INTRODUCTION

During the late summer of 1973, fall armyworm populations were abnormally high in the Hudson River Valley, and the resulting severe defoliation to late-planted dent corn caused much concern to producers and extension service personnel. Due to the ragged appearance of the plant resulting from larval feeding, a heavily infested field can be quite alarming. Many inquiries were received at this laboratory pertaining to the necessity of applying control measures to combat this pest.

It is recognized that the corn plant can recover from severe degrees of defoliation, the extent of recovery depending upon the particular stage of plant growth at which the damage occurs. Brown et al. (2), utilizing simulated defoliation, found that crop loss is negligible when defoliation occurs very early in the growth of the plant but becomes progressively greater as the plant matures. Hanway (3) found in small plot experiments that a 50 per cent simulated defoliation of plants at the time of tassel emergence reduced grain yield 25 per cent, but such data may not apply when one is concerned with large acreages within which the degree of defoliation may be quite variable. He also found that defoliation at this particular stage of growth resulted in a greater reduction in grain yield than did defoliation before or after that stage of growth. Neither of these studies make reference to the effect of concentrated damage within the developing whorl area of the plant and are somewhat unrealistic in that they do not consider the plant stress induced by larval re-inestation.

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2 Cooperative Extension Agent, Ulster County, Kingston, New York.
over a period of time. Morrill and Greene (4) found varying degrees of grain yield reduction in tests utilizing a series of plant maturity-larval infestation level treatments. Within the combinations, some non-significant levels of yield loss were found, but in certain instances losses from ca. 27-46 per cent occurred. The literature gives little or no reference to any silage yield reduction that may result from various degrees of defoliation.

Due to the fact that fall armyworm populations cannot overwinter in New York and must migrate from states to the south, a primary concern is to late-planted corn to be utilized for silage. Usually, initial infestations in such plantings are well advanced prior to detection; i.e., the larvae are in late stages of development and are within the whorl and difficult to reach with any toxin. In the past, we have been hesitant to recommend chemical control measures to such a crop under these conditions. However, in 1973, with comparatively high grain and feed costs and abnormally high fall armyworm populations and resulting severe defoliation in some areas, we were compelled to consider such treatments.

The most imminent questions were: How much does whorl damage and defoliation influence grain and silage yield and are insecticide applications to control initial and subsequent infestations economically justified? Two tests were conducted in Accord, New York in an attempt to answer these questions and provide a basis for control practice recommendations to producers.

**METHODS AND PROCEDURES**

The tests were conducted at separate locations within a 10-acre field of dent corn which was to be ensiled. The 75-80-day maturity corn was planted on July 10 in Poygam silty clay loam soil and was planted to ca. 18,000 plants per acre. The fertility history of the field included 300 pounds of 15-15-15 starter, plus an undetermined amount of manure, and 40 pounds of actual N as a sidedress application.

The infestation was discovered on August 22 when the plants were at the mid- to late-whorl stage. Treatments were initiated 5 days later when a majority of the plants were in the late whorl stage. Fall armyworm infestations are characteristically irregular throughout a large field, and the site of this test was typical in this respect. Some areas were very heavily infested while other sections were less severe. On the average, the test locations were 65 per cent infested at the time of treatment with many plants containing multiple larvae. It was determined that ca. 30 per cent of the larvae present at that time were down in the whorl and probably not subject to insecticidal action.

Two tests were conducted in separate areas of the field representing variations in plant vigor. Test 1 was located on a poorly drained area, and plant vigor was noticeably less than that of Test 2 which was located on well-drained soil. The sites were purposely chosen in this manner to determine if heavy insect stress on plants of low vigor would contribute a greater yield loss than an equal stress on vigorous plants.

Each treatment represented 1/10 acre. The treatments were: one application of parathion 8E (1 lb. Al/A), two applications of parathion 8E (1 lb. Al/A), and an untreated check. In the treatment which contained two applications, the applications were made 4 days apart. All treatments were applied to each 4-row plot with a high clearance sprayer operated at 40 p.s.i. and applied at a volume of 40 gallons per acre through three nozzles per row directed into the whorl area.

![Figure 2.—Fall armyworm damage to corn typical of that observed in untreated experimental plots.](image)

At the soft dough to early dent stage, the ears from each treatment were harvested by hand, weighed with husks intact, recorded, and the 36 per cent moisture corn was later converted to bushels per acre. Similarly, the above-ground plant portions from each treatment were harvested and weighed. This weight, plus the ear weight, constituted the silage yield which was computed as tons per acre. Due to the fact that each test contained non-replicated treatments, statistical analyses were not performed.

**RESULTS AND DISCUSSION**

**Grain Yield.** In view of the fact that grain yield was computed on ears of very high moisture, the authors assume that these data represent only the potential yields ob-
tainable from each test block. The data for potential grain yield are presented in Table 1. It is again pointed out that the grain yield figures include the husk weights, which present the yields as being slightly higher than they actually would have been. However, all treatment yields were computed on the same basis, so the data offer a valid comparison of treatment effectiveness.

The average yield difference between tests was 17.75 bu/A, with Test 2 giving the highest yield. In Test 1, the non-treated checkout-yielded both insecticide treatments. This fact makes it difficult to compare treatment effects between tests, but it appears that insect damage stress on the low vigor plants of Test 1 contributed to a greater yield reduction than did an equal stress on the more vigorous plants. A possible explanation for the apparent treatment non-effectiveness in Test 1 is that applied treatments were too late to influence survival of the partially defoliated, reduced vigor plants. At the time of treatment, many plants within this block were observed to be in a state of decline due to extensive whorl feeding, while Test 2, although ragged, did not exhibit such decline. Deep penetration of larvae into the bud results in death or stunting of the plant, but the production of a vigorous plant is effective in reducing the probability of larvae reaching and destroying the bud (4). It is concluded that the damage to Test 1 was irreversible due to low plant vigor at the time of infestation and that insecticide treatments were applied too late to alleviate this effect.

In Test 1, two insecticide applications resulted in a lower yield than did one insecticide application. The cause for this apparent reversal of effects is not obvious. Inconvenience to the cooperator prevented replication, but it is recognized that some degree of replication would have been desirable.

In Test 2, one insecticide application, when compared to the non-treated check, increased yield by 6.01 bu/A, while two applications resulted in an increase of 16.22 bu/A. These figures represent increases of 10.7 per cent and 28.9 per cent respectively, but they do not indicate if such yield increases justify the treatment costs. Certain economic comparisons within Test 2 are desirable to determine the feasibility of treatments to reduce fall armyworm injury.

Utilizing an aerial application rate of $3.50/A$ for each application, and the October 1973 corn quotation of $2.78/bu (Table 2), one application would yield a gain of $9.96/A$, while two applications would return a gain of $29.33/A. At this high corn value, probably one or two applications would be warranted. However, if one utilizes the average October corn quotation for the 3-year period, 1970-1972 ($1.33/bu), the justification of insecticide treatments is more difficult. One application would yield a gain of only $1.25/A and two applications would yield a gain of $5.81/A.

### Table 2—October #2 corn and corn silage quotations. New York, 1970-1973.

<table>
<thead>
<tr>
<th>Year</th>
<th>#2 Shelled Corn ($/Bu)</th>
<th>Corn Silage ($/T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>1.40</td>
<td>8.90</td>
</tr>
<tr>
<td>1971</td>
<td>1.10</td>
<td>8.83</td>
</tr>
<tr>
<td>1972</td>
<td>1.40</td>
<td>11.00</td>
</tr>
<tr>
<td>1973$</td>
<td>2.78</td>
<td>12.00</td>
</tr>
</tbody>
</table>

2 October 11, Binghamton, N. Y.
3 15.5 per cent moisture.
4 Corn silage assumed to be 1/3 value of good quality hay.

### Table 3—The influence of fall armyworm control on the silage yield of late-planted dent corn. Accord, N. Y. 1973.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate (AI/A)</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Increase Over Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parathon 8E 1 application</td>
<td>1 lb.</td>
<td>7.55</td>
<td>9.40</td>
<td>None</td>
</tr>
<tr>
<td>Parathon 8E 2 applications</td>
<td>1 lb.</td>
<td>7.40</td>
<td>10.36</td>
<td>1.76</td>
</tr>
<tr>
<td>Check</td>
<td>—</td>
<td>7.60</td>
<td>8.60</td>
<td>—</td>
</tr>
<tr>
<td>Average</td>
<td>—</td>
<td>7.52</td>
<td>9.45</td>
<td></td>
</tr>
</tbody>
</table>

### Silage Yield. The data for silage yield are presented in Table 3. The differences between tests regarding silage yield are similar to those described for grain yield and need no further explanation. In Test 2, one application, when compared to the non-treated check, increased yield by 0.80 T/A, while two applications resulted in an increase of 1.76 T/A. These figures represent increases of 9.3 per cent and 20.5 per cent respectively. Table 2 shows that the Oc-

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$^3$ Includes cost of parathon. This figure will vary according to the insecticide used and current application costs.

$^4$ Grain return estimates include discount for high moisture corn; i.e., 1 cent for each ½ per cent above 15.5 per cent up to 23 per cent; 1½ cents for each ½ per cent above 23 per cent.
October 1973 silage quotation was $12/T. Using this quotation and the same cost of application criteria previously described ($3.50/A/application), one application would return a gain of $6.10/A, while two applications would yield a gain of $14.12/A. At this value per ton, either one or two applications appear to be justified. The decision of treatment or non-treatment becomes more difficult if one uses the average quotation for the three previous years, 1970-1972 ($9.86/T). One application would have yielded a gain of $4.39/A and two applications would have realized a gain of $10.35/A. Table 4 presents a summary of the economic return from one and/or two insecticide applications with respect to both silage and grain yields.

There may be some question as to the pertinence of grain yield data taken from late-planted corn which is to be utilized for silage. Although grain yield is not of major concern in such instances, information on fall armyworm-induced losses is needed. In the event that high infestations occur, it is felt that these grain yield data may be applicable to earlier plantings destined for grain production.

CONCLUSIONS

Data are presented which show that the utilization of insecticide treatments to reduce fall armyworm feeding on late-planted dent corn can be beneficial and justified, depending upon plant vigor, the number of applications, and the ultimate market value of the product.

Insecticide treatments to plants of low vigor resulted in no yield increases, but treatments to plants of normal vigor did provide yield increases. This was true for both grain and silage. It is concluded that, in response to defoliation, the low vigor plants were in a state of physiological decline prior to treatment application and did not recover even though larval infestations were reduced.

It has been shown that one and/or two parathion applications are, in some instances, effective in the economic control of severe fall armyworm infestations, even though ca. 30 per cent of the initial infesting larvae are probably not within reach of the toxicant. Treatments were equally effective in producing silage and grain yield gains. Producers considering treatment against this insect and individuals responsible for recommending such treatments should make a serious effort to assess the ultimate value of the product. The individual producer is in the best position to determine treatment necessity and economic justification in his situation. Existing feed and forage prices should be of major concern. At a determined cost of spray application, a dollar value can be placed on the amount of increased yield required to cover costs. High feed, forage, and/or shelled corn prices would (appear to) indicate a favorable economic return from fall armyworm control.

LITERATURE CITED


ACKNOWLEDGMENTS

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