II. "ODOROUS CONSTITUENTS OF THE CORN PLANT IN THEIR RELATION TO THE EUROPEAN CORN BORER."

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Altho the European Corn Borer probably will never produce a direct change in the farming practice of Oklahoma, this insect is a serious menace to the agriculture of the states of the corn belt.

In the United States the borer was originally found in three distinct areas, one in New England and two in New York state. In the New England region it was reported in 1917. In 1919 it was reported in eastern New York at Scotia, and in the same year on a farm about 25 miles from Buffalo, New York. By 1925 the pest had spread until the boundary between the eastern New York and Lake Erie regions had been wiped out. At the present time the Lake Erie region includes a large part of Ontario, approximately one-third of Michigan, a corner of Indiana, the northern half of Ohio, the northwestern half of Pennsylvania, and practically all of New York. From this area infestation is spreading into the heart of the corn belt.

The problem of corn borer control has been attacked from many ang'es. The federal government appropriated $12,000,000 to combat the pest, most of which was used in an attempt to control the insect by mechanical means. Entomologists have been experimenting with insect parasites of the pest, the use of repellant dusts and stomach poisons, and the value of colors and odors as attractants. Agronomists have been determining the value of delayed planting, checking the growth of the young plant until after the peak of moth flight (and subsequently stimulating the crop to maturity before frost), clipping the young p'ants at the peak of moth flight, corn breeding, and so on. Ecologists have been mapping the forest areas in an effort to correlate them with the degree of infestation, in order that they might predict as far as possible the areas in which serious economic loss will be sustained as the European Corn Borer progresses westward and southward. The p'ant physiologist has been helping to solve the problem of control by adding to the results of the other workers, a more complete knowledge of host plants.

A wide variety of plants are attacked by the European Corn Borer. In New England, a total of 224 species have been recorded, including a number of field and vegetable crops, flowers and grasses. However, the insect seems to prefer corn to other hosts. There is little doubt that the moth is attracted to its host plants, corn in particu'ar, by some odorous constituent elaborated within the plant. While working at the Ohio State European Corn Borer Laboratory in the summer of 1926, Dr. Paul B. Sears of the University of Oklahoma, secured a substance by steam distillation of the corn that showed marked attraction for the adult insect when tested in an olfactometer.

During the past summer the work of finding the odorops principle was modified. Upon the suggestion of Mr. F. S. Bukey, of the University of Nebraska, petroleum ether as a solvent of the principle

was substituted by steam distillation. This change was made on the assumption that the attractant is an essential or ethereal oil such as is found in a wide range of plants and which often serves as the attractant to insects. Usually such oils are partly soluble in water and impart their odor strongly to the solution. Numerous extractions were made of corn and some of the more important substitute hosts, including smartweed, cocklebur, and the greater ragweed.

The degree to which the petroleum ether extract of corn would attract the adult moth before egg deposition was tested by using it as bait on artificial leaves. Results indicate that the moths may have some preference for the leaves treated with the corn extract. However the experiment was conducted a month after the normal flight of the moths, so late in the season that it was impossible to check the preliminary tests by repeating the experiment.

In the growing corn plant there are two distinct odors. When the green leaves are crushed, a very acrid odor is released, the intensity of which is directly proportional to the depth of the green color. The other odor is mild and aromatic in nature and is most pronounced in the yellow leaves of the growing tip and beneath the leaf sheaths. The relation between these odors and the moth attractant has not been established.

A morphological study of the corn leaf was made to locate if possible the cells in which the odorous principle was formed and further to determine its physical nature. Fresh sections of the epidermis taken from near the midrib were stained with Sudan III or Scharlach R. It was found that staining was facilitated by first treating the sections with hydrogen peroxide. Definite stained droplets were observed in the small cells between the elongated epidermal elements just above the vascular strands of the leaf. The small cells are usually found in conjunction with silicified cells that form a shallow wedge between the cells absorbing the stain and the neighboring epidermal cell.

Sections extracted in a variety of solvents for fats and oils and subsequently stained gave only occasional evidence of staining in the small cells referred to above. The solvents used were petroleum ether, ethyl ether, chloroform, carbon tetrachloride, absolute alcohol, acetone, chloral hydrate, and glacial acetic acid. As the last two solvents dissolve ethereal oils but not non-ethereal oils nor fats, the substance removed from the leaf may have been an ethereal oil.

Volatility in steam is considered a crucial test for ethereal oils. Sections of the epidermis placed over a steam bath from 3 to 8 minutes were stained in Sudan III. The substance absorbing the stain in this case was divided into small irregular masses in contrast to the spherical form of the substance staining in the fresh leaf. This residual material may be resin, fat, or mixture of resins and fat from which a volatile principle was removed by the steam.

Although the small cells in question were found in greatest numbers over the vascular strands of the leaf, modified forms were found over the palisade region. A few project above the surface as a two-celled structure resembling the antenna of an insect.

Although an essential odor of corn was secured in small quantities

from the steam distillate in 1924, the principle has not yet been extracted in pure form from the petroleum ether solution.

Conclusion

Preliminary evidence indicates that the odorous principle of corn may be an ethereal oil produced in small epidermal cells found in greatest numbers over the vascular strands of the corn leaf.