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The Effect of Varietal Resistance in Sugarcane on the Biology of Diatraeasaccharalis (F.).

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THE EFFECT OF VARIETAL RESISTANCE IN SUGARCANE ON THE BIOLOGY OF *Diatraea saccharalis* (F.)

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ABSTRACT

Studies on varietal resistance to the sugarcane borer, Diatraea saccharalis (F.) were conducted during 1965, 1966, and 1967 to (1) compare biologies and damage of sugarcane borer infestations on two varieties of sugarcane, N.Co. 310, a resistant variety, and C.P. 44-101, a susceptible variety; and (2) determine the insect resistance mechanism or mechanisms involved in N.Co. 310 resistance to borer attack.

In field plot experiments it was found that by harvest time, fewer joints were bored and less yield loss was attributed to sugarcane borer damage in variety N.Co. 310 than C.P. 44-101. When population counts were made throughout the growing season in field plot experiments, it was found that although total sugarcane borer populations were lower on N.Co. 310, seasonal population developmental patterns were quite similar on N.Co. 310 and C.P. 44-101.

Significantly more sugarcane borer tunnels were found in plants of variety C.P. 44-101 than in N.Co. 310. However, there was no significant difference between the two varieties in length of tunnels or number of vegetative buds ("eyes") damaged per stalk by sugarcane borer larvae.

In greenhouse, screen cage and field plot experiments,

no ovipositional preference between the varieties N.Co. 310 and C.P. 44-101 was exhibited by the sugarcane borer.

No significant differences were found in the weights of sugarcane borer larvae and pupae collected from field plots of varieties N.Co. 310 and C.P. 44-101.

When stools of varieties N.Co. 310 and C.P. 44-101 were artificially infested with sugarcane borer larvae and dissected at later periodic dates, there was an indication that the larval population on variety N.Co. 310 was adversely affected shortly after eclosion. Antibiosis appears to be the mechanism for resistance present in variety N.Co. 310 that affects young larvae of the first, second, and third instar.

INTRODUCTION

Varietal resistance has not been used to any appreciable extent by sugarcane growers as a method of controlling the sugarcane borer, *Diatraea saccharalis* (F.). This method of control has been neglected for the following reasons: (1) the highly effective insecticide control of the sugarcane borer; (2) lack of high levels of sugarcane borer resistance in agronomically acceptable varieties; and (3) lack of emphasis on selecting insect resistant varieties in variety breeding programs.

At present, insecticides are the major means employed by Louisiana growers for sugarcane borer control. Various chemicals have been used for sugarcane borer control in Louisiana since the early 1920's. The first extensive use of an effective insecticide in Louisiana began in 1958 when Long et al. (1958) recommended endrin for control of second and third generation infestations. By 1965 resistance to endrin in sugarcane borer populations had developed (Yadav et al., 1965) necessitating the use of other insecticides. Two organic phosphate insecticides (azinphosmethyl [guthion] and azodrin) are presently being used for sugarcane borer control (Hensley and Concienne, 1966). Thus, Louisiana growers have been able to successfully control sugarcane borer infestations with insecticides and have received an average return in profit of $4.00 for every dollar spent on this method of control (Hensley, 1965).

Lack of high levels of sugarcane borer resistance in commercial varieties is also evident. Damage to variety N.Co. 310, recognized as one of the more resistant to the sugarcane borer of all varieties presently grown in Louisiana, is perhaps no more than 20% lower than that found in C.P. 44-101, one of the more susceptible varieties. However, very few attempts have been made by plant breeders to emphasize the use of insect resistant parent varieties in breeding programs.

No commercial variety presently being grown in Louisiana is able to escape economically damaging sugarcane borer infestations during the crop season. However, the amount of insecticide necessary to control the sugarcane borer throughout the crop season differs greatly among varieties. One of the more susceptible varieties grown, C.P. 44-101, requires approximately three applications of insecticide per season for sugarcane borer control compared to less than two for N.Co. 310, a more resistant variety. Although this level of resistance to the sugarcane borer in N.Co. 310 is relatively low, this does not negate the potential for its use in a sound economic insect control program. In order to delay the development of insecticide resistance, to keep from adding to the already increasing environmental polution problem and to decrease the cost of an insecticide program during the crop season, other means of control incorporated in an integrated control program are desirable. Varietal resistance appears to offer excellent possibilities of being an additional effective method of control for use in an integrated control program.

The studies in this dissertation were undertaken with the following objectives in mind: (1) compare biologies and damage of sugarcane borer infestations on two varieties of sugarcane, N.Co. 310, a resistant variety, and C.P. 44-101, a susceptible variety; and (2) to determine the insect resistance mechanism or mechanisms involved in N.Co. 310 resistance to borer attack.

REVIEW OF THE LITERATURE

General Plant Resistance to Insects

Genetic manipulation of plant germ plasm is perhaps one of the oldest forms of biological control utilized by man in his competition for food with various pest species. As a consequence of the famine in Ireland in the middle of the 19th century, varieties of potatoes resistant to late blight were developed prior to 1900 (Weiss, 1966). Painter (1951) reported that plant resistance to insects was recorded as early as 1831, when an apple variety, Winter Majetin, was first reported to be resistant to the wooly aphid, *Eriosoma lanigerum* (Hausm). Another example of plant resistance to insects was recorded as early as 1860, with the discovery that American rootstocks of grapes were resistant to the grape phylloxera, *Phylloxera vitifoliae* (Fitch), while the European species, *Vitis vinifera* L., was very susceptible (Painter, 1951). One of the earliest recorded instances of development of varieties resistant to insects, however, occurred with the breeding of wheat varieties resistant to the Hessian fly, *Mayetiola destructor* (Say), in the early 1920's. This program is still in operation and has demonstrated a considerable reduction in Hessian fly populations in the wheat-growing areas of Kansas (Painter, 1966).

A relatively recent effort that was initiated in the early 1930's and is still directed towards host-plant resistance to an insect pest is the work on corn varieties resistant to the European corn borer (*Ostrinia nubilalis*) (Hubner). Brindley and Dicke (1963) summarized this work. One of the more significant findings resulting from European corn borer resistance work was the discovery of "resistant factor A" (6-methoxybenzoxazolinone) that exerted a deleterious effect on the feeding of first-instar larvae. Beck (1960) showed that this compound acts as a feeding deterrent and not as a simple repellent. This is the only example known in which a biochemical difference between varieties of a crop plant has been experimentally and satisfactorily associated with resistance to an insect (Painter, 1966).

Painter (1951), in his book, *Insect Resistance in Crop Plants*, gives an excellent review of the literature on resistance of plants to insects and discusses various concepts associated with this phenomenon. A review by Painter (1958) covers publications on plant resistance to insects between publication of his book in 1951 and May, 1957. A more recent review by Beck (1965) is "oriented exclusively toward the goal of an analysis of the mechanisms underlying resistance phenomena." This review is also valuable because it updates Painter's (1958) review.

Painter (1951) defines resistance of plants to insect attack as "the relative amount of heritable qualities possessed by the plant which influence the ultimate degree of damage done by the insect." He divides resistance, as seen in the field, into three bases or methanisms: preference (for oviposition, food, or shelter), antibiosis (adverse effect of plant on biology of the insect), and tolerance (repair, recovery, or ability to withstand infestation). Plant resistance may be the result of any one of these mechanisms but is usually the result of a combination of any two or all three mechanisms.

Beck (1965) defines plant resistance as "being the collective heritable characteristics by which a plant species, race, clone, or individual may reduce the probability of successful utilization of that plant as a host by an insect species, race, biotype, or individual." By this definition the resistance mechanism labeled "tolerance" by Painter (1951) is not considered and only the resistance mechanisms "nonpreference" and "antibiosis" can be considered. However, both these authors, Painter (1951) and Beck (1965), emphasize that such categories are arbitrary and vaguely delimited; and that not all aspects of the plant resistance problem can be adequately placed into one or another category.

I believe that the resistance mechanism labeled "tolerance" is, in fact, an important mechanism of plant resistance to insects. Therefore, the definition of plant resistance to insects and the concepts of plant resistant mechanisms set forth by Painter (1951) were utilized throughout this research program.

Sugarcane Resistance to the Sugarcane Borer, *Diatraea saccharalis* (F.)

In reviewing the literature it was found that differences in responses of sugarcane varieties to sugarcane borer attack had been quite well documented since the early part of the 20th century. Also, much speculation is presented on the resistance mechanisms involved, but a general lack of experimental data confirming these speculations was evident.

In an early publication, Rosenfield and Barber (1914) reported that in Argentina a difference in response of some sugarcane varieties to the sugarcane borer was observed. Also, the degree of development of the fiber and hardness of the rind were causes of resistance of some of the sugarcane varieties to the borer.

On a visit to Puerto Rico, Box (1923), reported that he noticed sugarcane borers attacking one variety of sugarcane less than others and a general difference in the severity of infestations among varieties.

Holloway and Haley (1927) investigated the extent of damage by the sugarcane borer in Louisiana to some new seedlings from Java, comparing them with some of the old established varieties in that country and with Louisiana Purple. They concluded that the new varieties were not resistant and appeared to be rather attractive to the borer. Also, these new varieties stubbled more; therefore less cane was replanted, thus lowering the incidence of replanting infested cane. These were off-setting phenomena.

Bored joint counts were used to compare varieties in British Guiana (Cleare, 1932). His results show a difference in damage caused by *D. saccharalis* and *D. canella* larvae among varieties and that such resistance is a heritable varietal characteristic. Later studies (Cleare, 1934) indicate that resistance of some of these varieties was due to high fiber content in stalks.

Tucker (1933) found an indirect ratio between the percent dry weight of plants in a variety and the degree of susceptibility to the sugarcane borer, *D. saccharalis*. He also found that there was no evidence of ovipositional preference between varieties. However, records were kept on position of egg masses oviposited in field plots from 1932 to 1933. From data on 2,912 egg masses examined, 67.2 percent were found on the upper leaf surface and 33.8 percent were found on the lower leaf surface. Of the egg masses located on the upper leaf surface, 20 percent were found on the midrib and 79.5 percent were found on the "green leaf surface." Of the egg masses located on the lower leaf surface, none were found on the midrib, 63.3 percent were found in creases between the midrib and the blade, and the rest were located on the "green leaf surface."

Later studies by Tucker (1936) showed that when six principal sugarcane varieties were tested, the percent internodes infested was in inverse proportion to the average number of cane shoots per stool. Also, the monthly average number of egg masses per eighty stools taken over a period of eight months were nearly three times as high in the variety with the lowest percentage of infested internodes as that for varieties with a much higher percentage of infested internodes. The variety with the lowest total number of egg masses was severely damaged and it was speculated that the larvae may have a high survival rate on this variety, perhaps because it was more easily penetrated by them. No significant differences in the number of eggs per cluster on the different varieties were found.

Holloway (1935) presented experimental evidence showing that preference existed as a basis for resistance in some Louisiana sugarcane varieties. Several varieties were tested and bored joint data were presented showing that in some varieties there were fewer joints bored than in others. He found a relationship between the hardness of the stalk and total infestations of D. saccharalis. Also, in those varieties he considered resistant, there were fewer egg masses found and fewer eggs per mass.

Of the sugarcane varieties tested, Holloway (1935) found Co. 290 to be the least susceptible to the sugarcane borer. Other workers (Ellisor and Jaynes, 1938 and Ingram and Ellisor, 1940) rated Louisiana sugarcane varieties for resistance to the sugarcane borer and reported that Co. 290 was the least damaged. This sugarcane variety was also found by Ingram et al. (1938) to tolerate damage caused by the sugarcane beetle, Euetheola rugiceps (LeConte) better than other commercial sugarcane varieties tested.

Agarwal (1959) reported that the sugarcane variety Co. 290 had shown high levels of resistance to D. saccharalis in Louisiana, Brazil and Queensland. However, D. saccharalis is not known to occur in Queensland.

Ingram and Bynum (1941) recommended that in Louisiana the resistant sugarcane variety Co. 290 should be planted and C.P. 29-116 and C.P. 29-103 should be avoided in areas with heavy infestations of D. saccharalis.

Mathes and Ingram (1944) rated Louisiana sugarcane varieties as susceptible or resistant to D. saccharalis attack according to bored joint counts. The variety Co. 290 was found to be the most resistant. However, these authors also reported that Co. 290 tolerance to D. saccharalis damage appeared to have decreased in recent years and that it had increased in susceptibility to the fungus disease, red rot, Physalospora tucumanensis Speg. (conidial stage, Colletotrichum falcatum Went.).

Mathes et al. (1939) made a study of plant characteristics possibly associated with borer injury and presented data with the following results: (1) the percent joints bored increased in a direct proportion to an increase in stalk diameter; (2) the percent joints bored was inversely proportional to plant height; (3) there was no relationship between percent joints bored and width of leaves; and (4) white and pink stalks were significantly less bored than green stalks.

Ingram and Bynum (1941) discussed results of laboratory tests comparing four *D. saccharalis* susceptible and six resistant sugarcane varieties with corn. They reported that the rate of survival, the proportion developing to pupae, the size and reproductive capacity of sugarcane borers reared on corn were much greater than those reared on any of the ten sugarcane varieties. Also, these figures averaged greater for borers reared on susceptible varieties than those reared on resistant varieties. However, no data or experimental techniques or designs were given for these laboratory experiments.

Mathes and Ingram (1942) reported no relationship between hardness of rind and resistance to *D. saccharalis* or between borer injury and color of the stalk, width of leaves or ease of stripping. However, they suggested that there is a relationship between the resistance or susceptibility of sugarcane varieties and infestations of *D. saccharalis* in surrounding fields. They recommended that Co. 290 should be planted in areas which normally have a heavy infestation in order to reduce borer damage.

Hayward (1943) presents a general discussion of *D. saccharalis* in Argentina. In his discussion he reported that "borers attack soft canes especially, but in their absence, or in heavy infestations, injury of almost the same intensity occurred in hard canes."

Mathes and Charpentier (1962) reported ways in which *D. saccharalis* resistance is operative in sugarcane varieties and described a number of varietal characters associated with this resistance. The main types of borer resistance that they reported to be found in sugarcane varieties were: (1) non-preference for oviposition, in general varieties having narrow leaves are the least attractive; (2) prevention of larval establishment, typical of this kind of resistance are varieties that shed their lower leaves and thus decrease much needed shelter for the young borers and varieties that have leaf sheaths that remain intact with little or no splitting, therefore, holding water and drowning many young larvae; (3) inhibition of borer development in the plant, high-fiber canes are generally less suited to borer development than low-fiber canes; and (4) plant tolerance, this form of resistance seems to be found mostly in varieties that are not susceptible to red rot, do not have brittle stalks or which produce suckers or "lalas" when injured by the borer. However, no supporting data were presented in this report.

Some other varietal characters that these authors reported as being known to be associated with borer resistance are: "(1) tall thin stalks with long internodes that are widest at the joint; (2) long erect leaves spaced far apart on the stalk; (3) leaf sheaths that fit very tightly around the collar; (4) stalks with a heavy coating of wax and very little sooty mold; (5) long leaf spindles; (6) light-colored rather than dark-green stalks; (7) stalks with hard rind; and (8) plants with high vigor. Resistance was not related to sucrose content of the cane." However, I want to point out here that "character" (3) is a morphological impossibility.

These workers rated some commercial sugarcane varieties with respect to borer resistance as follows: resistant, N.Co. 310; average, C.P. 36-105, C.P. 43-47, C.P. 47-193, and C.P. 52-68; susceptible, C.P. 44-101, C.P. 36-13, C.P. 44-155, and C.P. 48-103.

Mathes and Charpentier (1962) conducted a resistance test on three commercial varieties of sugarcane that made up about eighty percent of the total acreage of cane in Louisiana. The varieties tested were C.P. 36-105, C.P. 44-101, and N.Co. 310. This test was of a randomized-block design with nine replications of each of three levels of borer infestation for each of the three varieties. A high infestation level was produced by artificially infesting plants with borer eggs and applying hepachlor and sulphur presumably to reduce natural enemies of the borer. The low infestation level was produced by treating the plots with insecticide and the medium level was left untreated. Results showed that the variety C.P. 44-101 developed the highest infestation, followed closely by C.P. 36-105 and with N.Co. 310 in third place for both the high and medium levels of infestation.

Long et al. (1961) reported a new method for rating varietal susceptibility to the sugarcane borer, Diatraea saccharalis. Prior to this time, sugarcane varieties had been rated for their susceptibility to the sugarcane borer on the basis of the percentages of joints bored at harvest time. However, these authors believed that the actual crop loss associated with certain percentages of joints bored varies with the location of injury on the stalk, the maturity of the stalk at the time of attack, the variety of sugarcane being grown, and that equal percentages of joints bored may result in different amounts of yield loss among different varieties.

This new method to estimate varietal susceptibility was based entirely on relative yield increases resulting from sugarcane borer control.

A randomized block design was used with half the plots treated with insecticide to suppress borer populations and half the plots left untreated. At harvest time cane in all the plots was weighed and the varietal susceptibility ratings were based on ratios of yields from insecticide-treated to untreated plots divided by the corresponding ratio for C.P. 44-101, a variety used as a standard because it was currently the most widely grown variety in Louisiana at the time. They reported C.P. 36-105 and N.Co. 310 to be the least susceptible and C.P. 44-101, C.P. 48-103, and C.P. 47-193 to be the most susceptible to sugarcane borer damage of the ten varieties tested.

METHODS AND MATERIALS

Field Studies of Sugarcane Borer Infestations and Damage to Varieties N.Co. 310 and C.P. 44-101

Three experiments were conducted during 1965 and 1966 to compare naturally occurring sugarcane borer larval infestations and damage in the sugarcane varieties N.Co. 310 and C.P. 44-101.

Experiment I

Eleven plots of each variety were located on three plantations in St. James and Assumption parishes. Arrangements with growers were made so that these twenty-two plots would not receive insecticide treatments during the 1965 sugarcane growing season. Each plot of N.Co. 310 was selected as close as possible to its corresponding plot of C.P. 44-101 so that the experimental design would be in a paired plot arrangement. Each plot was four rows wide. Weekly samples consisting of ten stalks randomly selected from individual stools at two-pace intervals from the middle two rows of each plot were carefully examined for sugarcane borer larvae and pupae. Samples were taken from June 10 until September 1. Bored joint counts were made on 10 stalk samples taken in each plot on September 8. The total number of joints, those bored and the location of each bored joint on the stalk was recorded.

Experiment II

The second experiment was conducted during 1965 on the L.S.U. Hill Farm. A randomized block experimental design was employed with eight varieties of the first ratoon crop replicated eight times. Individual plots were three rows (18 feet) wide x 35 feet long or 1/70 of an acre in area. None of the plots received any insecticide treatment. Data on varietal resistance was taken only on N.Co. 310 and C.P. 44-101. Small larvae of the first-generation usually enter and feed on the apical meristem of young sugarcane plants causing the center shoots to die and turn brown. These dead central shoots are called "dead-hearts" and may be used as a measure of first-generation borer infestation. Dead-heart counts were made on May 30, June 9, and June 17, in all plots. All visible "dead-hearts" were removed by cutting the plants below the soil surface. Ten stalk samples were randomly selected from each plot of N.Co. 310 and C.P. 44-101 on June 23, July 1, and July 14. These stalks were dissected and the number and instar of sugarcane borer larvae found were recorded. At harvest time, 60 stalks from each plot were visually examined and the number of total joints, those bored and their position on the stalk recorded.

Experiment III

The third experiment was conducted in 1966 on the

L.S.U. Hill Farm. This experiment was designed in a checkerboard arrangement of paired plot comparisons of the two varieties with each replicated ten times. Each plot was eight rows wide and forty-eight feet long or 1/20 of an acre. "Dead heart" counts were made in all plots on May 31, June 7, and June 16. Weekly samples, consisting of ten stalks randomly selected from individual stools at one-pace intervals from the middle four rows of each plot were taken. These stalks were dissected and the number and instar of sugarcane borer larvae found were recorded. At harvest time, 50 stalks from each plot were visually examined and the number of total joints, those bored and their position on the stalk recorded.

Varietal Yield Responses to Sugarcane Borer Damage and Infestations

During 1965 an experiment was conducted to compare the effect of sugarcane borer infestation and damage on yield among different sugarcane varieties. The following varieties were included in the test: C.P. 44-101, C.P. 55-30, C.P. 52-68, N.Co. 310, C.P. 47-193, C.P. 36-105, C.P. 48-103, and C.P. 36-13. A randomized block design was employed with varieties replicated eight times. Individual plots were three rows (18 feet) wide x 35 feet long or 1/70 of an acre in area. One-half of the variety replications were treated throughout the season with insecticides for control of the sugarcane borer and the other half was left untreated. Azinphosmethyl (7%) granules were applied at a rate of .75 lbs. active ingredient per acre per application. Three applications were made at three-week intervals between applications from July 13 to September 8 for control of second- and third-generation borer infestations.

Sugarcane borer damage in treated and untreated plots was evaluated by determining the number, position, and percentage of joints bored in each of 25 stalks selected at random from each plot. Yields were estimated by handcutting and weighing all cane in each plot.

Comparison of Number and Length of Sugarcane Borer Tunnels in Varieties N.Co. 310 and C.P. 44-101

At harvest time during the 1966 crop season the number and length of sugarcane borer tunnels resulting from natural infestations in varieties C.P. 44-101 and N.Co. 310 were evaluated. Twenty-five stalks of each variety were randomly selected from one replication of a variety experiment that had not received any insecticide application for control of the sugarcane borer during that crop season. These stalks were dissected and the number of joints tunneled and length of tunnels recorded. Measurements of tunnel lengths were then grouped into categories of those less than 1/4 inch long and those more than 1/4 inch long.

Ovipositional Preference of the Sugarcane Borer for Varieties N.Co. 310 and C.P. 44-101

In 1966 and 1967 greenhouse, screen cage, and field plot experiments were conducted to determine if there was any ovipositional preference by the sugarcane borer moth for the varieties N.Co. 310 and C.P. 44-101.

Greenhouse Investigations

In 1967, "single-eye" seed pieces of the sugarcane varieties N.Co. 310 and C.P. 44-101 were planted in 10" x 11" clay pots and allowed to germinate in a greenhouse. Five pots of each variety were arranged in a completely randomized experimental design. When the plants had formed the first internode and were approximately ten inches high, seventy-five virgin female and one hundred and twenty-five male sugarcane borer moths were released within the greenhouse. The moths were released March 9, and five days later the plants were examined and the number and location of sugarcane borer egg masses on the plants were recorded.

Screen Cage Investigations

During the summer of 1966 two rows of the sugarcane varieties N.Co. 310 and C.P. 44-101 were planted on the L.S.U. Hill Farm. On one row the stools of the two varieties were planted in alternate arrangement in very close proximity to each other, so that the stalks became intermixed. Alternate stools of the two varieties were planted six inches apart on the second row so that plants from one variety were not in contact with those of the other variety.

A 15-mesh screen wire cage (14' x 8' x 5½') was placed over each row and fifty laboratory-reared virgin female moths plus seventy-five virgin males all less than thirty-six hours old were released in each cage. These moths were reared by utilizing procedures described by Hammond (1967). After approximately one week, the cages were removed and the number and location of egg masses on each plant was recorded.

Walk-in Screen Cage Investigations

During 1967, single-eye seed pieces of the sugarcane varieties N.Co. 310 and C.P. 44-101 were planted in 10" x 11" clay pots and allowed to germinate in the greenhouse. When all plants had at least one or two internodes formed above ground, the pots were moved to a large walk-in type screen cage (40' x 58'8" x 7'10") located on the L.S.U. Hill Farm. Fifteen pots of each variety were arranged in a paired comparison design. Approximately two hundred virgin male and female sugarcane borer moths were released in the screen cage on March 21. Seven days later the plants were examined and the number and location of egg masses on each plant was recorded.

Field Plot Investigations

Field plots of the two sugarcane varieties were arranged in a randomized block design replicated four times. Each plot was eight rows wide and forty-eight feet long. On

July 28, 1967, one hundred stalks of sugarcane were randomly selected from individual stools at two-pace intervals from the center four rows of each plot and carefully examined for sugarcane borer egg masses. These stalks were cut at the ground level and removed from the field so that the upper and lower leaf surfaces of each individual stalk could be examined closely. The number and location of egg masses on leaves of each plant was recorded.

On September 11, one hundred stalks of sugarcane were randomly selected from the two plots in replication one and fifty stalks from each of the two plots in replications two, three, and four. Numbers of stalks sampled in individual replications were reduced to 50 after examination of the first replication because the numbers of egg masses found was considered to be sufficient for numerical comparisons with larger stalk samples examined earlier in the season. The number and location of egg masses on each plant was recorded.

Developmental Potential of Sugarcane Borer Larvae in Varieties N.Co. 310 and C.P. 44-101

During 1967 two similar experiments were conducted to compare the developmental potential of sugarcane borer larvae in the varieties N.Co. 310 and C.P. 44-101. Stools of the two varieties were artificially infested with sugarcane borer larvae and at different time intervals after infestation, the plants were dissected and the numbers and instars of larvae recorded. A completely random design was used in both experiments.

Stools consisting of five to ten plants of each variety in the earlier experiment and one to four plants in the later experiment were isolated in a field in which the two sugarcane varieties were planted in replicated plots. No plant in a stool was in contact with a plant from another stool, thereby decreasing the possibility of larval migration from stool to stool. Two hundred and forty stools of each variety were artificially infested in the following manner. A sugarcane borer egg mass on waxed paper was pinned to the midrib of a plant in the center of every other stool. Each egg mass contained from five to thirty eggs. Egg masses were pinned on the plants April 24 and removed April 27. Prior to infesting stools, the number of eggs in each mass was counted in the laboratory and after removal of masses from stools, the number of eggs that had hatched were counted to determine the approximate number of larvae placed on each stool.

The stools in each variety were tagged and randomly selected for dissections at four predetermined times. Thirty artificially infested stools, each with a corresponding check stool, were dissected and the number and instar of sugarcane borer larvae found was recorded.

This experiment was repeated in a similar manner later in the sugarcane growing season using one hundred and sixty isolated stools in each variety with half of these being used for check stools. The isolated stools were arranged and treated in the same manner as the early season experiment but the size of the egg masses ranged from thirteen to seventy-eight eggs per mass. The egg masses were placed on the plants July 7, and removed July 10. Twenty artificially infested stools, each with a corresponding check stool, were dissected three, seven, fourteen, and forty-two days, respectively, after removal of egg masses. Each plant in each stool was carefully dissected and both the number and instar of sugarcane borer larvae found were recorded.

Comparative Weights of Field Collected Sugarcane Borer Larvae and Pupae From the Varieties N.Co. 310 and C.P. 44-101

In order to compare the weights of field collected sugarcane borer larvae and pupae from the varieties N.Co. 310 and C.P. 44-101, larvae and pupae were randomly collected from a first-year ratoon-crop of the two varieties from about the middle of July through August, 1967. This experiment was located on the L.S.U. Hill Farm and the design consisted of paired plot comparisons of the two varieties replicated ten times. The plots were eight rows (forty-eight feet) wide x forty-eight feet long.

The larvae collected were brought into the laboratory and width of head capsules was measured by means of an ocular micrometer in a dissecting microscope. The larvae were then grouped into the following categories according to the head capsule size: Group I, .40 m.m. or less; Group II, .41 m.m. to .60 m.m.; Group III, .61 m.m. to .90 m.m.; Group IV, .91 m.m. to 1.30 m.m.; Group V, 1.31 m.m. to 2 m.m.; Group VI 2.01 m.m. to 2.53 m.m.; and Group VII, 2.54 m.m. or larger. The larvae within each group were individually weighed on a Mettler electric balance. The groups into which the larvae were placed were based on work by Hensley (1960) who found that considerable overlap in head capsule size occurred between instars, especially in instars III, IV, and V.

The field collected pupae were brought into the laboratory, separated according to sex and weighed on a Mettler electric balance.

Statistical Analysis

The significance of difference among or between means was determined by simple analyses of variance in Tables IV, V, VI, VII, VIII and IX. Duncan's Multiple Range Test was used in the statistical analysis in Table III. Student's t-test method was used to determine the significance of difference between means in Tables I, II, X, and XI.

One abbreviation and two symbols are used without explanation in some tables of results. The abbreviation, ns, indicates that the difference between means was not significant at the 5 percent level. The single asterisk (*) and double asterisk (**) indicate significance at the 5 percent and 1 percent levels, respectively.

RESULTS

Sugarcane Borer Infestations and Damage in Varieties N.Co. 310 and C.P. 44-101

Data in Table I show the average percentage of joints bored by the sugarcane borer and the average numbers of borer larvae found per plot in varieties N.Co. 310 and C.P. 44-101 in field Experiments I, II, and III. There were significantly more joints bored and more sugarcane borer larvae found in the variety C.P. 44-101 in the second and third experiments. Although more larvae and a higher percentage of joints bored were recorded for variety 44-101 than for N.Co. 310 in Experiment I, these differences were not statistically significant.

The seasonal population development of sugarcane borer larvae in the two sugarcane varieties N.Co. 310 and C.P. 44-101 are illustrated graphically in Figures 1 and 2. These graphs indicate that the seasonal population developmental patterns of sugarcane borer larvae are similar in both varieties in Experiments I and III.

Figure 3 shows a histogram of the data from Experiment II. These data also show similar seasonal larval population patterns in both sugarcane varieties.

Table I. Average numbers of Diatraea saccharalis (F.) larvae and percent joints bored in the sugarcane varieties N.Co. 310 and C.P. 44-101,[a] 1965

Field Experiment	Variety	Larvae	Percent Joints Bored
I	N.Co. 310	23.18	10.05
		ns	ns
	C.P. 44-101	27.18	15.36
II	N.Co. 310	35.66	41.00
		*	**
	C.P. 44-101	53.00	69.19
III	N.Co. 310	42.37	47.38
		**	**
	C.P. 44-101	79.25	73.13

[a]Averages for experiment I are based on data shown in Appendix Tables 1 and 4, those for experiment II in Appendix Tables 2 and 6, and those for experiment III in Appendix Tables 3 and 5.

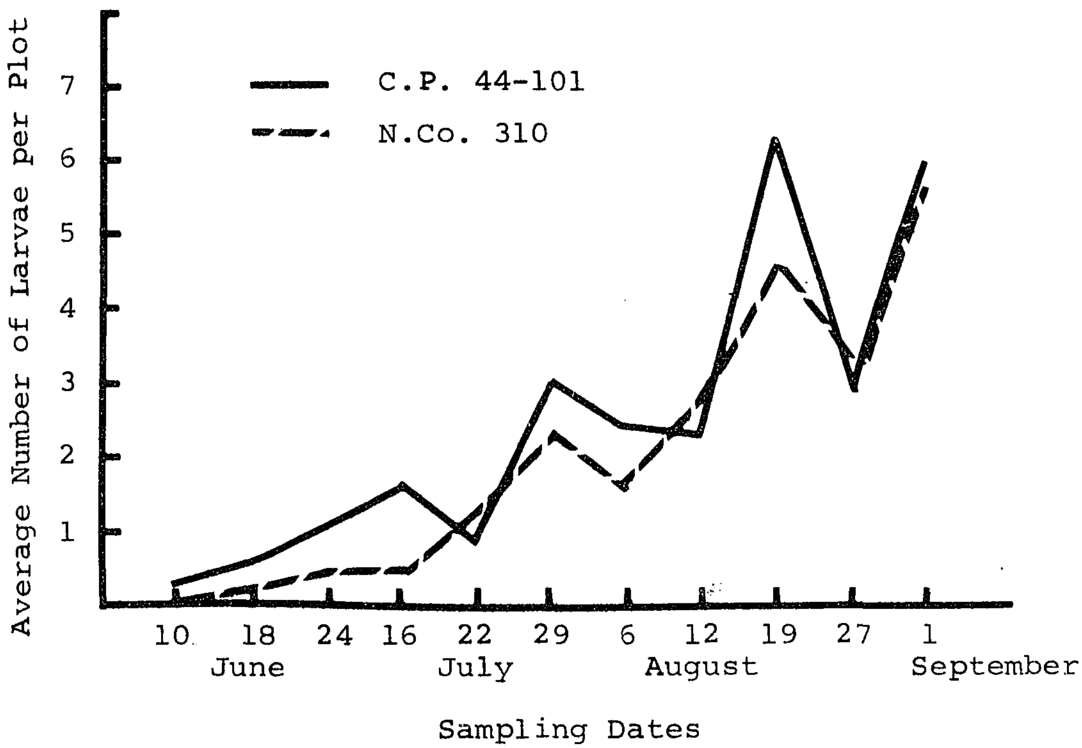

Figure 1. Average numbers of Diatraea saccharalis (F.) larvae collected from June to September, 1965 in 10-stalk samples from 11 plots each of the varieties N.Co. 310 and C.P. 44-101, South Louisiana[a]

[a]These data are illustrated in Appendix Table 4.

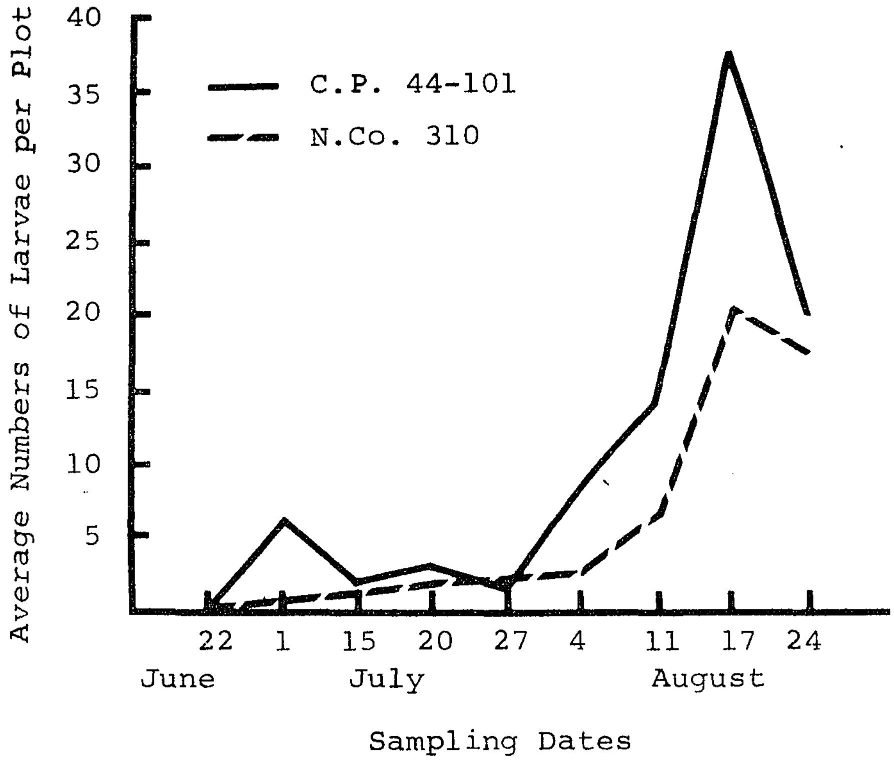

Figure 2. Average numbers of Diatraea saccharalis (F.) larvae collected from June to August, 1966 in 10-stalk samples from 10 plots each of varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana[a]

[a]These data are shown in Appendix Table 5.

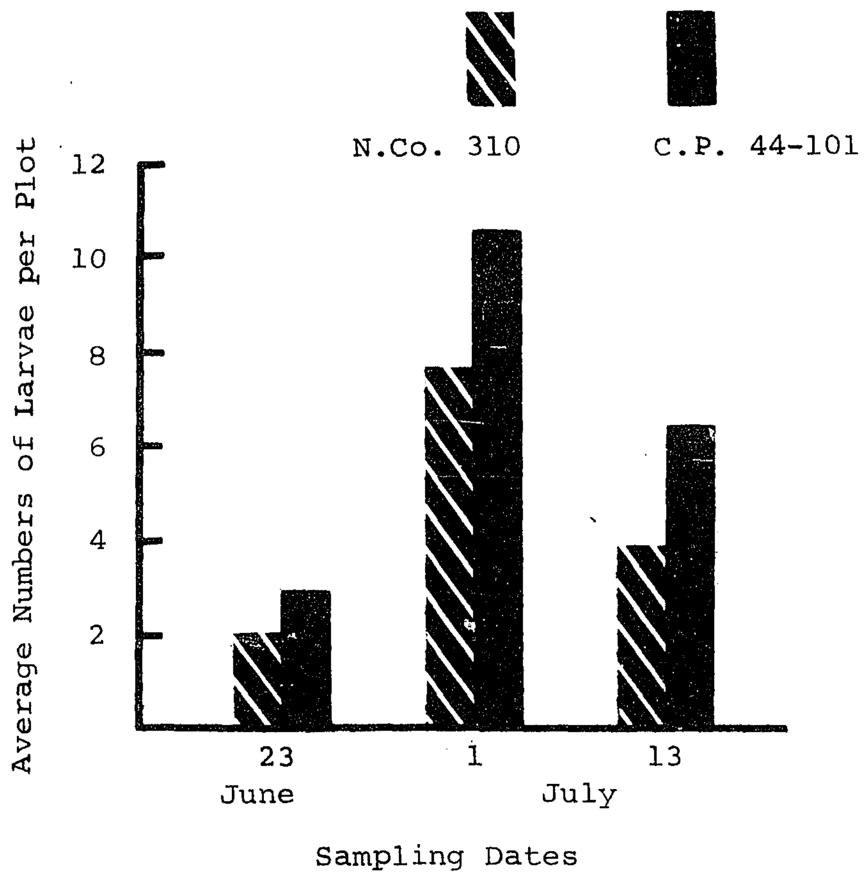

Figure 3. Average numbers of Diatraea saccharalis (F.) larvae collected in June and July, 1966 in 10-stalk samples from 8 plots each of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana[a]

[a]These data are shown in Appendix Table 6.

The percentages of individual joints bored by sugarcane borer larvae in the varieties N.Co. 310 and C.P. 44-101 are illustrated graphically in Figures 4, 5, and 6. Consistently more individual joints were bored in the variety C.P. 44-101 than in N.Co. 310, but seasonal damage patterns were quite similar in both varieties in all three field experiments (Figures 4, 5, and 6). These differences were statistically significant in the second and third experiments but not in the first experiment.

Data in Table II show the average number of "dead hearts" per plot in the varieties N.Co. 310 and C.P. 44-101. These data provide a comparative estimate of first-generation sugarcane borer larvae populations in the two sugarcane varieties. In Experiment II, a first-year ratoon-crop, there was significantly more dead-hearted plants in the sugarcane variety C.P. 44-101 than in N.Co. 310. In the third experiment, a plant cane crop, the numbers of dead hearts were too low to provide meaningful data.

Yield Responses to Sugarcane Borer Damage in Varieties N.Co. 310 and C.P. 44-101

Data presented in Table III show the percent control of sugarcane borer larvae with azinphosmethyl-treatments and percent yield loss caused by borer larvae in eight commercial sugarcane varieties. Percent control was based on the reduction of bored joints in treated plots compared to those in untreated plots. The percent yield loss was based on the

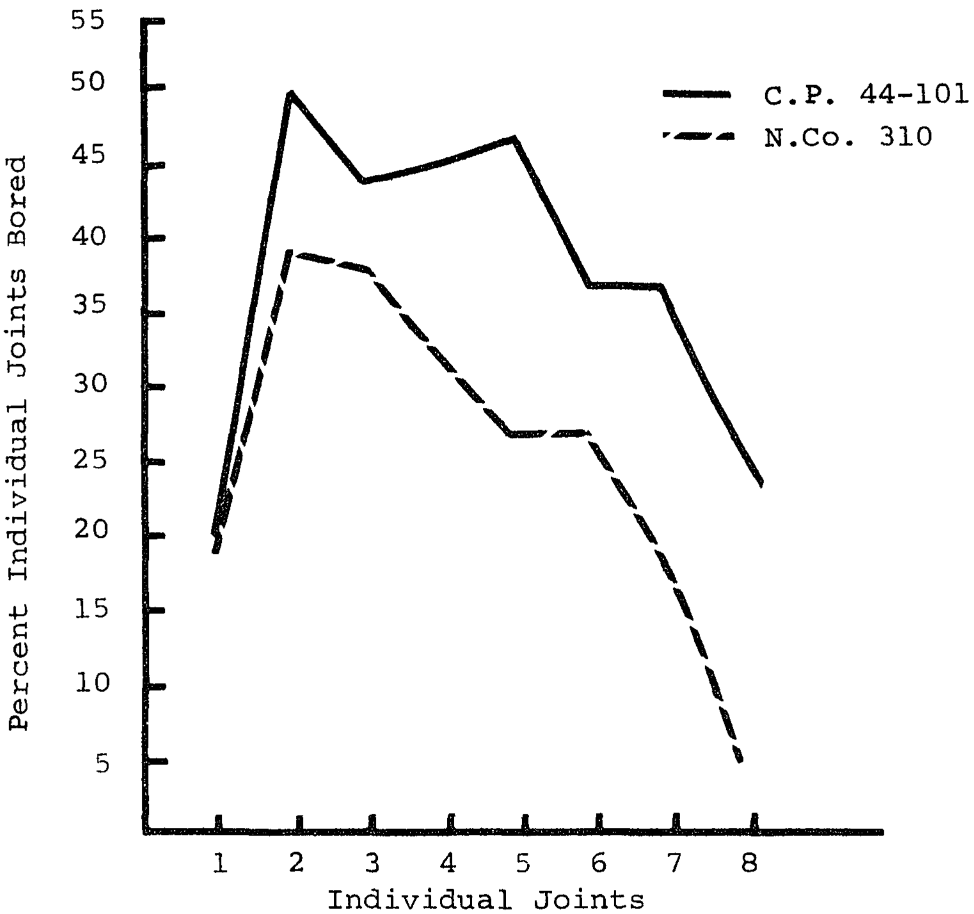

Figure 4. Percentages of individual joints bored by _Diatraea saccharalis_ (F.) larvae in 10-stalk samples from each of 11 plots of the sugarcane varieties N.Co. 310 and C.P. 44-101, Louisiana, 1965[a]

[a]These percentages are based upon data from Appendix Table 7.

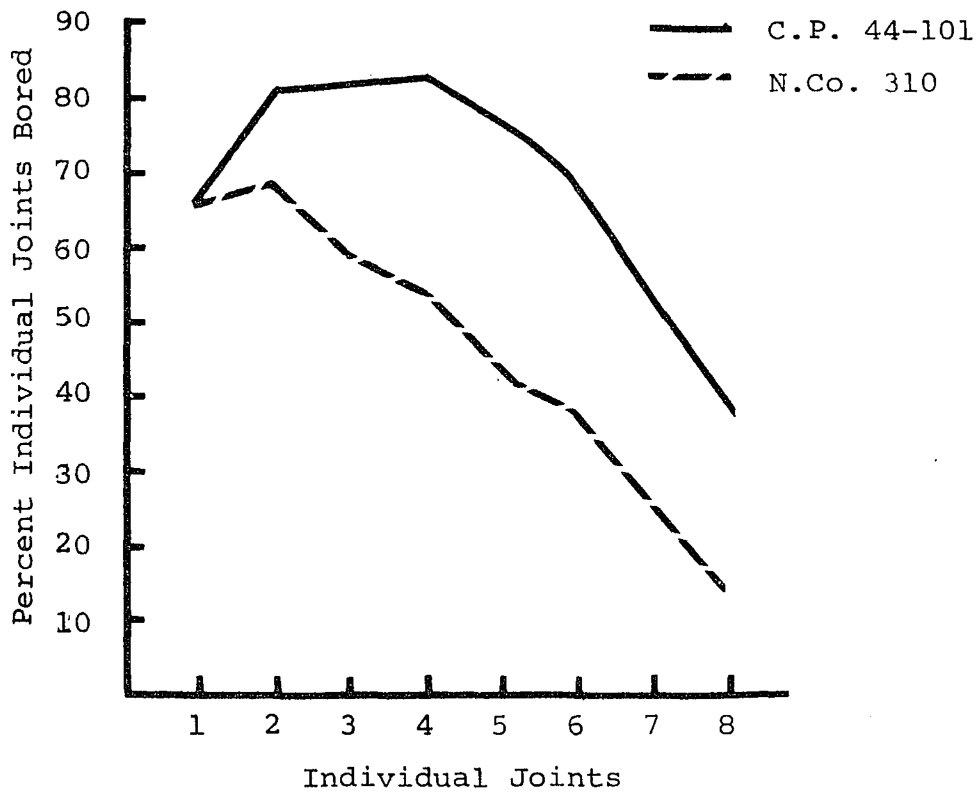

Figure 5. Percentages of individual joints bored by <u>Diatraea saccharalis</u> (F.) larvae in 60-stalk samples from each of 8 plots of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966[a]

[a]These percentages are based upon data from Appendix Table 8.

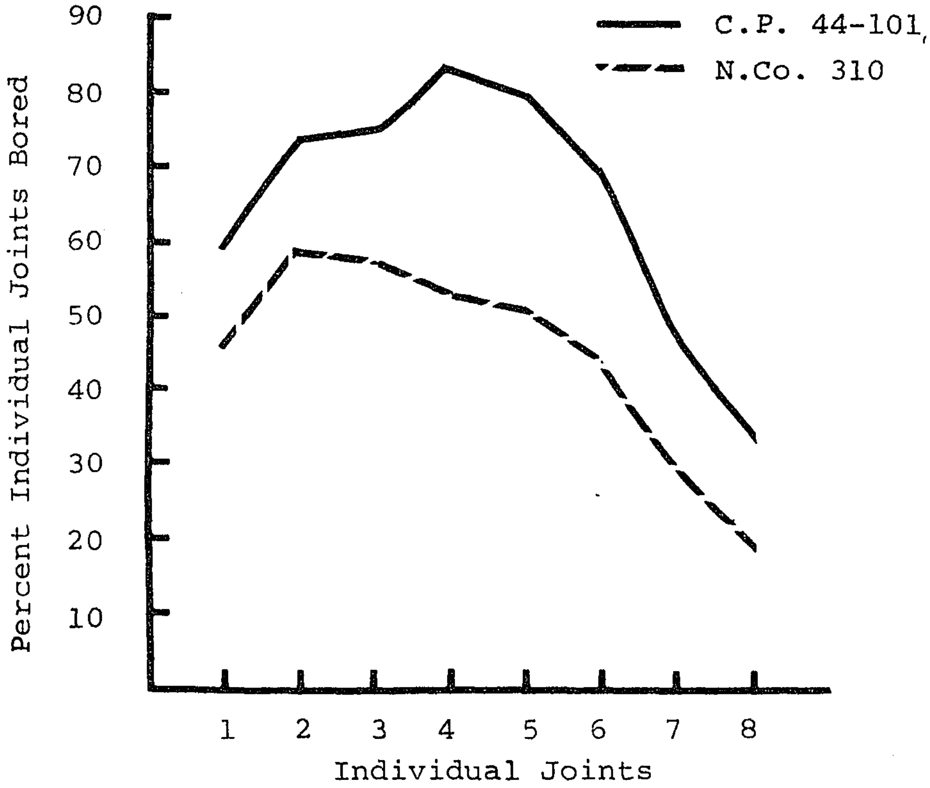

Figure 6. Percentages of individual joints bored by Diatraea saccharalis (F.) larvae in 50-stalk samples from each of 10 plots of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966[a]

[a]These percentages are based upon data from Appendix Table 9.

Table II. Average numbers of "dead hearts" per plot found in the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966

Field Experiment	Date	Sugarcane Varieties N.Co. 310		C.P. 44-101
II[a]	5-30	10.13	**	41.13
	6- 9	11.13	**	33.13
	6-17	6.13	**	16.50
III[b]	5-31	.10	ns	.40
	6- 7	.70	ns	.80
	6-16	.60	ns	.50

[a]These figures are based o data shown in Appendix Table 10 and are averages of 10 replications.

[b]These figures are based on data shown in Appendix Table 11 and are averages of 8 replications.

Table III. Percent control of <u>Diatraea saccharalis</u> (F.) and percent yield loss from azinphosmethyl-treated and untreated plots of 8 varieties of sugarcane, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1965[a]

Variety	Percent Control	Percent Yield Loss[b]	
C.P. 44-101	74.21	49.96	A
C.P. 47-193	71.69	34.99	B
C.P. 52- 68	72.70	26.32	B C
C.P. 55- 30	69.63	25.05	B C
C.P. 36- 13	76.56	24.86	B C
C.P. 48-103	64.98	20.64	C
C.P. 36-105	78.87	19.17	C
N.Co. 310	83.26	18.17	C

[a]These percentages are based on data shown in Appendix Table 12 and are averages of 4 replications.

[b]Percentages of yield loss not followed by the same letter differ significantly at the 5% level according to Duncan's Multiple Range Test.

reduction of yield in the untreated plots compared to those in the treated plots.

There was no significant difference in the percent control among the varieties. However, the variety C.P. 44-101 was shown to have a statistically significant higher percent yield loss attributed to sugarcane borer damage than the other seven varieties tested (Table III). The variety C.P. 47-193 had a statistically significant higher percent yield loss attributed to borer damage than the varieties C.P. 48-103, C.P. 36-105, and N.Co. 310. There was no significant difference in percent yield losses among the varieties C.P. 52-68, C.P. 55-30, C.P. 36-13, C.P. 48-103, C.P. 36-105, and N.Co. 310 or the varieties C.P. 47-193, C.P. 52-68, C.P. 55-30, and C.P. 36-13.

Figure 7 illustrates graphically the percentages of individual joints bored by sugarcane borer larvae in insecticide-treated and untreated plots of the varieties N.Co. 310 and C.P. 44-101. The data show that in insecticide-treated or untreated plots of the two varieties, there were significantly more joints bored in C.P. 44-101 than in N.Co. 310. However the seasonal damage patterns were very similar in both varieties.

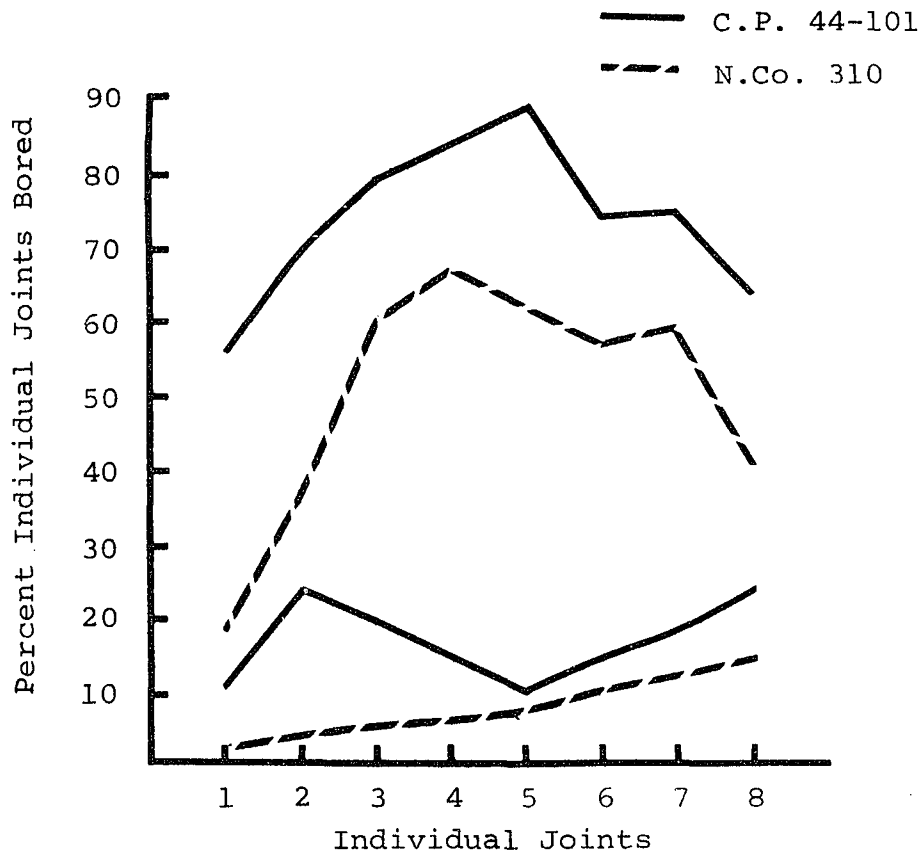

Figure 7. Percentages of individual joints bored by Diatraea saccharalis (F.) larvae in 25-stalk samples from each of 4 Azinphosmethyl-treated and 4 untreated plots of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1965[a]

[a]These percentages are based upon data from Appendix Tables 13 and 14.

Comparison of Percentages of Joints Tunneled by the Sugarcane Borer with Number and Length of Tunnels and Number of Vegetative Buds ("Eyes") Injured in Varieties N.Co. 310 and C.P. 44-101

Data in Table IV show that the percentage of joints bored and number of sugarcane borer tunnels were both significantly higher in variety C.P. 44-101 than in N.Co. 310. When sugarcane borer tunnels were measured and separated into two categories consisting of those less than ¼" in length and those over ¼" in length, there was no significant difference between the two varieties in length of tunnels over ¼" or number of vegetative buds ("eyes") damaged by sugarcane borer larvae. However, there were significantly more tunnels in each category found in variety C.P. 44-101 than N.Co. 310.

Ovipositional Preference Studies of Sugarcane Borer Moths in Varieties N.Co. 310 and C.P. 44-101

When clones of the sugarcane varieties N.Co. 310 and C.P. 44-101 were either intermixed or alternated on a row, sugarcane borer moths showed no ovipositional preference between the two varieties (Table V). However, in both cases significantly more egg masses were found on the lower surface of the sugarcane leaf.

When the two varieties N.Co. 310 and C.P. 44-101 were grown in clay pots and placed in the greenhouse or in a large walk-in screen cage, sugarcane borer moths did not demonstrate any ovipositional preference between the two

Table IV. An evaluation of *Diatraea saccharalis* (F.) damage in 25-stalk samples from each of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966[a]

Percent or Average Number per Stalk	N.Co. 310		C.P. 44-101
Percent Joints Bored	43.62	**	69.38
Percent Eyes Bored	20.31	ns	16.83
Average Number of Tunnels	8.68	**	15.60
Average Number Tunnels Over ¼"	4.20	**	8.76
Average Number Tunnels Under ¼"	4.48	**	6.84
Average Length of Tunnels Over ¼"	2.07"	ns	2.37"

[a]These averages are based upon data in Appendix Tables 15 and 16.

Table V. Average numbers per plant and location of <u>Diatraea saccharalis</u> (F.) egg masses on sugarcane plants of varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966[a]

	Variety	Egg Masses on Leaves: Upper Surface		Egg Masses on Leaves: Lower Surface	Leaf Sheath	Leaves and Leaf Sheaths
Intermixed Stools	C.P. 44-101	.94	**	1.38	0	2.31
						ns
	N.Co. 310	.94	**	2.13	0	3.06
Alternating Stools	C.P. 44-101	2.27	*	4.80	.07	7.13
						ns
	N.Co. 310	2.27	*	3.13	0	5.40

[a]These averages are based upon data in Appendix Tables 17 and 18.

varieties (Table VI). In both cases, more egg masses were oviposited either on or in contact with the mid-rib of the leaf. Sugarcane borer moths oviposited significantly more egg masses on the lower leaf surface in the sugarcane variety C.P. 44-101. However, there was no significant difference in the number of egg masses found on the upper or lower leaf surface in variety N.Co. 310. There was no ovipositional preference exhibited by the sugarcane borer moths for the upper or lower leaf surfaces in either variety when sugarcane plants were grown in a walk-in screen cage.

No significant ovipositional preference by sugarcane borer moths occurred in field plots of the two sugarcane varieties N.Co. 310 and C.P. 44-101 (Table VII) and no preference for upper or lower leaf surfaces was shown in variety C.P. 44-101. However, significantly more egg masses were found on the lower leaf surface on both sampling dates in the sugarcane variety N.Co. 310.

Developmental Potential of Sugarcane Borer Larvae in Varieties N.Co. 310 and C.P. 44-101

When stools of the two sugarcane varieties, N.Co. 310 and C.P. 44-101, were isolated and artificially infested with sugarcane borer larvae early in the sugarcane growing season (April 27), no significant difference could be detected in larval mortality seven, fourteen, twenty-eight or forty-nine days after infestation (Table VIII). Stools of both varieties were artificially infested with

Table VI. Average numbers per plant and location of *Diatraea saccharalis* (F.) egg masses on sugarcane plants of N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1967[a]

Experiment	Variety	Upper Leaf Surface		Lower Leaf Surface		Leaf Sheath	Total No. Egg Masses Per Plant
		Touching Mid-Rib	Away From Mid-Rib	Touching Mid-Rib	Away From Mid-Rib		
Greenhouse[b]	101	0	0	2.40	.20	0	2.60
							ns
	310	.60	0	.60	.60	0	1.80
Walk-in Screen Cage[c]	101	.73	.07	.53	.07	0	1.40
							ns
	310	.60	0	.47	.07	0	1.13

[a]These averages are based upon data from Appendix Tables 19 and 20.

[b]Figures are averages of 5 replications.

[c]Figures are averages of 15 replications.

Table VII. Average numbers per plot and location of <u>Diatraea saccharalis</u> (F.) egg masses found on sugarcane plants of varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana 1967

Variety	Date Sampled	Plot	Number Stalks Observed	Numbers of Egg Masses Found Per Plot: Upper Leaf Surface	Lower Leaf Surface	Touching Mid-Rib	Away From Mid-Rib	Leaf Sheath	Number of Egg Masses Per Plot
N.Co.310	7-28-67	1	100	7	6	11	2	0	13
		2	100	6	4	7	3	0	10
		3	100	6	2	6	2	0	8
		4	100	5	0	4	1	0	5
C.P.44-101	7-28-67	1	100	10	12	18	4	0	22
		2	100	2	5	6	1	0	7
		3	100	0	4	2	2	0	4
		4	100	4	2	6	1	0	6
N.Co.310	7-28-67	Av.	400	6.00 *	3.00	7.00	2.00	0	9.00
									ns
C.P.44-101	7-28-67	Av.	400	4.00 ns	5.75	7.75	2.00	0	9.75
N.Co. 310	9-11-67	1	100	56	19	56	19	0	75
		2	50	22	3	19	6	0	25
		3	50	22	6	24	4	0	28
		4	50	23	7	21	9	0	30
C.P.44-101	9-11-67	1	100	29	46	55	20	0	75
		2	50	10	21	27	4	0	31
		3	50	9	17	22	4	0	26
		4	50	10	11	16	5	0	21
N.Co. 310	9-11-67	Av.	250	30.75 **	8.75	30.00	9.50	0	39.50
								0	ns
C.P.44-101	9-11-67	Av.	250	14.50 ns	23.75	30.00	8.25		38.25

Table VIII. Total numbers of *Diatraea saccharalis* (F.) larvae and pupae recovered from artificially and naturally infested stools (5-10 plants) of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1967[a]

Variety	Infestation	Number of Stools Examined	Average Number of Larvae Released Per Stools	Post Infestation Time	Instars Observed For	Average Number Found Per Stool
N.Co. 310	Artificial	30	12.16	7 days	2nd & 3rd	.47
	Natural	30		7 days		.13
						ns
C.P. 44-101	Artificial	30	10.87	7 days	2nd & 3rd	1.07
	Natural	30		7 days		.73
N.Co. 310	Artificial	30	11.40	14 days	3rd & 4th	.10
	Natural	30		14 days		.10
						ns
C.P.44-101	Artificial	30	12.50	14 days	3rd & 4th	.13
	Natural	30		14 days		.10
N.Co. 310	Artificial	30	10.80	28 days	4th & 5th	.07
	Natural	30		28 days		.13
						ns
C.P.44-101	Artificial	30	12.27	28 days	4th & 5th	.60
	Natural	30		28 days		.20
N.Co. 310	Artificial	30	12.13	49 days	5th & pupae	.17
	Natural	30		49 days		.03
						ns
C.P.44-101	Artificial	30	11.70	49 days	5th & pupae	.73
	Natural	30		49 days		.07

[a]Sugarcane stools artificially infested with *D. saccharalis* larvae April 27, 1967.

approximately equal numbers of sugarcane borer larvae. However, recovery of these larvae was extremely low and the experiment was repeated later in the season. Those data are shown in Table IX. These stools were infested July 10, and examined three, seven, fourteen, and forty-two days after infestation. No significant difference between the two varieties in larval mortality was detected.

Comparisons of Field Collected Sugarcane Borer Larvae and Pupae from Varieties N.Co. 310 and C.P. 44-101

When sugarcane borer larvae were collected from field plots of the two varieties N.Co. 310 and C.P. 44-101, no significant varietal effects on larval weights were detected (Table X).

Weights of pupae of both sexes collected from varieties N.Co. 310 and C.P. 44-101 did not differ significantly (Table XI) and differences in weight of female pupae were not significant between varieties. However, weights of males collected from variety N.Co. 310 were significantly less than for males collected from C.P. 44-101.

Table IX. Total numbers of <u>Diatraea saccharalis</u> (F.) larvae and pupae recovered from artificially and naturally infested stools (1 to 4 plants) of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1967[a]

Variety	Infestation	Number of Stools Examined	Average Number of Larvae Released Per Stool	Post Infestation Time	Instars Observed For	Average Number Found Per Stool
N.Co. 310	Artificial	20	23.20	3 days	1st & wnd	1.75
	Natural	20	ns	3 days		.80
						ns
C.P. 44-101	Artificial	20	19.40	3 days	1st & 2nd	3.10
	Natural	20		3 days		1.60
N.Co. 310	Artificial	20	22.90	7 days	2nd & 3rd	1.85
	Natural	20	ns	7 days		2.10
						ns
C.P. 44-101	Artificial	20	23.30	7 days	2nd & 3rd	3.25
	Natural	20		7 days		4.70
N.Co. 310	Artificial	20	21.80	14 days	3rd & 4th	.95
	Natural	20	ns	14 days		.85
						ns
C.P. 44-101	Artificial	20	21.90	14 days	3rd & 4th	.80
	Natural	20		14 days		1.10
N.Co. 310	Artificial	20	25.20	42 days	5th & pupae	1.10
	Natural	20	ns	42 days		1.30
						ns
C.P. 44-101	Artificial	20	23.55	42 days	5th & pupae	1.85
	Natural	20		42 days		.85

[a]Sugarcane stools artificially infested with <u>D. saccharalis</u> larvae July 10, 1967.

Table X. Comparison of head capsule width in millimeters and weight in milligrams of field collected <u>Diatraea saccharalis</u> (F.) larvae from the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1967

Group[a]	Approximate[b] Instar	N.Co. 310 Number of Observations	N.Co. 310 Average[c] Head Capsule Width	N.Co. 310 Average[d] Weight	C.P. 44-101 Number of Observations	C.P. 44-101 Average[c] Head Capsule Width	C.P. 44-101 Average[d] Weight
I	1st				1	.40	1.00
II	2nd	8	.53	1.75	4	.58	2.25
III	3rd	30	.78	3.07	31	.81	3.81
IV	4th	44	1.18	11.91	49	1.16	14.08
V	5th	109	1.71	50.83	104	1.71	56.43
VI	6th	27	2.24	139.44	28	2.23	129.54
VII	7th				1	2.60	255.00

[a]Larval weights are grouped according to the following head capsule widths:

Group I head capsule width = 0 - .40 mm.
Group II head capsule width = .41 - .60 mm.
Group III head capsule width = .61 - .90 mm.
Group IV head capsule width = .91 - 1.30 mm.
Group V head capsule width = 1.31 - 2.00 mm.
Group VI head capsule width = 2.01 - 2.53 mm.
Group VII head capsule width = 2.54 - mm.

[b]These instar approximations are based on work by Hensley (1960). He found that "as the number of instars increased, the width of head capsules became more variable" with overlapping occurring in the fourth and fifth instars. Therefore, these groupings are used for comparative purposes only and are used only to approximate the instar of these field collected larvae.

[c]These averages did not differ significantly in any of the groupings.

[d]These averages did not differ significantly in any of the groupings.

Table XI. Average weight, in milligrams, of field collected *Diatraea saccharalis* (F.) pupae from paired plot comparisons of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1967

Variety	Number of Observations	Males	Number of Observations	Females	Number of Observations	Males and Females
N.Co. 310	29	81.07	12	120.83	41	92.71
		*		ns		ns
C.P. 44-101	33	84.79	23	121.65	56	99.93

DISCUSSION

The fact that the sugarcane variety N.Co. 310 is less susceptible to sugarcane borer attack than C.P. 44-101 was illustrated at harvest time when it was found that less joints were bored and less yield loss was attributed to sugarcane borer damage in variety N.Co. 310 (Tables I and III). When population counts of sugarcane borer larvae were made during June, July and August (Figures 1, 2, and 3), it was demonstrated that although borer population density was lower in N.Co. 310, the seasonal development of the two populations was similar in both varieties. This is also apparent when damage to individual joints of plants from the two varieties is considered (Figures 4, 5, 6, and 7). Even though this damage to joints does not provide information on the actual borer population in any one variety, it can be used to compare the relative density of populations between two varieties.

A close examination of the damage caused by sugarcane borer larvae revealed that even though there were significantly more borer tunnels in variety C.P. 44-101, there was no significant difference in the length of these tunnels (Table IV). It would seem that once the larvae began to tunnel in the plants, they did not cause more damage to one variety than to the other. These larvae usually began boring into sugarcane plants during the third instar.

In screen cage, greenhouse and field plot experiments sugarcane borer moths did not demonstrate any ovipositional preference for either variety N.Co. 310 or C.P. 44-101 (Tables V, VI, and VII). However, significantly more egg masses were oviposited on or in contact with the mid-rib than on the other portions of the leaf blade in both varieties. The majority of these egg masses were located in the crease between the mid-rib and the rest of the leaf blade. However, data on the number of egg masses oviposited on the upper and lower surfaces of the leaf were too variable in both varieties to conclude any preference for either surface by moths.

"Dead-heart" counts made in a first-year ratoon-crop of the varieties N.Co. 310 and C.P. 44-101 showed that a significantly higher first generation borer population was present in C.P. 44-101 (Table II). Numbers of "dead-hearts" in the first-year crop of the two varieties were too low to show any differences.

No significant differences in the sizes of field collected larvae or pupae were detected (Tables X and XI). The majority of these differences, although not significant, consistently indicate that the larvae collected from C. P. 44-101 weighed more than those collected from N.Co. 310. Most of the larvae weighed were large borers that were found tunneling in the stalk and there was a large amount of variation in the weights of these larvae and pupae collected from both varieties. However, it appears that once larvae establish in sugarcane stalks, they develop about as well on one variety as the other.

Considering these results, it appears that preference is not a mechanism involved in N.Co. 310 resistance to the sugarcane borer. Also tolerance could not be considered an operative resistance mechanism here because there were consistently less borers found on the variety N.Co. 310.

In sugarcane borer population counts the majority of the larvae counted were from second and fifth instars. Although undoubtedly some first instars were missed because of their small size, once established, it seems that borer larvae did equally well on both N.Co. 310 and C.P. 44-101. However, there appears to be some antibiotic effects of variety N.Co. 310 on early instar borer larvae since fewer small larvae were consistently found on this variety. Painter (1951) states that when antibiosis is a mechanism involved in plant resistance to insects it usually affects early instar individuals.

Stools of both varieties were artificially infested with borer larvae in an effort to obtain a more precise indication of what developmental stage of the borer larvae is adversely affected by the varietal differences. However, in the artificially infested populations on the two varieties, no significant differences were found at any of the dissection dates (Tables VIII and IX). It should be emphasized that biological data should be analyzed on a biological level before being analyzed on a mathematical level (Painter, 1951). These data indicate a higher mortality level for first- to third-instar borers in the variety N.Co. 310. Due to the fact that no larvae were found on many stools, these differences were not significant. This high overall mortality of larvae may be accounted for by one or any combination of the following: a high natural mortality; large numbers of predators observed in the field plots; or the fact that not enough larvae were released per stool. Further investigations are warranted to determine at what stage of development the sugarcane borer larvae are adversely affected by one or more resistance mechanisms in N.Co. 310 plants.

Based on all criteria utilized for measuring larval populations or borer damage in this study, populations and damage were consistently lower on N.Co. 310 than on C.P. 44-101. Thus, the reproductive potential of the sugarcane borer is more adversely affected on N.Co. 310 than C.P. 44-101. As further proof, when plants were infested in July, there was only 10% survival of first, second, and third instar larvae on N.Co. 310 compared to 15% on C.P. 44-101. Assuming that one individual sugarcane borer is produced per "dead heart," there is a 1:1 sex ratio, and the potential fecundity of each individual female is 200 eggs; theoretically, the first generation population of sugarcane bores in an acre of N.Co. 310 would be 1,890 borers compared to 6,370 in C.P. 44-101, the second generation would consist of 18,900 borers in N.Co. 310 compared to 95,550 in C.P. 44-101 and the fourth generation would consist of 189,000 borers in N.Co. 310 compared to 1,433,250 in C.P. 44-101.

No attempt was made in these investigations to determine exactly what antibiotic mechanisms were involved in N.Co. 310 resistance to the sugarcane borer. However, this research should stimulate further and more detailed investigations into those mechanisms and their association with different developmental stages of the sugarcane borer.

Data in Figure 7 illustrate the fact that although N.Co. 310 is quite resistant to sugarcane borer attack, the degree of this resistance is not sufficient to exclude insecticide use as a first line of defense against borer attack.

Newsom (1966) states that "there are no currently acceptable alternative methods to use of insecticides for control of most pest, either now or for the foreseeable future; rapid changes in agriculture and increasing trade between nations continually increase the complexity and severity of pest problems; and improving the efficiency of pest control methods becomes an urgent need as a means of helping to meet the demands of a burgeoning world population for food and fiber. The answer to this seemingly impossible challenge is to be found in integrated control."

An awareness of those commercial sugarcane varieties with a sufficient degree of resistance to reduce the number of insecticide applications necessary to control sugarcane borers, coupled with a conscientious effort to produce and release only varieties that show some degree of borer resistance is necessary if we are to continue to obtain our high degrees of insect control and at the same time lessen the amount of insecticide pollution of the environment that is presently taking place. It should be further emphasized that the danger of insect resistance to insecticides is increased when insecticides are used as the only line of defense against insect attack. Therefore, the potential for an integrated insecticide, insect varietal resistance program for sugarcane borer control is at hand and although further research efforts may be required for its perfection, it has many worthwhile advantages.

CONCLUSIONS

1. The sugarcane variety N.Co. 310 was more resistant to sugarcane borer attack than C.P. 44-101 which was classed as susceptible.

2. While total sugarcane borer populations were less on variety N.Co. 310, seasonal population developmental patterns were quite similar on N.Co. 310 and variety C.P. 44-101.

3. No ovipositional preference between varieties N.Co. 310 and C.P. 44-101 was demonstrated by sugarcane borer moths.

4. Sugarcane borer moths preferred to oviposit on or near the mid-rib of the sugarcane leaf rather than on the edges and distal surfaces of the leaf.

5. Less yield loss may be attributed to sugarcane borer damage in variety N.Co. 310 than in C.P. 44-101.

6. Although variety N.Co. 310 is resistant to sugarcane borer attack, the level of resistance is not high enough to exclude insecticide use as a first line of defense against economic infestations of sugarcane borers.

7. There was a high percentage of joints tunneled by sugarcane borers in variety C.P. 44-101 than in N.Co. 310. However, there was no significant difference in the number

of vegetative buds ("eyes") injured or the lengths of individual sugarcane borer tunnels in varieties N.Co. 310 and C.P. 44-101.

8. There was no significant difference in the weights of field collected sugarcane borer larvae and pupae from varieties N.Co. 310 and C.P. 44-101.

9. The sugarcane borer resistance mechanism present in variety N.Co. 310 appears to be antibiosis that affects young larvae of the 1st, 2nd, or 3rd instars.

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APPENDIX

Table 1. Percent joints bored by *Diatraea saccharalis* in 10-stalk samples from each of 11 plots of the sugarcane varieties N.Co. 310 and C.P. 44-101, Louisiana, 1965

	Sugarcane Varieties		
Plot	N.Co. 310		C.P. 44-101
1	7.22		12.33
2	5.64		14.86
3	11.82		21.57
4	14.50		0
5	6.58		38.79
6	15.88		11.15
7	24.12		12.21
8	4.91		14.81
9	4.85		18.63
10	7.82		21.16
11	7.17		2.42
Means	10.05	ns	15.36

Table 2. Percent joints bored by Diatraea saccharalis in 60-stalk samples from each of 8 plots of the sugarcane varieties N.Co. 310 and C.P. 44-101. Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966

Plot	Sugarcane Varieties	
	N.Co. 310	C.P. 44-101
1	33.16	55.97
2	55.52	75.76
3	43.73	65.93
4	37.67	70.29
5	48.59	78.76
6	34.62	67.28
7	39.42	71.30
8	37.10	68.22
Means	41.10	** 69.19

Table 3. Percent joints bored by <u>Diatraea saccharalis</u> in 50-stalk samples from each of 10 plots of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966

Plot	Sugarcane Varieties	
	N.Co. 310	C.P. 44-101
1	36.80	80.00
2	50.00	77.96
3	39.80	66.97
4	42.35	71.32
5	50.90	77.53
6	46.04	72.94
7	47.17	80.00
8	42.06	63.93
9	58.46	75.00
10	60.24	65.65
Means	47.38	* * 73.13

Table 4. Numbers of <u>Diatraea saccharalis</u> larvae collected from June to September, 1965, in 11 plots each of the sugarcane varieties N.Co. 310 and C.P.44-101, Louisiana, 1965

Sampling Date	Number of Larvae			
	Total Per Plot		Average Per Plot	
	N.Co. 310	C.P. 44-101	N.Co. 310	C.P. 44-101
6 - 10	0	3	0	.27
6 - 18	1	7	.09	.63
6 - 24	5	12	.45	1.09
7 - 16	5	17	.45	1.55
7 - 22	21	10	1.91	.91
7 - 29	25	33	2.27	3.00
8 - 6	18	26	1.64	2.36
8 - 12	30	25	2.73	2.27
8 - 19	51	69	4.64	6.27
8 - 27	36	32	3.27	2.91
9 - 1	63	65	5.73	5.91
Means	23.18 ns	27.18		

Table 5. Numbers of *Diatraea saccharalis* larvae collected from June to September, 1966, in 10 plots each of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana

Sampling Date	Number of Larvae			
	Total Per Plot		Average Per Plot	
	N.Co. 310	C.P. 44-101	N.Co. 310	C.P. 44-101
6 - 22	0	0	0	0
7 - 1	10	59	1.0	5.9
7 - 15	10	19	1.0	1.9
7 - 20	20	29	2.0	2.9
7 - 27	20	14	2.0	1.4
8 - 4	28	86	2.8	8.6
8 - 11	63	139	6.3	13.9
8 - 17	202	374	20.2	37.4
8 - 24	174	202	17.4	20.2
Means	42.37	* * 79.25		

Table 6. Numbers of *Diatraea saccharalis* larvae collected in June and July, 1966, in 8 plots each of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana

Sampling Date	Numbers of Larvae			
	Total for 8 Plots		Average Per Plot	
	N.Co. 310	C.P. 44-101	N.Co. 310	C.P. 44-101
6 - 23	15	23	1.87	2.88
7 - 1	61	85	7.63	10.63
7 - 13	31	51	3.88	6.38
Means	35.66	* 53.00		

Table 7. Number and percent of individual joints bored by *Diatraea saccharalis* larvae in 10-stalk samples from each of 11 plots of the sugarcane varieties N.Co. 310 and C.P. 44-101, Louisiana, 1965

Variety	Individual Joints	Total Number of Individual Joints Bored												Percent Individual Joints Bored
		Plots												
		1	2	3	4	5	6	7	8	9	10	11	Plots 1-11	
N.Co. 310	1	2	0	2	4	1	3	7	0	1	1	2	21	19.09
	2	2	2	2	5	3	7	12	1	4	4	1	43	39.09
	3	3	3	5	5	1	5	12	2	1	2	3	42	38.18
	4	2	1	5	7	1	5	6	2	3	1	2	35	31.82
	5	1	2	3	4	2	6	6	2	0	2	2	30	27.27
	6	2	1	3	2	2	5	6	1	2	3	2	30	27.27
	7	0	1	3	1	1	3	5	2	0	2	3	21	19.09
	8	0	1	1	1	0	0	0	0	0	2	0	5	4.55
C.P. 44-101	1	2	2	4	0	4	1	3	4	0	2	0	22	20.00
	2	2	7	8	9	10	6	2	4	10	6	0	55	50.00
	3	5	6	7	0	9	5	3	3	5	5	0	48	43.64
	4	2	8	7	0	10	2	2	3	5	9	2	50	45.45
	5	1	2	6	0	16	4	6	6	3	7	1	52	47.27
	6	2	5	3	0	14	3	3	2	3	6	0	41	37.27
	7	3	3	3	0	12	1	3	5	4	6	1	41	37.27
	8	1	0	3	0	8	2	2	4	7	1	1	29	26.36

Table 8. Number and percent of individual joints bored by <u>Diatraea saccharalis</u> larvae in 60-stalk samples from each of 8 plots of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966

Variety	Individual Joints	Total Number of Individual Joints Bored									Percent Individual Joints Bored
		Plots									
		1	2	3	4	5	6	7	8	Plots 1-8	
N.Co. 310	1	34	53	38	43	46	31	38	33	316	65.83
	2	36	49	37	55	51	31	39	32	330	68.75
	3	28	47	41	35	35	28	42	28	284	59.17
	4	28	42	39	37	34	29	29	34	262	54.58
	5	16	37	30	18	29	23	30	28	211	43.96
	6	18	31	30	23	26	19	20	21	188	39.17
	7	12	31	14	15	12	15	10	15	124	25.83
	8	8	17	10	6	7	12	5	5	70	14.58
C.P. 44-101	1	41	46	40	49	49	25	37	34	321	66.88
	2	50	51	53	55	55	40	46	45	395	82.29
	3	46	53	50	55	57	44	45	48	398	82.92
	4	40	54	53	55	52	50	52	47	403	83.96
	5	32	49	42	52	51	51	51	48	376	78.33
	6	34	46	43	38	42	43	46	45	337	70.21
	7	22	34	25	40	35	34	38	33	261	54.38
	8	11	24	22	24	26	30	28	25	190	39.58

Table 9. Number and percent of individual joints bored by <u>Diatraea saccharalis</u> in 50-stalk samples from each of 10 plots of the sugarcane varieties N.Co. 310 and C.P. 44-101

Variety	Individual Joints	Total Number of Individual Joints Bored: Plots 1	2	3	4	5	6	7	8	9	10	Plots 1-10	Percent Individual Joints Bored
N.Co. 310	1	16	25	14	22	36	22	24	15	31	25	230	46.00
	2	24	30	25	28	35	29	30	23	38	33	295	59.00
	3	22	34	26	32	34	28	24	27	31	28	286	57.20
	4	20	29	25	25	23	25	23	26	32	36	264	53.00
	5	11	33	21	18	26	32	28	25	28	33	255	51.00
	6	13	19	22	22	18	21	31	21	24	34	225	45.00
	7	8	11	12	18	13	15	21	12	12	27	149	29.80
	8	4	8	6	12	18	11	14	5	9	15	102	20.40
C.P. 44-101	1	26	32	30	30	29	29	36	28	36	18	294	58.80
	2	40	45	38	33	37	37	37	32	40	33	372	74.40
	3	43	44	37	41	38	39	41	15	41	36	375	75.00
	4	46	44	40	39	49	40	49	39	45	40	421	84.20
	5	45	40	33	39	43	43	43	38	38	37	399	79.80
	6	39	36	34	30	44	35	33	34	26	28	349	69.80
	7	21	19	26	33	29	18	35	25	14	20	240	48.00
	8	16	12	24	22	25	15	23	17	11	12	177	35.40

Table 10. Numbers of "dead-hearts" per plot found in a first-year ratoon-crop of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966

Date Sampled	Plot	Sugarcane Varieties	
		N.Co. 310	C.P. 44-101
5-30-66	1	20	34
	2	10	40
	3	6	30
	4	7	45
	5	6	50
	6	3	20
	7	5	52
	8	24	58
	Means	10.13	41.13
6-9-66	1	15	25
	2	8	27
	3	6	40
	4	18	37
	5	10	44
	6	2	22
	7	12	40
	8	18	30
	Means	11.13	33.13
6-17-66	1	5	19
	2	10	11
	3	3	19
	4	4	13
	5	2	35
	6	7	7
	7	2	18
	8	10	10
	Means	6.13	16.50

Table 11. Numbers of "dead-hearts" per plot found in a first-year crop of the sugarcane varieties N.Co. 310 and C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966

Date Sampled	Plot	Sugarcane Varieties	
		N.Co. 310	C.P. 44-101
5-31-66	1	0	0
	2	0	0
	3	0	1
	4	0	1
	5	0	0
	6	0	0
	7	1	0
	8	0	0
	9	0	2
	10	0	0
	Means	.10	.40
6-7-66	1	0	0
	2	1	2
	3	2	1
	4	1	0
	5	0	0
	6	0	2
	7	3	1
	8	0	0
	9	0	2
	10	0	0
	Means	.70	.80
6-16-66	1	0	0
	2	0	0
	3	2	1
	4	0	2
	5	0	0
	6	0	0
	7	4	1
	8	0	1
	9	0	0
	10	0	0
	Means	.60	.50

Table 12. Sugarcane yields and bored joints from Azinphos-methyl treated and untreated plots of 8 varieties of sugarcane replicated 4 times, Hill Farm, Louisiana State University, Baton Rouge, Louisiana, 1965

		Percent Joints Bored		Lbs. Sugarcane Per Plot	
Variety	Replication	Treated	Check	Treated	Check
C.P.44-101	1	23.0	72.6	498	358
	2	12.9	75.8	675	292
	3	23.1	72.7	725	278
	4	13.7	60.9	658	351
	Average	18.18	70.50	639.00	319.75
47-193	1	15.4	60.9	362	280
	2	19.1	61.4	461	304
	3	19.2	59.3	508	283
	4	14.2	58.3	441	285
	Average	16.98	59.98	443.00	288.00
52-68	1	11.1	58.2	441	320
	2	17.9	69.8	516	315
	3	24.1	50.4	533	478
	4	10.0	52.7	550	390
	Average	15.78	57.78	510.00	375.75
55-30	1	13.8	56.0	426	412
	2	14.6	61.3	510	289
	3	27.8	58.0	546	442
	4	12.7	51.7	510	350
	Average	17.23	56.75	498.00	373.25
36-13	1	12.6	67.1	581	341
	2	15.7	65.2	566	477
	3	19.0	68.1	712	512
	4	12.9	56.4	578	501
	Average	15.05	64.20	609.25	457.75
48-103	1	15.8	62.8	361	419
	2	35.0	73.4	493	393
	3	27.3	65.0	509	376
	4	9.7	49.5	531	315
	Average	21.95	62.67	473.50	375.75
36-105	1	10.2	57.8	322	430
	2	17.0	65.4	575	365
	3	10.8	59.3	744	468
	4	9.6	42.8	581	433
	Average	11.90	56.33	555.50	449.00
N.Co. 310	1	3.9	52.4	504	464
	2	18.2	61.4	532	449
	3	8.7	38.8	698	471
	4	1.8	42.1	607	535
	Average	8.15	48.68	586.25	479.75

Table 13. Number and percent of individual joints bored by *Diatraea saccharalis* larvae in 35-stalk samples from each of 8 plots, 4 Azinphosmethyl-treated and 4 untreated, of the sugarcane variety C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1965

Treatment	Individual Joints	Total Number of Individual Joints Bored: Plots 1	2	3	4	Plots 1-4	Percent Individual Joints Bored
Treated	1	3	1	2	5	11	11
	2	6	6	7	5	24	24
	3	7	4	4	5	20	20
	4	5	5	2	3	15	15
	5	10	2	6	2	20	20
	6	3	2	9	1	15	15
	7	9	3	5	1	18	18
	8	5	3	9	7	24	24
Untreated	1	9	13	18	16	56	56
	2	15	16	18	21	70	70
	3	21	18	22	18	79	79
	4	22	23	23	16	84	84
	5	23	24	24	18	89	89
	6	17	23	19	15	74	74
	7	18	22	19	16	75	75
	8	20	21	14	9	64	64

Table 14. Number and percent of individual joints bored by _Diatraea saccharalis_ larvae in 25-stalk samples from each of 8 plots, 4 Azinphosmethyl-treated and 4 untreated, of the sugarcane variety N.Co. 310, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1965

Treatment	Individual Joints	Total Number of Individual Joints Bored					Percent Individual Joints Bored
		Plots					
		1	2	3	4	Plots 1-4	
Treated	1	1	0	2	0	3	2
	2	0	4	0	0	4	4
	3	0	3	3	0	6	6
	4	0	5	1	0	6	6
	5	1	3	2	1	7	7
	6	0	5	4	2	11	11
	7	1	6	4	1	12	12
	8	1	10	4	0	15	15
Check	1	7	4	3	5	19	19
	2	13	8	8	8	37	37
	3	14	17	12	17	60	60
	4	16	20	16	15	67	67
	5	13	21	16	12	62	62
	6	14	16	15	12	57	57
	7	12	22	15	10	59	59
	8	12	13	10	6	41	41

Table 15. An evaluation of <u>Diatraea saccharalis</u> damage in 25 stalks randomly selected from the sugarcane variety C.P. 44-101, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966

Stalk	Percent Joints Bored	Total Number of Tunnels	Number of Tunnels Over ¼"	Number of Tunnels Under ¼"	Percent Eyes Damaged	Average Length of Tunnels Over ¼"
1	61.54	18	9	9	7.69	3.625
2	70.00	10	7	3	30.00	2.563
3	75.00	23	13	10	0	1.813
4	53.33	15	7	8	6.67	1.063
5	50.00	7	5	2	30.00	1.813
6	63.64	17	8	9	9.09	2.063
7	70.00	19	4	15	10.00	6.500
8	66.67	10	9	1	25.00	3.375
9	63.64	14	6	8	9.09	2.875
10	72.73	16	12	4	27.27	3.313
11	83.33	12	4	8	0	2.625
12	44.44	9	6	3	0	.813
13	60.00	9	4	5	10.00	2.688
14	50.00	11	4	7	10.00	4.313
15	66.67	13	6	7	11.11	1.750
16	83.33	29	18	11	16.67	1.313
17	100.00	22	14	8	55.56	1.938
18	83.33	12	7	5	0	2.063
19	63.64	21	7	14	27.27	1.000
20	80.00	19	15	4	30.00	2.438
21	41.67	16	11	5	8.33	1.500
22	100.00	9	7	2	0	1.563
23	84.61	20	11	9	30.77	2.063
24	70.00	18	11	7	20.00	1.688
25	76.92	21	14	7	46.15	1.375
Means	69.38	15.60	8.76	6.84	16.83	2.365

Table 16. An evaluation of _Diatraea saccharalis_ damage in 25 stalks randomly selected from the sugarcane variety N.Co. 310, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1966

Stalk	Percent Joints Bored	Total Number of Tunnels	Number of Tunnels Over ¼"	Number of Tunnels Under ¼"	Percent Eyes Damaged	Average Length of Tunnels Over ¼"
1	30.00	6	4	2	20.00	1.500
2	42.86	14	7	7	35.71	1.750
3	63.64	15	6	9	9.09	3.313
4	28.57	2	2	0	14.29	1.750
5	50.00	8	3	5	20.00	3.500
6	36.36	7	4	3	27.27	2.625
7	27.27	4	1	3	9.09	3.000
8	66.64	14	9	5	26.67	2.688
9	22.22	10	2	8	22.22	1.125
10	60.00	8	5	3	30.00	3.688
11	16.67	8	1	7	0	1.500
12	42.86	9	5	4	28.57	1.188
13	18.18	7	3	4	9.09	1.063
14	57.14	7	3	4	42.86	1.438
15	50.00	8	3	5	0	1.063
16	60.00	11	9	2	30.00	0.813
17	70.00	12	7	5	20.00	3.000
18	33.33	9	5	4	11.11	2.188
19	33.33	6	1	5	25.00	3.313
20	16.67	5	4	1	17.65	3.313
21	55.56	9	5	4	22.22	1.500
22	27.27	8	3	5	0	2.000
23	45.45	6	2	4	9.09	0.938
24	90.00	17	8	9	60.00	2.250
25	45.95	7	3	4	18.18	1.188
Means	43.62	868	4.20	4.48	20.32	2.068

Table 17. Numbers and location of <u>Diatraea saccharalis</u> egg masses on intermixed stools of N.Co. 310 and C.P. 44-101 sugarcane, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1967

Variety	Stalk	Egg Masses on Leaves		Leaf Sheath	Total No. Egg Masses Per Plant
		Top	Bottom		
N.Co. 310	1	1	1	0	2
	2	0	0	0	0
	3	0	0	0	0
	4	2	2	0	4
	5	0	2	0	2
	6	0	4	0	4
	7	2	1	0	3
	8	1	5	0	6
	9	0	1	0	1
	10	1	2	0	3
	11	2	4	0	6
	12	2	0	0	2
	13	0	1	0	1
	14	1	9	0	10
	15	1	2	0	3
	16	2	0	0	2
	Means	.94	2.13	0	3.06
C.P. 44-101	1	2	5	0	7
	2	1	1	0	2
	3	0	1	0	1
	4	0	0	0	0
	5	1	2	0	3
	6	0	2	0	2
	7	1	0	0	1
	8	3	1	0	4
	9	1	2	0	3
	10	1	4	0	5
	11	2	2	0	4
	12	1	2	0	3
	13	0	0	0	0
	14	1	0	0	1
	15	1	0	0	1
	16	0	0	0	0
	Means	.94	1.38	0	2.31

Table 18. Numbers and location of Diatraea saccharalis egg masses on alternating stools of N.Co. 310 and C.P. 44-101 sugarcane, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1967

Variety	Stalk	Egg Masses on Leaves		Leaf Sheath	Total No. Egg Masses Per Plant
		Top	Bottom		
N.Co. 310	1	2	2	0	4
	2	1	3	0	4
	3	1	0	0	1
	4	3	2	0	5
	5	0	5	0	5
	6	0	3	0	3
	7	0	3	0	3
	8	2	6	0	8
	9	9	5	0	14
	10	3	0	0	3
	11	1	5	0	6
	12	1	0	0	1
	13	4	1	0	5
	14	4	5	0	9
	15	3	7	0	10
	Means	2.27	3.13	0	5.40
C.P. 44-101	1	3	9	0	12
	2	2	4	0	6
	3	2	0	0	2
	4	1	6	0	7
	5	3	0	0	3
	6	1	6	0	7
	7	2	16	0	18
	8	2	2	0	4
	9	1	2	0	3
	10	3	2	0	5
	11	0	0	0	0
	12	1	3	0	4
	13	1	5	0	6
	14	3	3	1	7
	15	9	14	0	23
	Means	2.27	4.80	.07	7.13

Table 19. Numbers and location of *Diatraea saccharalis* egg masses on potted sugarcane plants, of varieties N.Co. 310 and C.P. 44-101, placed in a greenhouse, Hill Farm, Louisiana State University Campus, Baton Rouge, Louisiana, 1967

Variety	Stalk	Top of Leaf: Touching Mid-Rib	Top of Leaf: Away From Mid-Rib	Bottom of Leaf: Touching Mid-Rib	Bottom of Leaf: Away From Mid-Rib	Leaf Sheath	Total No. Egg Masses Per Plant
N.Co. 310	1	3	0	2	0	0	5
	2	0	0	0	1	0	1
	3	0	0	0	0	0	0
	4	0	0	1	1	0	2
	5	0	0	0	1	0	1
	Means	.60	0	.60	.60	0	1.80
C.P. 44-101	1	0	0	1	0	0	1
	2	0	0	0	0	0	0
	3	0	0	1	0	0	1
	4	0	0	5	1	0	6
	5	0	0	5	0	0	5
	Means	0	0	2.40	.20	0	2.60

Table 20. Numbers and location of *Diatraea saccharalis* egg masses on potted sugarcane plants, of the varieties N.Co. 310 and C.P. 44-101, placed in a large walk-in screen cage, Hill Farm, Louisiana State University, Baton Rouge, Louisiana, 1967

Variety	Stalk	Top of Leaf		Bottom of Leaf		Leaf Sheath	Total No. Egg Masses Per Plant
		Touching Mid-Rib	Away From Mid-Rib	Touching Mid-Rib	Away From Mid-Rib		
N.Co. 310	1	0	0	1	0	0	1
	2	0	0	0	0	0	0
	3	1	0	0	0	0	1
	4	1	0	2	1	0	4
	5	0	0	0	0	0	0
	6	0	0	0	0	0	0
	7	0	0	0	0	0	0
	8	1	0	0	0	0	1
	9	3	0	0	0	0	3
	10	0	0	0	0	0	0
	11	0	0	1	0	0	1
	12	1	0	0	0	0	1
	13	1	0	2	0	0	3
	14	0	0	1	0	0	1
	15	1	0	0	0	0	1
	Means	.60	0	.47	.07	0	1.13

Table 20. (Continued)

Variety	Stalk	Top of Leaf: Touching Mid-Rib	Top of Leaf: Away From Mid-Rib	Bottom of Leaf: Touching Mid-Rib	Bottom of Leaf: Away From Mid-Rib	Leaf Sheath	Total No. Egg Masses Per Plant
C.P. 44-101	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	2	0	0	0	0	2
	5	2	0	1	0	0	3
	6	0	0	0	0	0	0
	7	0	0	1	0	0	1
	8	2	0	0	0	0	2
	9	0	0	1	0	0	1
	10	0	0	0	0	0	0
	11	1	0	1	1	0	3
	12	0	0	1	0	0	1
	13	1	1	1	0	0	3
	14	3	0	1	0	0	4
	15	0	0	1	0	0	1
	Means	.73	.07	.53	.07	0	1.40

VITA

Melvin Litton Kyle, Jr., was born July 31, 1939, at Houma, Louisiana. He graduated from Istrouma High School in Baton Rouge, Louisiana in June, 1957. He obtained a Bachelor of Science degree in Zoology from Southeastern Louisiana College in January, 1962 and a Master of Science degree in Entomology from Louisiana State University in June, 1965.

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EXAMINATION AND THESIS REPORT

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Major Field: Entomology

Title of Thesis: The effect of varietal resistance in sugarcane on the biology of *Diatraea saccharalis* (F.)

Approved:

S. D. Hensley
Major Professor and Chairman

R. D. Anderson
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Date of Examination:

March 28, 1968