OBSERVATIONS ON THE LIFE CYCLE OF *DALBULUS MAIDIS* ON THREE PLANT SPECIES[1]

H. N. PITRE[2]

Department of Entomology, Mississippi State University,
State College 39762

ABSTRACT

Dalbulus maidis (Delong and Wolcott) preferred corn to gamagrass or Johnsongrass for adult survival and oviposition. Incubation periods for eggs in these plants were approximately the same. Developmental period from eclosion to adult was shorter on corn than on gamagrass, whereas nymphs did not survive on Johnsongrass. Leafhoppers reared on corn weighed .0003 mg (average per insect) more than leafhoppers reared on gamagrass.

The corn leafhopper, *Dalbulus maidis* (Delong and Wolcott), was reported by Kunkel (1946) to be a vector of the corn stunt virus[3]. This leafhopper is generally considered to be a subtropical species and has been collected in the United States from California east to the Atlantic, but no farther north than Missouri or North Carolina.

D. maidis has received much attention during the past few years in connection with the corn stunt disease problem of recent origin in the Southeastern United States (Stoner 1965). This leafhopper, one of 4 known vectors of the corn stunt disease agent, occurs in some areas of epidemic infection (Douglas et al. 1966). However, studies on the biology and occurrence of *D. maidis* in Mississippi and surrounding states revealed that this leafhopper is of little significance in the incidence of corn stunt infection in the southeastern United States (Pitre et al. 1967). It has not been collected in Mississippi and other Southeastern States until late summer, but the disease is prevalent earlier in the season. Adults apparently migrate into the area late in the summer and are unable to survive the winter, at least in the northern part of Mississippi.

Kunkel (1948) reported that both the corn stunt virus and *D. maidis* seemed highly specific for corn, *Zea mays* L., and toesinte, *Eucheaena mexicana* Schrad. However, a gamagrass, *Tripsacum dactyloides* (L.) L, was recently reported to be the third plant species to serve as a host for *D. maidis* (Pitre et al. 1966).

Johnsongrass, *Sorghum halepense* (L.), has been the subject of much speculation as to its role in the epidemiology of corn virus diseases, particularly corn stunt. This perennial grass is a common overwintering host for several mosaic viruses of corn and serves as a source of spring inoculum, but evidence that this species is not susceptible to the corn stunt disease agent was recently obtained (Pitre, unpublished results). The apparent unsuitability of Johnsongrass to be a breeding host for *D.*

---

[1]Publication No. 1815, Mississippi Agricultural Experiment Station.

[2]Associate Professor

[3]Evidence has been presented recently suggesting that the causal agent of corn stunt, transmitted by leafhoppers, is a mycoplasma-like organism. Until there is additional information concerning this etiological agent, I will refer to the causal organism as "virus".

maidis has also been reported (Pitre 1967). In the present study the life cycle of *D. maidis* on Johnsongrass and its potential as a breeding host for this leafhopper vector were examined.

Comparative data on some phases of the life cycle of *D. maidis* on 2 known host plants, corn and gamagrass, and 1 potential host plant, Johnsongrass will be presented.

Methods and Materials

Corn (Pioneer 309B hybrid) and Johnsongrass plants used in these studies were grown from seed, whereas gamagrass plants were grown from rootstocks collected at State College, Miss. All plants were grown in clay pots in the greenhouse and transferred to the laboratory for testing. Generally, plants were about 1 month old at initiation of the various studies.

Most *D. maidis* used in these studies were reared in an airconditioned insectary on Pioneer 309B dent corn. Nymphs or adults were removed as needed from the culture cages with a glass tube (mouth suction) aspirator and transferred to confinement cages attached to test plants.

The small cages used to confine the test leafhoppers on the plants were 1½" square clear plastic boxes[4], fitted with a hinged-lid and a snap-type fastener, with openings cut into the sides of the box and covered with nylon screen. An additional small hole with a tight fitting cotton plug served as an insect introduction hole. A strip of foam rubber 1/8 inch thick was glued around the edges of the box top and lid so that when a leaf blade was inserted into the box and the lid closed the leaf tissue was not injured and leafhoppers were unable to escape. The cages were held in place by attaching them with rubber bands to wood stakes implanted in the soil in which the plants were growing.

The laboratory temperature varied from 72 to 88°F (avg 84°F) and the RH from 28 to 46% (avg 39%). Gro-Lux fluorescent lamps mounted 2 ft above each table top provided constant light.

Results

D. maidis approximately 2-3 weeks old, individually confined for 4 days in clip-on cages, laid an average of 66 (9♀), 2.4 (15♀) and 1.2 (32♀) eggs per female in the leaves of corn, gamagrass and Johnsongrass, respectively. These data were determined by leaf dissection and egg chorion counts recorded 9 days after the leafhoppers were removed from the plants. All 9 females confined on corn laid eggs (range 40-82 eggs), whereas, only 5 of 32 females oviposited in Johnsongrass (range 2-24 eggs), and 4 of 15 females in gamagrass (range 3-13 eggs).

The average incubation period for eggs in Johnsongrass, corn, and gamagrass was 8.5 (2 eggs), 9.0 (25 eggs) and 9.3 (38 eggs) days, respectively.

The clip-on cages were allowed to remain on the leaves over the oviposition sites to restrict movement of nymphs and to allow visual observations of activity within the cages. Observations of nymphal emergence

[4]Althern Products, 2301 Benson Avenue, Brooklyn 14, New York

over the above 9-day period plus egg deposition data (chorion counts) indicate that 74, 31, and 28%, respectively, of the eggs laid in corn, Johnsongrass, and gamagrass, hatched.

First instar nymphs were individually isolated and allowed to develop to adults within the clip-on cages attached to leaves of the plant species (corn or gamagrass) on which they hatched. Since egg hatch was so low on Johnsongrass and the nymphal population almost negligible, first instar nymphs, hatched on corn, were transferred to and confined on the leaves of this plant species. Observations over the next few days revealed that of 20 insects confined on Johnsongrass, all died before reaching the second instar.

Eighteen females and 18 males required an average of 12.2 and 12.1 days, respectively, to complete development on corn from egg hatch to the adult stage. Developmental times for nymphs ranged from 11 to 16 days. Development of nymphs through this same period on gamagrass averaged 15.4 days for 14 females and 15.3 days for 21 males.

Survival of nymphs from egg hatch to the adult stage on corn, gamagrass, and Johnsongrass was 74%, 53% and 0%, respectively.

To compare weight differences of insects which had developed on corn and gamagrass, newly formed adults were removed from the clip-on cages, sexed, and weighed on a Mettler, Type H 15 balance. The average weights of 29 females and 28 males reared on corn, was 0.0012 mg and 0.0010 mg, respectively. When reared on gamagrass, both sexes, 39 females and 26 males, had an average weight of 0.0008 mg.

Sixteen leafhoppers, 9 females and 7 males, were confined on corn for various intervals and survival was recorded. One female died 7 days after confinement and another in 12 days, and 7 leafhoppers were alive when the observations were terminated after 48 days. Three males died after 11, 18, and 29 days of confinement; 4 test males were alive when observations were terminated either 48 or 51 days later.

On gamagrass 19 females and 26 males lived an average of 33 (range 5-104 days) and 11.6 (range 2-44 days) days, respectively. Two males were alive 63 days after confinement when observations on male survival were terminated; therefore, the data on these insects were not included in the averages on male survival. However, these data do show that males can survive on *T. dactyloides* for more than 3 months.

Little data were obtained to provide sufficient evidence of the ability of adult *D. maidis* to maintain itself on Johnsongrass. In one instance, 20 females were confined on this species and after 24 hr. 80% mortality was recorded. All test insects had died after 96 hr.

Discussion:

Results on the survival of *D. maidis* on corn are in agreement with data presented by Barnes (1954), Davis (1966), and Combs (1967) that this plant species is a good host for this leafhopper. In the present study most males and females survived confinement on corn for 48-51 days. Barnes (1954) reported the average life span of females in the field in Central Mexico to be 44 days, whereas, Davis (1966) found that adults lived from 26-51 days at 70°F. and 60% RH. A longer average life span of 61 days for adult *D. maidis* was reported by Granados et al. (1968),

who also reported that some females lived more than 4 months at 24 ± 2°C. Combs (1967) found that in a growth cabinet with the temperature ranging from 52°-60°F., 2 females lived 139 days; however, the average longevity was 40.7 days.

My data on the longevity of *D. maidis* on *T. dactyloides* indicate that this leafhopper can not survive as well on this host as it can on corn. Data are also presented on the unsuitability of Johnsongrass for *D. maidis* survival. However, previous data from this laboratory (Pitre 1967) showed that approximately 33% of the adults of this species survived a 30-day confinement on Johnsongrass. In this same test all *D. maidis* survived when caged on corn for the same period in the greenhouse.

Corn appears to be greatly preferred over gamagrass or Johnsongrass for egg laying. Fifty-six and 28 times more eggs were laid per female in corn than in Johnsongrass or gamagrass, respectively. All females tested on corn laid eggs, whereas only a small percentage of the test females oviposited in either gamagrass or Johnsongrass. These data obviously demonstrate the reluctance of *D. maidis* to utilize either gamagrass or Johnsongrass as oviposition hosts.

The data reported from this study on egg laying by *D. maidis* in corn (4-day average of 66 eggs per female) is low compared with oviposition data reported by others, but it does show the high suitability of corn for egg laying by this leafhopper. Barnes (1954), Combs (1967), and Davis (1966), respectively, reported average number of eggs laid in corn by *D. maidis* during the life span to be 131.9, 196.5 and 151 eggs per female.

The average incubation periods of eggs in all 3 plants tested at 84°F were approximately the same, 8.5 days in Johnsongrass, 9.0 days in corn, and 9.3 days in gamagrass. Kunkel (1948) reported a longer incubation period of 11 days at lower temperatures (72-75°F).

Data on egg hatch further demonstrated the ability of *D. maidis* to survive on corn compared to gamagrass or Johnsongrass. Forty-six and 43% fewer eggs hatched on gamagrass and Johnsongrass, respectively, than on corn.

Development of nymphs from egg hatch to adult on corn required approximately 3 days longer on gamagrass than on corn. About 20% more nymphs survived on corn than on gamagrass. Thus, it would appear that some factors make corn a better host plant for development of *D. maidis* than gamagrass. Adult leafhopper weights 24 hr after the last nymphal molt suggest that this factor may be nutritional. Insects reared on corn weighed an average of 0.0003 mg more than insects reared on gamagrass.

Although many eggs laid in Johnsongrass were observed to hatch, the nymphs did not complete development through the first instar. Thus, from this and similar data presented by Pitre (1967), I would conclude that Johnsongrass is not a breeding host of *D. maidis*.

Literature Cited

Barnes, D. 1954. Biologia, ecologia y destribucion de las chicharritas, *Dalbulus elimatus* (Ball) y *Dalbulus maidis* (Del. and W.). Folleto Technico Nol 11 of the Secritatia de Agricultura y Ganaderia officina de Estudios Especiales, Mexico, D. F. 112 p.

Combs, R. L. 1967. Biological studies of *Dalbulus maidis* (Del. and W.)

a leafhopper vector of corn stunt virus in Mississippi. Ph.D. Dissertation. Miss. State Univ. 134 p.

Davis, R. 1966. Biology of the leafhopper *Dalbulus maidis* at selected temperatures. J. Econ. Entomol. 59: 766.

Douglas, W. A., W. H. Whitcomb, L. W. Hepner, V. M. Kirk, and R. Davis. 1966. Some Cicadellidae (Homoptera) collected from corn in the Southeastern United States. Ann. Entomol. Soc. Amer. 59: 393-6.

Granados, R. R., Johanna S. Granados, K. Maramorosh, and Josh Reinitz. 1968. Corn stunt virus: transmission by three Eichclellid vectors. J. Econ. Entomol. 61: 1282-87.

Kunkel, L. O. 1946. Leafhopper transmission of corn stunt. Proc. Nat. Acad. Sci. 32: 246-7.

Kunkel, L. O. 1948. Studies on a new corn virus disease. Archiv. fur. die Gesamte Virusforschung. 4: 24-46.

Pitre, H. N. 1967. Greenhouse studies of the host range of *Dalbulus maidis* a vector of the corn stunt virus. J. Econ. Entomol. 60: 417-21.

Pitre, H. N. 1966. Gamagrass, *Tripsacum dactyloides*: a new host of *Dalbulus maidis*, vector of corn stunt virus. Plant Dis. Reporter 50(8): 570-71.

Pitre, H. N., Jr., W. A. Douglas, R. L. Combs, Jr., and L. W. Hepner. 1967. Annual movement of *Dalbulus maidis* into the Southeastern United States and its role as vector of the corn stunt virus. J. Econ. Entomol. 60: 616-17.

Stoner, W. N. 1965. A review of corn stunt disease (Achoparramiento) and its insect vectors, with resumes of other virus diseases of maize. USDA, ARS. 33-99: 1-35.