were captured per tank each day. Greater than 5% of the total crickets available in the test were captured each day for the first 7 days. During the 14-day sampling period, an average of 1.14 crickets per tank were captured daily or 5.7% of the total crickets available.

If a similar experiment was conducted with tawny or short-winged mole crickets, probably most of the mole crickets would be captured in one of the turfgrass quadrants.

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SPATIAL DISTRIBUTION OF SOUTHERN RED MITE ON FIELD GROWN *ILEX CRENATA*[1]

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Abstract. **Southern red mites [*Oligonychus ilicis* (McGregor)] and eggs were collected from commercially grown holly, *Ilex crenata* Thunb. 'Hetzii' at a nursery near Macclenny, Florida to determine distribution on the host. Plants were spatially divided into 1) lower, middle, and upper heights, 2) inner and outer zones, and 3) north, south, east, and west quadrants. Egg and mite densities were highest on leaf undersurfaces. Eggs were uniformly distributed with respect to plant height. However, 44% of the mites were collected from leaves in the upper plant height. The inner zone of the plant contained 61 and 58% of the eggs and mites, respectively. Eggs and mites were most abundant in the north-south plant quadrants. The highest egg density was recorded from the inner-middle-south site and mites were most prevalent in the inner-upper-north plant region. Based upon density, the optimum sampling location appears to be in the inner zone at either the upper or middle heights in the north or south quadrants.**

Information concerning the spatial distribution of an insect or mite on its host plant is essential to estimate population densities accurately. Many pests exhibit a preference for a particular location on a host plant (2, 5, 7, 8). A knowledge of a pest's distribution can increase efficiency of a pest management program by reducing sample variability and size (10).

The spatial distribution of *Oligonychus ilicis* (McGregor), the southern red mite, on field grown holly, *Ilex crenata* 'Hetzii' was studied to determine the optimum sampling location.

Materials and Methods

The spatial distribution of *O. illicis* on *I. crenata*, a commercially grown holly, was studied in March 1977 at Blair Nursery near Macclenny, Florida. The experimental plot (ca. 0.1 ha) contained 20 north-south rows of untreated, 1 m high plants. To the east, adjacent to the experimental plot, were 1.5 ha of holly plants which were treated periodically with ground applications of a dicofol-parathion mixture. Samples were taken from the center of the experimental plot to avoid effects of pesticide drift. Five contiguous plants were sampled in each of 2 rows, and 24 samples were collected from each plant. Each sample consisted of 10 leaves, and sampling sites were selected from lower, middle, and upper heights (20, 50, and 80 cm, respectively) and from outer and inner zones (delineated by ½ the radius) of the plant. Samples from these 3 heights and 2 zones were further subdivided so as to represent the north, south, east, and west quadrants of the holly plants. All plant material was refrigerated until examined to prevent mite movement. Since leaves of *I. crenata* were somewhat cupshaped and ranged in size from 2.5-3.5 cm^2, examination of plant material under a dissecting microscope was chosen as the most desirable method for obtaining accurate counts of eggs and mites (6). Analysis of variance and Duncan's multiple range test were used to determine significant differences in the distribution patterns.

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Results and Discussion

Eggs and mites were found primarily on the lower surface of the holly leaves but under crowded conditions they were found on both leaf surfaces. Denmark (4) and Calsa and Sauer (3) reported similar observations, which conflicted with Smith (9) and Jeppson et al. (6), who stated that *O. ilicis* lived principally on the upper leaf surfaces. Textural conditions of the leaf surfaces such as hirsuteness or presence of plant exudates along with the influences of rain, temperature, and light may cause the mites to seek specific locations. The upper leaf surface of *I. crenata* is waxy and smooth and may discourage feeding and oviposition.

In Fig. 1, the individual effects of heights, zones, and quadrants are shown without considering how the interrelationships among these parameters affect density. When only height was considered, eggs were uniformly distributed (Fig. 1B). Mite distribution was influenced by height, with 26, 30, and 44% of the mites located in the lower, middle, and upper parts of the plant, respectively. The mean number of mites in the upper portion of the plant was significantly greater (1% level) than the means for the lower and middle strata and may be attributed to the general tendency of tetranychid mites to exhibit negatively geotropic movements. Whether this greater accumulation of mites in the upper part of the host was for dispersal purposes is uncertain. Masses of mites or webbing were never observed at the tops of holly plants.

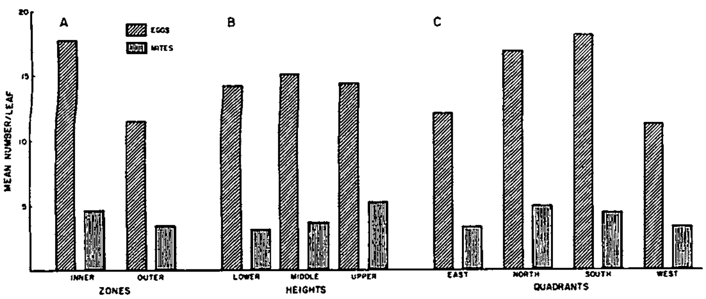

Fig. 1. Number of eggs and mites of *Oligonychus ilicis* collected from different zones (A), heights (B), and quadrants (C) of *Ilex crenata*.

The inner and outer zones contained 61 and 39% of the eggs, respectively. A similar pattern existed for mites with 58% in the inner zone and 42% in the outer. The mean number of eggs and mites for the inner zone was significantly greater (1% level) than the mean for the outer zone (Fig. 1A). *I. crenata* plants are usually densely foliated; possibly the inner location provided protection from desiccation, wind or predation.

Significantly (1% level) more eggs were located in the north and south quadrants than in the east and west quadrants (Fig. 1C) with 31% in the south, 29% in the north, 21% in the east, and 19% in the west quadrant. No statistical differences were detected between mites in the north, south, east, or west quadrants of the plants. Thirty-one percent of the mites were in the north quadrant, 27% in the south, and 21% in both the east and west quadrants. Eggs and mites in the north and south quadrants were afforded more protection because branches of adjacent plants overlapped. Rust mites were also found in greatest numbers in the north and south quadrants of citrus trees (1), but unlike southern red mites, the rust mites were found in the lower parts of trees.

All heights in the inner zone contained more eggs than any of the heights in the outer zone (Fig. 2A). The largest number of eggs in the inner zone occurred at the middle and upper levels while the opposite was true for the outer zone. Mite abundance was positively correlated with height only in the inner zone (Fig. 2B). The lack of positive correlation in the outer zone resulted in a significant interaction (1% level) for mites between zones and heights. In contrast to egg density, mites were most prevalent in both zones at the upper height.

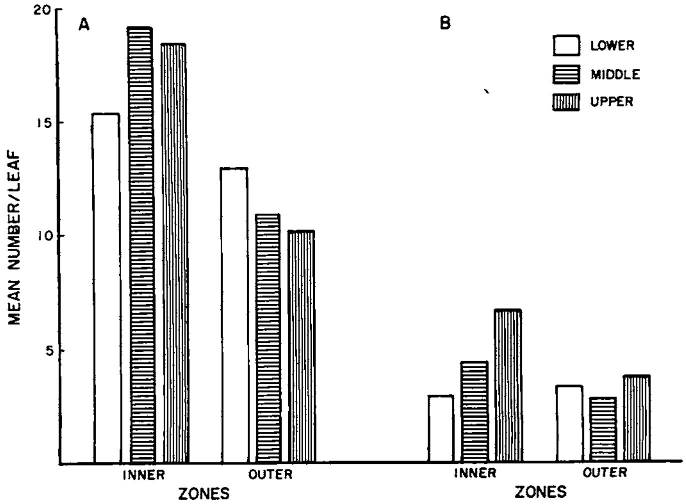

Fig. 2. Number of eggs (A) and mites (B) of *Oligonychus ilicis* collected from the inner and outer zones of *Ilex crenata* at 3 different heights (lower, middle, upper).

The south quadrant of the inner zone contained significantly more eggs than the other quadrants in either the inner or outer zones (Fig. 3A). The most pronounced difference in egg and mite (Fig. 3B) densities occurred in the outer zone between the north-south and east-west quadrants.

The north-south quadrants had the highest egg densities at all plant heights (Fig. 4A). The south quadrant contained the greatest number of eggs at the lower and middle heights, and the north quadrant contained the most eggs at the upper heights. Fewest eggs were found in the west quadrant at the lower and middle heights and in the east quadrant at the upper height. The highest mite densities were found in the upper north quadrant (Fig. 4B). At the lower height, more mites were located in the east quadrant, which was the only exception to the pattern of more eggs and mites in the north and south quadrants. The distribution patterns for both eggs and mites at the upper height were similar.

An analysis of all possible combinations of zones, heights, and quadrants for egg and mites indicated that the greatest egg density occurred at the inner-middle-south sampling site (Table 1). This value did not differ significantly at the

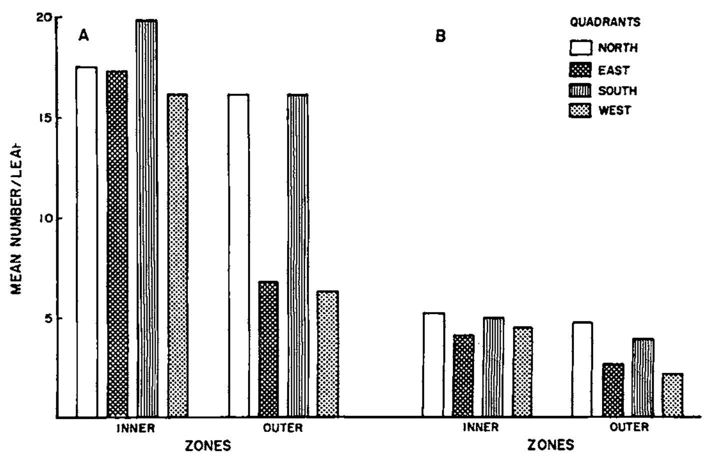

Fig. 3. Number of eggs (A) and mites (B) of *Oligonychus ilicis* collected from the inner and outer zones of *Ilex crenata* in 4 different quadrants.

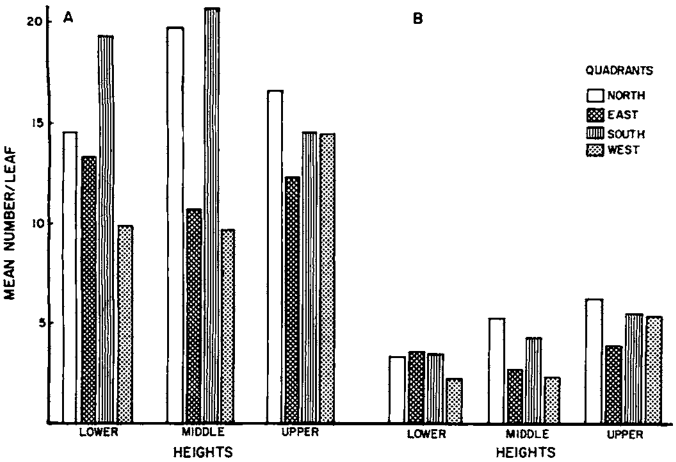

Fig. 4. Number of eggs (A) and mites (B) of *Oligonychus ilicis* collected at 3 different heights in *Ilex crenata* and from 4 different quadrants.

Table 1. Mean number of eggs and mites, *Oligonychus ilicis*, in each of 24 sampling sites on *Ilex crenata*.

Location[y]	Eggs	Mites
ILN	14.88abcd[z]	2.89cd[z]
ILS	17.91abc	2.95bcd
ILE	15.83abcd	3.26abcd
ILW	13.11abcd	2.52d
IMN	17.92abc	5.22abcd
IMS	23.82a	4.66abcd
IME	19.36ab	4.14abcd
IMW	16.01abcd	3.63abcd
IUN	19.89ab	7.56a
IUS	17.95abc	7.36ab
IUE	16.82abcd	4.86abcd
IUW	19.52ab	7.26abc
OLN	14.17abcd	3.82abcd
OLS	20.50ab	4.00abcd
OLE	10.80abcd	3.77abcd
OLW	6.59bcd	1.93d
OMN	21.31ab	5.34abcd
OMS	17.31abc	3.94abcd
OME	2.01d	1.26d
OMW	3.26d	0.97d
OUN	13.23abcd	5.02abcd
OUS	10.95abcd	3.80abcd
OUE	7.70bcd	2.97bcd
OUW	9.24abcd	3.68abcd

[z]Mean separation in columns by Duncan's multiple range test, 1% level.
[y]I = Inner, O = Outer, L = Lower, M = Middle, U = Upper, N = North, S = South, E = East, W = West.

1% level from 19 of the other sites. The greatest density of mites was recorded from the inner-upper-north location and this value was not significantly different from 16 other means. The fewest mites were in the outer-middle-west sampling site and the fewest eggs in the outer-middle-east site. Therefore, the optimum sampling location appears to be in the inner zone at either the upper or middle heights in the north or south quadrants.

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