SPATIAL DISTRIBUTION OF FRIT FLY,
OSCINELLA FRIT (DIPTERA: CHLOROPIDÆ),
IMMATURES IN TURFGRASS

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ABSTRACT: The spatial distribution of frit fly, Oscinella frit, immatures was studied by rearing adults from golf course turfgrass samples taken every 2 wks and placed in a greenhouse for 4 wks. The spatial distribution conformed to an aggregated type as indicated by K of the negative binomial, Taylor’s power law, and regression of mean crowding on mean density. The common K (Kf), 1.23, exhibited agreement with a 0 y intercept and there was independence of 1/K from the sample means.

A primary requisite to understanding an organism in its ecosystem is knowledge of spatial distribution (Sevacherian and Stern, 1972). Information on spatial patterns aids in life table studies, population surveys, and recognition of subtypes (Harcourt, 1965). Moreover, understanding spatial patterns is vital in constructing sequential sampling plans (Waters, 1955), selecting variance stabilizing transformations (Southwood, 1978), and determining sample size (Karandinos, 1976).

The frit fly (FF), Oscinella frit (L.), a pest commonly abundant in turfgrass (Schread and Radko, 1958; Niemczyk, 1981), causes damage by larvae feeding on the central shoot. Jonasson (1982) determined that FF eggs exhibited an aggregated spatial pattern on oats; distribution of larvae was less contagious than that of eggs.

Research on FF larvae in turfgrass is labor-intensive. This is because larvae live in the base of grasses and the time required to dissect them and ascertain whether a larva is present is great. In the present study, an attempt was made to describe the spatial distribution of FF by rearing adults from turfgrass samples placed in a greenhouse. This information may be of value in future FF sampling regimes, life table studies, sequential sampling plans, and data analysis.

1Received March 19, 1988. Accepted June 20, 1988.

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MATERIALS AND METHODS

Sampling methods

Estimates of the densities of FF immatures were obtained by rearing adults from turf samples placed in a greenhouse. On each sampling date, 66 turf samples (ca. 300 cm$^2$ per sample) were collected at random with a 17.5 cm wide spade from fairway 3 at the College of Wooster Golf Course, Wooster, Ohio, every 2 wk from mid-April to mid-October, 1985. Sample locations were determined using a scaled map with locations specified by a table of random numbers. Replacement sod was used to fill sample holes left in the fairway. Fairway 3 was comprised of ca. 60% perennial ryegrass, *Lolium perenne* L., 20% Kentucky bluegrass, *Poa pratensis* L., and 20% annual bluegrass, *Poa annua reptans* L. Physical properties were: thatch = 2.5 cm, soil pH = 6.7, organic matter = 2.8%, cation exchange capacity = 10.2, sand = 30.4%, silt = 47.6%, and clay = 22.0%. The last known insecticide applied was isofenphos in 1981.

Samples were planted into a punctured, plastic-lined planter bed filled with Metro-mix 350 growing medium. The planter bed and samples were initially irrigated to moisten throughout. Thereafter, a tubing drip-irrigation system was used weekly to sustain grass growth. The punctured plastic liner allowed for water drainage. An emergence trap was placed over each sample to capture emerging FF adults. Emergence traps were maintained for 4 wk as this approximated the time of FF egg-to-adult development at greenhouse temperatures. Each trap consisted of a cone of sheer drapery cloth attached to the mouth of a 0.26 liter (0.5 pint) Ball mason jar supported 45 cm above each sample by a 6 mm diameter wooden dowel. Tapetrap was applied to the inside of each jar to capture adults as they flew up the cloth cone into the jar. Adults were removed from the Tapetrap and identified.

Statistical methods

A FORTRAN program (Davies, 1971) was used to fit negative binomial distributions to density data. The negative binomial program also calculated $K$, a parameter representing the degree of aggregation, and tested for overdispersion. The common $K(K_c)$ was approximated by the method of Southwood (1978). The following dispersion indices were calculated: $K$ of the negative binomial, slope and intercept of Iwao's mean crowding mean relationship (Iwao, 1968; Iwao and Kuno, 1971), and the slope of Taylor's power law (Taylor, 1961).

The negative binomial distributions were tested for goodness-of-fit
by the \( \chi^2 \) test. The aggregation index \( b \) of Taylor's power law and slope and intercept of Iwao's mean crowding mean relationship were tested for departure from 1 (for slopes) and 0 (for intercepts) by Student's t test.

**RESULTS**

The negative binomial indicated FF were aggregated since it fitted those data for 67% of the 12 sampling days. Estimates of the dispersion index \( K \) of the negative binomial ranged between 0.79 and 3.03. Southwood (1966) notes a \( K \) value < 8 indicates an aggregated pattern: thus, \( K \) reflects the clumped nature of FF immatures. The common \( K \) (\( K_c \)) was determined to be 1.23. The validity of \( K_c \) was determined by the nonsignificant correlation coefficients between \( 1/K \) values and sample means (\( r = 0.45; \text{df} = 6; P > 0.05 \)). The t test indicated that the intercept was not significantly different from 0 (\( t = 0.65; \text{df} = 6; P > 0.05 \)) (Southwood, 1978). The existence of a common \( K \) is important as it aids in the development of sequential sampling plans, selecting variance stabilizing transformations, and direct comparison of means between two or more distributions (Bliss and Owen, 1958).

Table 1 shows the results of Taylor's power law fitted to the log of means and variances of adults reared and Iwao's regression of mean crowding (\( m \)) on the mean. The aggregated pattern of FF was evident, because the slope (\( b \); index of aggregation) of Taylor's power law was significantly different from 1, (\( t = 6.42; \text{df} = 10; P < 0.05 \)).

The \( y \) intercept of the regression of mean crowding on the mean indicates dispersion due to behavior such as oviposition of egg masses, mutual attraction, or repulsion of individuals. The slope of the \( m-x \) regression reflects aggregation due to habitat heterogeneity in relation to population density (Iwao, 1968). The intercept from the \( m-x \) regression had a low value and was not significantly different from 0 (\( t = 0.59; \text{df} = 10; P > 0.05 \)); thus, the number of immatures in the sample unit (ca.

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**Table 1. Regression equations of Taylor's power law relating the log of variances to the log of mean counts of the FF and the association between mean crowding \( (m) \) and the mean.**

<table>
<thead>
<tr>
<th>Index</th>
<th>Equations ((n = 12))</th>
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<tbody>
<tr>
<td>Taylor's power law</td>
<td>( \log(s^2) = \log 0.302 + 1.546(\log \bar{x}) )</td>
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<tr>
<td></td>
<td>( r = 0.98^* )</td>
</tr>
<tr>
<td>( m-x ) regression</td>
<td>( m = -0.690 + 1.958(\bar{x}) )</td>
</tr>
<tr>
<td></td>
<td>( r = 0.96^* )</td>
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\(^*\)significantly different from 0; \( P < 0.05 \); t test.
300 cm$^2$) exhibited a low degree of aggregation. Low aggregation may be the result of larval migration from shoots to tillers and other plants (Jones, 1969). The slope was significantly greater than 1 ($t = 5.69; df = 10; P < 0.05$), and, thus, indicated the highly aggregated distribution of samples containing FF due to habitat heterogeneity (Iwao, 1968). Such aggregation could result from a patchy distribution of turfgrass hosts with withered leaves which are preferred by females as multiple oviposition sites (Vickerman, 1978). Jonasson (1982) noted an aggregated pattern of eggs on oats due to distribution of hosts with morphological characteristics conducive for oviposition. In addition, he noted larvae exhibit less aggregation than eggs due to migration from main shoots to tillers.

CONCLUSIONS

FF immatures appear to be distributed in an aggregated pattern which may be due to the distribution of hosts with withered leaves onto which females oviposit and larva migration from old shoots to new tillers and plants. This aggregation conformed to a negative binomial distribution with a common $K (K_e)$.

ACKNOWLEDGMENTS

We thank Alyce Amstutz and Thanh Lu for much needed assistance in the field. We are grateful to Phil Williams for the use of the College of Wooster Golf Course. Funding support for this research provided by The Ohio Turfgrass Foundation, and by state and federal funds appropriated to the Ohio Agricultural Research and Development Center. This paper is a part of a dissertation submitted to the Graduate School, The Ohio State University, in partial fulfillment of the requirements for the Doctor of Philosophy degree in Entomology. This is Journal Article No. 170-87.

LITERATURE CITED


BOOK RECEIVED AND BRIEFLY NOTED


The purpose of this book is to highlight some agriculturally important plants and their associated arthropod complexes with a biological, as well as an agricultural, perspective. Chapters include presentations on the entomology of ten plants or plant groups as indigenous and cultivated sunflowers, crucifers and cruciferous crops, muscadine grapes, strawberries, rabbiteye blueberries, Johnson grass & sorghum, rice, wheat, and pecans.