1/] During 1 hr. mowing[2/]	Mean per hr. during 2 weeks non-mowing[3/]
9 August	7	-
15 August	-	0.009
25 August	7	-
29 August	-	0.036
12 September	-	0.036

1/ No. mites caught on 224 - 75 x 25 mm sticky slides (16 traps x 14 slides/trap = 224 slides).

2/ No. mites caught during mowings of 1 hr. duration on August 9, 1979 and August 25, 1979.

3/ No. mites caught over 2 weeks ÷ 336 hr.

Cage Tests

Mite damage was inversely related to the distance the caged peanut was from the source of infestation. However, mites that had to disperse over 3.0 m of barren soil to reach peanut plants caused significantly ($P \leq .05$) more damage to peanut plants than did mites that had to disperse over 4.5 or 6.0 m of barren soil (Figure 3). A linear plateau (1) indicates a significant change in the slope of the damage curve when mites had to travel across 4.5 of 6.0 m of barren soil compared to damage after crossing only 3.0 m of barren soil.

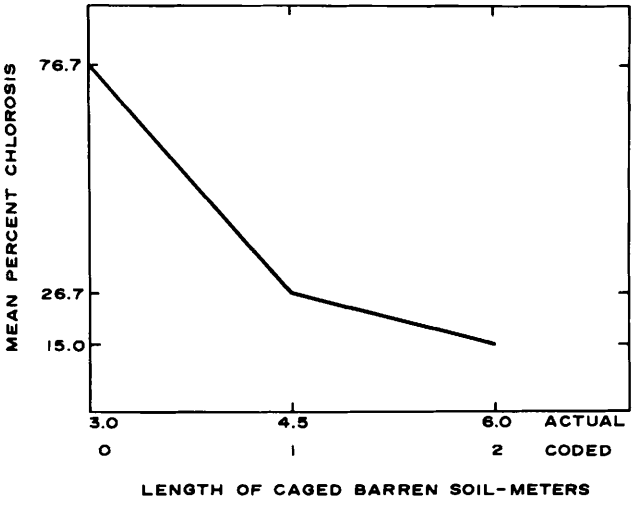

Fig. 3. Effect of barren soil and distance on the movement of *T. urticae* from infested lima bean to pesticide-treated peanut and the resulting mite chlorosis to peanuts in field cages. Northampton County, NC. 1978.

Discussion

McGregor (7) reported that *T. urticae* dispersed into cotton fields mainly by walking over the soil surface at a rate of ca. 6 m/hr. Parker (8) showed that speed of mite movement depended on the type of soil surface; mites could move 2 m/hr over packed soil but only 5 cm/hr on loose soil. Our cage tests indicated that the 3.0 m barrier of barren soil around fields is not wide enough to stop mites from walking into peanut fields. A 4.5 or 6.0 m barrier of barren soil may delay mite movement into peanut fields if walking were the only or major means of dispersal. However, a 4.5 or 6.0 m barrier of barren soil will not prevent mites from dispersing into peanut fields. One reason the barren soil does not prevent *T. urticae* from entering peanut fields is that wind dispersal is an important part of twospotted spider mite ecology in peanut (2).

Disturbing weed borders by, e.g., mowing during the growing season increased the number of aerially dispersed twospotted spider mites, and therefore, may alter the pattern and/or rate of mite movement into peanut fields. Samples taken early in field check plots showed an accumulation of twospotted spider mites at 0.3 m; presumably these mites walked into these plots. Mite numbers decreased rapidly further into the field and began increasing again at 9.0 m into the peanut plots. This spotty, uneven distribution is characteristic of aerial mite dispersal. Fewer mites were found at 0.3 m into peanut plots bordering mowed and herbicide-treated weeds than check weeds. However, the curves showing mite dispersal into peanut from mowed and herbicide-treated weeds decrease more gradually and linearly than the curve showing mite dispersal into peanut from check weeds; possibly a function of ambulatory plus increased aerial movement.

Finally, barren soil borders of 6.0 m or less will not prevent twospotted spider mites from entering peanut fields. However, barren soil borders may slightly delay mite entry. Treatments of weed borders may slightly delay mite entry. Treatments of weed borders should be avoided during the growing season especially when fungicides and insecticides are being used in peanut fields (2,3), since removing the food supply forces *T. urticae* to disperse. Herbicide treatments of weed borders during the growing season could force twospotted spider mite dispersion into peanut fields when peanut is most vulnerable to *T. urticae* population increase (2). However, early season treatments of weed borders may help reduce mite problems by removing the mite's food source and forcing mites to move when peanut is less susceptible to mite establishment (2).

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