THE RELATIONSHIP OF CHINCH BUG (BLISSUS LEUCOPTERUS HEMIPTERA:LYGAEIDAE) PRESENCE AND ABUNDANCE TO PARAMETERS OF THE TURFGRASS ENVIRONMENT

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ABSTRACT

THE RELATIONSHIP OF CHINCH BUG (BLISSUS LEUCOPTERUS HEMIPTERA:LYGAEIDAE) PRESENCE AND ABUNDANCE TO PARAMETERS OF THE TURFGRASS ENVIRONMENT

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Selected parameters of the chinch bug (Blissus leucopterus) turfgrass environment were examined over a three year period in a survey of 108 home lawns in the greater Lansing area of Michigan. Variables included were thatch thickness, grass height, dry weight of the grass, chlorophyll content, thatch and ambient temperature, soil moisture, and species composition of the lawn. Numbers of chinch bug and predaceous arthropod were counted using a transect sampling method. Thatch thickness was positively correlated to the abundance of chinch bugs in all three years. It was the only variable that was significantly correlated to chinch bug abundance in all three years. In field experiments thick thatch was induced by applications of the fungicide mancozeb, and chinch bug populations increased. In lawn surveys, thatch grew thicker over a two year period in chinch bug infested lawns, but did not change in non-infested ones. Chinch bugs released into thatchy and dethatched areas appeared to have at least a short-term habitat preference for thatchy turf. Big-eyed bugs (Geocoris bullatus Say) were observed to feed on adult chinch bugs in the laboratory, but confinement with big-eyed bugs did not significantly affect chinch bug population sizes in the laboratory.

There was significantly more fine fescue (Festuca rubra) and less Kentucky bluegrass (Poa pratensis) in infested lawns as compared with

non-infested lawns. A linear discriminant function was determined for 1986 data using percent Kentucky bluegrass and thatch thickness as the variables of interest. When tested using data from 1986, 1987, and 1988 the function correctly predicted chinch bug presence in lawns between 63 and 81 percent of the time. In the laboratory, chinch bugs were found to feed more on Kentucky bluegrass than on fine fescue. There was a tendency for chinch bugs to hide in Kentucky bluegrass preferentially over fine fescue, although the difference was not significant.

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TABLE OF CONTENTS

LIST OF TABLES viii

LIST OF FIGURES.....ix

GENERAL INTRODUCTION AND
LITERATURE REVIEW.....1

CHAPTER 1. Relationship of chinch bug (Blissus leucopterus Hemiptera:Lygaeidae) abundance to parameters of the turfgrass environment.....11

Introduction.....12

Materials and Methods.....13
1986 Survey.....13
1987 Survey.....15
1988 Survey.....16

Results.....16

Discussion.....28

Literature Cited.....31

CHAPTER 2. Influence of Thatch Layer on Populations of Chinch Bugs (Blissus leucopterus Hemiptera:Lygaeidae) in Turfgrass.....33

Introduction.....34

Materials and Methods.....35
Induced Thatch Experiment.....35
Dethatching Experiment.....36
Predation Experiment.....37
Survey.....38

Results.....38
Induced Thatch Experiment.....38
Dethatching Experiment.....42
Predation Experiment.....42
Survey.....46

Discussion.....46

Literature cited.....50

CHAPTER 3. Feeding Preference of Chinch Bug (Blissus leucopterus Hemiptera:Lygaeidae) for Fine Fescue and Kentucky Bluegrass.....52

Introduction.....53

Materials and Methods.....53
Resting Habitat Preference.....54
Feeding Preference Tests.....54

Results.....57

Discussion.....57

Literature Cited.....59

SUMMARY.....60

APPENDIX 1. Record of Deposition of Voucher Specimens.....62

APPENDIX 1.1 Voucher Specimen Data.....63

LIST OF TABLES

Table 1. Correlation coefficients of lawn parameters in 1986.Probability of r is reported in parentheses. For chinch bug abundance, n=28, for all other variables, n=34 18

Table 2. Correlation coefficients of lawn parameters in 1987. Probability of r is reported in parentheses. For chinch bug abundance, n=22, for all other variables, n=27 19

Table 3. Correlation coefficients of lawn parameters in 1988. Probability of r is reported in parentheses. For chinch bug abundance, n=14, for all other variables n=66 20

Table 4. Coefficients of linear discriminant function. Values of variables are multiplied by the appropriate coefficient and then added to the constant. The calculation giving the larger number is the predicted habitat type of the lawn in question, either chinch bug habitat (INF) or not chinch bug habitat (NON) 23

Table 5. Computer classifications of infested (INF) and non-infested (NON) lawns using percent Kentucky bluegrass and thatch thickness variables. Data from 1986 were used to calculate the initial discriminant function. Data from 1987 and 1988 are independent tests of the function. Underlined values are percent correct classification for each group 24

Table 6. Mean number of chinch bugs observed in thatched and dethatched turfgrass plots. Variance is reported in parentheses 43

LIST OF FIGURES

Figure 1. Average proportion of chinch bug infested (inf) and non-infested (non) lawns composed of Kentucky bluegrass, fine fescue, and other plants..... 21

Figure 2. Plot of thatch thickness and species composition data from 1986 showing relative relationship to discriminant function line. Points falling below the line are classified by the function as chinch bug habitats (INF). Those above the line are classified as non-chinch bug habitats (NON). Sixty-three percent of the non-infested lawns are correctly classified (i.e. fall above the line) as are 78% of the infested lawns (i.e. fall below the line)..... 25

Figure 3. Plot of thatch thickness and species composition data from 1987 showing relative relationship to discriminant function line. Points falling below the line are classified by the function as chinch bug habitats (INF). Those above the line are classified as non-chinch bug habitats (NON). Seventy-five percent of the non-infested lawns are correctly classified (i.e. fall above the line) as are 81% of the infested lawns (i.e. fall below the line)..... 26

Figure 4. Plot of thatch thickness and species compostion data from 1988 showing relative relationship to discriminant function line. Points falling below the line are classified by the function as chinch bug habitats (INF). Those above the line are classified as non-chinch bug habitats (NON). Seventy -one percent of the non-infested lawns are correctly classified (i.e. fall above the line) as are 64% of the infested lawns (i.e. fall below the line)..... 27

Figure 5. Cumulative number of chinch bugs in control and mancozeb treated plots in 1986. Data are sums of average number of bugs observed in 3720 cm^2 in each of 4 plots. Slopes of lines are significantly different (control: m=.0665, mancozeb: m=.137, t=2.51, df=10 .02<P<.05)..... 39

Figure 6. Cumulative number of chinch bugs in control and dithane treated plots in 1987. Data are sums of average number of bugs observed in 6 transects in each of 7 plots. Slopes of lines are significantly different (Control:m=.094, mancozeb:m=.186, t=7.40, df=26, P<<.001). Vertical bars represent peak density of instar groups, determined as the 50% point in the cumulative instar group count. N_{1+2} means the group of nymphal instars 1 and 2, etc. and A stands for adult.....40

Figure 7. Number of chinch bugs surviving one week confinement with different numbers of big-eyed bugs (BEB), first experiment. Due to mortality of BEB during the experiment, BEB numbers are reported as the average live BEB. Slopes and intercepts of lines are not significantly different (slope of non-thatch treatment =1.41, thatch treatment=1.56, t=1.195, P>.05; for test of intercepts, t=0.322, P>.05.....44

Figure 8. Number of chinch bugs surviving one week confinement with different numbers of big-eyed bugs (BEB), second experiment. Due to mortality of BEB during the experiment, BEB numbers are reported as the average live BEB. Slopes and intercepts are not significantly different.....45

Figure 9. Choice chamber used in feeding preference test. The chamber consisted of a modified 90 mm plastic Petri dish. One fine fescue and one Kentucky bluegrass plant were held upright in moist white silica sand.....56

GENERAL INTRODUCTION

The chinch bug, Blissus leucopterus Montandon (Hemiptera:Lygaeidae), is a native North American insect that has become a major pest of turfgrass. In 1985, Michigan lawn care companies reported it to be the number one turfgrass pest (D. R. Smitley, pers. comm.). Although insecticides provide the major means of control (Niemczyk, 1984), cultural management may be more practical and desirable for urban turf. Reduction of pesticide input may not only reduce human health hazards, but also ameliorate stressed predator or pathogen populations, thus allowing natural enemies to play a role in control of the chinch bug (Knipling, 1979; Tashiro, 1987). Moreover, changes in cultural practices may present a long term solution to outbreaks rather than short term control (Knipling, 1979). A better understanding of the factors that regulate population growth and decline of an insect is the first step in the development of an effective cultural control (Knipling, 1979).

LITERATURE REVIEW

Four species of the genus Blissus are known in North America: leucopterus, insularis, arenarius, and maritimus (Leonard, 1966), but only B. leucopterus and B. insularis are considered economically important. Two subspecies of B. leucopterus, B. l. hirtus and B. l. leucopterus, differ slightly

in morphology, geographic distribution, host preference, and habitat preference, but readily interbreed. It is fruitless to assign a subspecies name where the ranges of the two overlap (Leonard, 1966). Blissus leucopterus hirtus, or the "hairy" chinch bug, typically feeds on northern cool season turfgrasses, whereas B. l. leucopterus generally feeds on grains, such as wheat, corn and sorghum. The range of B. l. hirtus spans a triangle from Minnesota, to Virginia, to Maine. Blissus leucopterus leucopterus has a distribution south of B. l. hirtus, and west to Nebraska, Kansas, Oklahoma, and Texas, although the two have a large area of overlap in Michigan. The southernmost portion of the United States is inhabited by B. insularis, a pest of the warm-season turfgrasses (Leonard, 1966).

The first record of damage by the chinch bug in North America dates to 1783 in North Carolina, when the insect nearly destroyed the wheat crop there (Fitch, 1856). The species Blissus leucopterus was first described in North America by Say in 1831 from a specimen collected on the coast of Virginia. The insect was established as a pest of grains in the Midwest, however widespread damage did not occur until 1864 when grain losses in Illinois were estimated at 73 million dollars (Leonard, 1966). Blissus leucopterus hirtus was first described as a species, B. hirtus, by Montandon (1893) and later given subspecies status by Leonard (1966). Heavy infestations of B. l. hirtus in lawns and golf courses was first reported on Long Island, New York, in 1932 (Maxwell and MacLeod, 1936).

The chinch bug overwinters as an adult, usually in tufts of grass or under plant debris, and often around the foundations of buildings (Leonard, 1966). Diapause is apparently photoperiod induced, with short day length inhibiting mating and feeding behavior (Smith et al., 1981). The bugs become active in the spring when temperatures rise above 7°C (Liu and McEwen, 1979). Eggs

are laid in April or May, depending on the latitude. The species is bivoltine in Ohio (Martin, 1976) but may be univoltine in some northern areas (Niemczyk, 1984).

There is some confusion over the base temperature for development of the insect. Liu and McEwen (1979) calculated the base temperature for development to be 7°C. They dissected females kept at various temperatures and determined the minimum temperature for egg development in the ovaries. Mailloux and Streu (1981) determined the base temperature to be 14.6°C. They determined this from observation of development of eggs kept at different temperatures. None of the authors observed the effect of temperature on the development of immature stages. Seven degrees centigrade is taken to be the activity threshhold by most authors (Kennedy,1981; Tashiro, 1987). In this dissertation, 14.6°C is the base temperature used in degree day calculations for development. Approximately 122 degree-days (base 14.6°C) is the minimum for completion of egg development (Mailloux and Streu, 1981).

The insect passes through five nymphal stages (Mailloux and Streu, 1981) and it is these stages that cause the most lawn damage (Duble and Niemczyk, 1979). The early instars are bright red with a white stripe across the abdomen. The later instars become progressively darker, with the fifth instar being a dark brownish black. Development of wing pads increasingly obscures the white stripe in later instars. A taxonomic key that uses head width to distinguish among the nymphal instars appears in Mailloux and Streu (1981). The adult chinch bug is approximately 4.5 mm long, with a black body and yellow legs; the hemelytra are milky-white. In B. l. leucopterus, the setae covering the head are silver-gray , whereas they are straw-yellow in B. l. hirtus (Leonard,1968).

The first instar was found to reach peak population size at 176 degree days and the second instar at 236 degree days(base 14.6°C, Mailloux and Streu, 1981). The number of third and fourth instars, lumped together owing to difficulty in differentiating between them in the field, was found to peak at 334 degree days. Fifth instars peaked at 501 and adults at 637 degree days (Mailloux and Streu, 1981).

The chinch bug feeds by inserting its proboscis into the vascular tissue of a plant and sucking out the sap. The saliva may be toxic to the plant. Feeding damage clogs the plant's conductive tissues, preventing water and nutrients from reaching leaves and new shoots. Prolonged feeding may eventually kill the plant. The damage usually appears as scattered patches in open sunny areas of the lawn which become yellow and brown as the turf dies (Martin, 1976).

Most of the cool season turfgrasses are fed upon by the hairy chinch bug, including the two most common, fine fescue (Festuca rubra) and Kentucky bluegrass (Poa pratensis)(Leonard, 1966, Tashiro, 1987). Other cool-season grasses that serve as hosts are perennial ryegrass (Lolium perenne) and bentgrasses (Agrostis sp.)(Baker et al., 1981a). Leonard (1966) states that bentgrasses are preferred, but gives no empirical evidence. Some feeding preferences for cultivars within grass species are known (Ratcliffe, 1982), but between species preferences are not. Crabgrass (Digitaria sp.) is usually avoided, and is often left undamaged in an otherwise decimated lawn (Leonard, 1966). Significant differences in tolerance to feeding exist among Kentucky bluegrass cultivars (Baker et al., 1981b). Ahmad et al. (1984) report that Kentucky bluegrass does not serve as a host for B. l. leucopterus in Nebraska; this is consistent with its status as a pest of grain crops, not of turfgrass.

It is not clear why chinch bug outbreaks do not occur in all lawns. Four groups of variables which may be important in regulating chinch bug population density are discussed in the literature. These are 1) grass species, 2) lawn health, 3) cultural practices, and 4) natural enemies.

The species of grass present may be an important factor in whether or not a lawn becomes infested. Non-native grass species in Kansas (such as the cool-season turfgrasses) have been shown to be more susceptible to chinch bug attack than indigenous species (Hayes and Johnson, 1925). Differences in tolerance of cultivars of turfgrasses to chinch bug feeding have been identified and may explain discrepancies in host range descriptions (Ratcliffe, 1982). Antibiosis has been shown in some cultivars of Kentucky bluegrass (Ahmad et al., 1984). Ramoska and Todd (1985) demonstrated a reduced infectivity rate by the insect pathogenic fungus Beauveria bassiana when B. l. leucopterus was fed on corn or sorghum, as compared to bugs fed on barley, wheat, artificial diet, or water alone. Efficacy of pathogens may also differ for B. l. hirtus depending on host plant.

The health of the lawn may play a role in chinch bug attack. The chinch bug is commonly described as a dry weather insect, being most often reported in abundance in hot dry years (Flint et al., 1935; Mailloux and Streu, 1981; Schread, 1970). Guthrie and Decker (1954) found that dry weather favors longevity if food is available. The greatest injury to turf occurs during July and August, when it is drought stressed (Duble and Niemczyk, 1979). However, it is not clear from the literature whether drought-stressed lawns are attractive to the chinch bug, conducive to population growth, or whether damage is simply more apparent on these lawns.

Turf cultural practices may influence the susceptibility of a lawn to chinch bug damage. One way this is possible is through pesticide-induced

suppression of natural enemies. Hairy chinch bug populations were shown to increase following several years of treatment with chlordane (Streu and Cruz, 1972; Streu and Vasvary, 1966). The southern chinch bug, Blissus insularis, is known to be resistant to organophosphate pesticides in Florida (Reinert and Portier, 1983). An increase in B. l. hirtus numbers in chlordane treated plots was more likely to have been caused by reduced chinch bug predator pressure, as chinch bug population increases were correlated with reductions in predaceous mite species (Streu, 1973), but a direct cause and effect was not established. In general, insecticide applications have been shown to greatly reduce predaceous arthropod populations in turf (Cockfield and Potter, 1983). Fungicides have also been shown to eliminate naturally occurring insect pathogenic fungi on potatoes (Loria et al., 1983); they may have similar impact in turfgrass.

Various components in fertilizer used in turf culture may also influence susceptibility of a lawn to damage. Sorghum resistance to chinch bug attack was substantially reduced by treatment with sodium nitrate but its resistance was significantly increased by treatment with phosphate (Dahms and Fenton, 1940).

Several biotic factors have been determined to be important in chinch bug population regulation. Five egg mortality factors have been identified, which result in a 48% reduction in population size The five factors are: 1) Eumicrosoma beneficum Gahan, a hymenopteran parasite (Scelionidae), 2) Amara sp. (Carabidae) which preys on eggs, 3) desiccation, 4) an undescribed fungal disease, and 5) failure to hatch due to unknown causes (Mailloux and Streu, 1981).

Factors causing mortality of nymphs and adults are not as well defined. Wet thatch causes mortality of the first instars during eclosion (Mailloux and

Streu, 1981). Although chinch bug predators were shown by Mailloux and Streu (1981) not to have an important effect, other authors (Cruz, 1972; Niemczyk, 1984) have identified the big-eyed bug, Geocoris bullatus, as an important predator. At present no empirical evidence has been published. Leonard (1966) points out that it is not known whether the big-eyed bug actually preys on the chinch bug or whether they simply have similar habitat preferences. Parasitoids have never been observed to emerge from nymphs or adults (Mailloux and Streu, 1981).

The fungal pathogen Beauveria bassiana is a significant mortality factor, reducing generation sizes by about 17% (Mailloux and Streu, 1981). Ramoska (1984) found conidia to be invasive and pathogenic at all relative humidities tested, although production of conidia only occurred in chinch bugs incubated at 75% relative humidity or higher.

Winter mortality ranges between 28 and 68% in Metuchen New Jersey, depending on the severity of the winter (Mailloux and Streu, 1981). Leonard (1966) reports a winter mortality of 34% in Mansfield, Connecticut. Decker and Andre (1936) showed that the ability of chinch bugs from Iowa to withstand freezing temperatures is relatively low. Minimum temperatures recorded in the northern half of the United States should be sufficient to cause 100% mortality. They suggest that the insulation provided by dead grass, leaves, and snow cover is essential to the over-wintering survival of the chinch bug.

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