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**S. A. FORBES**

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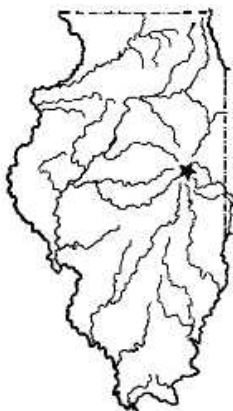
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BULLETIN NO. 95.

THE MORE IMPORTANT INSECT  
INJURIES TO INDIAN CORN.

GENERAL INTRODUCTION TO THE SUBJECT, AND DISCUSSION OF INSECTS  
INJURIOUS TO THE PLANT ABOVE GROUND.

By S. A. FORBES,  
STATE ENTOMOLOGIST.



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URBANA, ILLINOIS, NOVEMBER, 1904.

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## THE MORE IMPORTANT INSECT INJURIES TO INDIAN CORN.\*

BY S. A. FORBES, STATE ENTOMOLOGIST.

The Illinois State Entomologist is by law required to investigate "the entomology of Illinois," and particularly to study "the history of the insects injurious to the products of the horticulturists and agriculturists of the state," and to prepare "reports of his researches and discoveries in entomology for publication by the state." While the main end of his studies should thus be economic, the whole subject of the entomology of Illinois is nevertheless open to his investigation and report. The advancement of entomology as a science and the adaptation of entomological knowledge to educational uses, if not his duty, are clearly within the general field of his privilege. I have accordingly, in the preparation of this report, taken into especial account the rapidly rising interest in nature study as a useful feature of the work of the elementary school, and I have availed myself of the opportunity to incorporate into the present discussion much matter of little or no economic interest, but worthy of presentation, nevertheless, as material of value to the public school teacher in search of information concerning the commoner objects of his neighborhood.

The corn plant is so conspicuous a feature in the agriculture, and hence in the civilization, of Illinois, that it must always be an attractive subject of study to the youth of the state, and suitable in a multitude of cases for use in the public schools. Like most of the larger and more abundant plants, it draws to itself a considerable assemblage of insects which find in it various attractions and advantages contributing to their maintenance or their pleasure, and which thus, by their common interest in this one great plant, come to form a kind of associate group, the group of the *corn insects*. Very few of them are peculiar to the corn plant alone, since nearly all of them are equally or even more strongly attracted to other plants as well. Many of them, indeed, belong to a considerable number of such plant-insect groups, visiting or living on many other plant species, cultivated and wild.

Not one of them is immediately beneficial to the corn plant itself,

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\*This article contains the introduction and the first division of the Twenty-third Report of the Illinois State Entomologist. The remaining divisions of that report are devoted to the less important and the relatively unimportant corn insects.

although a considerable number, parasitic or predaceous on other insects, are indirectly beneficial to it by relieving it to some extent from the attacks of insect enemies. Several of them do no appreciable harm at any time; others are injurious only under special conditions more or less rare; and still others are injurious to it whenever and wherever they occur. Their common interest in this one plant of course brings these insects also into important relations to each other, like those which influence any local assemblage of animals—those of a pond, of a grove, or of a barnyard, for example—and make of them a related group instead of a mutually indifferent assemblage.

It is the object of the present report to discuss this entire group of corn insects, to the end that the teacher and student, of whatever grade, may find in this paper a clue to the whole system of insect life of which the corn plant is the center. The study here presented may thus stand as in many respects a type or example of the relations of a plant to its insect visitants. While in this treatment the economic features of the system will receive full attention, this will not be to the exclusion of features of scientific or educational interest merely; but to avoid encumbering the more important economic matter with details and discussions of secondary interest, the paper is divided into sections, based on the economic relation.

#### DIVISIONS OF THE CORN INSECT GROUP.

The entire assemblage of corn insects is much too large and complicated for convenient discussion as a whole, and it may consequently best be divided into subordinate groups, some corresponding to the different organs and structures of the corn plant itself, others to different stages of its growth, and still others to the previous history of the land on which the corn is grown or to the situation of the field with respect to other and adjacent crops. There is, for example, a small group of insects which become abundant in corn-fields only where corn is grown on the same ground year after year—the corn root-worm is an instance—while others, like the wireworms, infest corn injuriously only when this follows within a year or two upon grass, and others, like the stalk-borer, may invade corn only from grass-lands outside. The corn root-aphis makes its main attack on the crop while the plant is young, and the leaf-aphis usually does not appear until the crop is well advanced, and continues in rapidly increasing numbers until frosty weather checks its multiplication.

Among the groups corresponding to the different parts and organs of the growing plant the most definite distinction is between those especially adapted to a life under ground, and those which never enter the earth in search of food. The white grubs, wireworms, corn root-worms, seed-corn maggots, and root-lice are on one side of this dividing line, and the



chinch-bug, army-worm, corn-worm, leaf-louse, and a host of additional species are on the other. Among the subterranean corn insects we may distinguish a few which feed only on the softened seed in the earth; others confined to the living roots; other root insects which may extend their injuries to the underground part of the stalk; and still others which may also eat the seed.

While the relations of the injurious species of corn insects to the plant thus differ widely, making it possible to divide the species according to these relations, groups so formed are by no means as definite and sharply limited as those in a classification based on form and structure, but they overlap and intermingle variously, and may even undergo radical change with the lapse of time—a change corresponding to a change of habit in a species with the changing conditions around it. This is merely saying in other words that the actions, behavior, habits, and preferences of insects are more flexible and variable and far more readily adaptable than such of their structures as are used in their classification.

#### ADAPTATIONS AND REACTIONS OF THE CORN PLANT TO ITS INSECT VISITANTS.

There is little in the structure or the life history of the corn plant to suggest any special adaptation to its insect visitants—no lure to insects capable of service to it, or special apparatus of defense against those especially liable to injure it. The fertilization of its seed is fully provided for without reference to the agency of insects, and would be as well accomplished if none of them ever carried pollen from the tassel of one plant to the silk of another. Hence the plant secretes no honey and has no floral odor or colored bloom. It has no armature of spines or bristly hairs to embarrass the movements of insects over its surface or to defend against their attack the softer and more succulent foliage at its growing tip. It secretes no viscid fluids to entangle them, and forms no chemical poisons or distasteful compounds in its tissues to destroy or repel them. The cuticle of its leaf is neither hardened nor thickened by special deposits; its anthers are neither protected nor concealed; and its delicate styles—the silks at the tip of the ear—are as fully exposed as if they were the least essential of its organs. Minute sucking insects are able at all times to pierce its roots and its leaves with their flexible beaks, and with the single exception of its fruit there is no part of it which is not freely accessible at any time to any hungry enemy. Only the kernel, which was lightly covered in the wild corn plant by a single chaffy scale or glume, has become, in the long course of development, securely inclosed beneath a thick coat of husks, impenetrable by nearly all insects; and we may perhaps reasonably infer that among the possible injuries

against which this conspicuous protective structure defends the soft young kernel those of insects are to be taken into account.

There are also, of course, many insect species, even among those which habitually frequent the plant, which are unable to appropriate certain parts of its substance to their use, but this is because of the absence of adaptation on their part and not because of any special defensive adaptation on the side of the plant. The adult or beetle of the corn root-worm (*Diabrotica longicornis*) is an example. The larva of this insect feeds only on the roots of corn, and the beetles consequently all make their first appearance for the year in corn-fields, and find their food at first on the corn plant. Owing, however, to the weakness of their jaws they are unable to eat the leaves of corn, and feed only on the fallen pollen and the young silks just growing out from the husks. Later, as the pollen disappears and the silk dries up, they are driven to other plants, or even compelled to leave the field entirely in search of food, and hence are found at that time on clover heads and on the flowers of thistles and ragweed and other late-blooming plants.

Thus we may say that with the exception of the ear the whole plant lies open and free to insect depredation, and that it is able to maintain itself in the midst of its entomological dependents only by virtue of its unusual power of vigorous, rapid, and superabundant growth. Like every other plant which is normally subject to a regular drain upon its substance from insect injury, it must grow a surplus necessary for no other purpose than to appease its enemies; and this, in a favorable season, the corn plant does with an energetic profusion unexampled among our cultivated plants. Insects, indeed, grow rapidly as a rule, but soon reach their full size. Many species multiply with great rapidity, but even these the corn plant will outgrow, if given a fair chance, provided they are limited to corn itself for food.

The great injuries to corn by insects are done by species which come into it from other and earlier crops; insects which are in the full tide of their multiplication, or perhaps at their maximum number for the season, while the corn plant is still small and young. It is not the corn root-aphis which injures corn most seriously, although confined to the corn plant and endowed with a power of multiplication scarcely surpassed among insects; it is the chinch-bug, which breaks into the field of young corn from adjoining wheat or oats, where it has already increased a hundredfold since spring began; it is the army-worm or the cutworms or the wireworms or the white grubs, which began and got most of their growth in grass, and now, by their numbers and voracity, overwhelm the young corn before the time of its most rapid growth has arrived. Practically limited to this vigor of growth as a means of escape from insect attack, anything which checks or retards its growth for a considerable time has, of course, the effect to increase insect injury.

Thus, a cold and backward spring after corn-planting increases injury to the seed and the young plant by wireworms, seed-corn maggots, and the corn root-aphis; and a midsummer drouth greatly increases the effect, if not the amount, of injury by chinch-bugs, white grubs, and the corn root-worm.

#### GENERAL EFFECTS OF INSECT INJURY.

With few exceptions, the effects of injury to corn by insects, where they do not amount to a total destruction of the plant, may be compared to the effects of simple starvation. Anything which lessens the store of food laid up in the corn kernel for use in germination and early growth, or damages seriously the roots or the leaves, or draws away the sap before it has served its purpose in the plant, practically amounts to a diminution of the available food supply. An impoverished soil, very dry weather, the sapping of the cells and vessels of the plant by sucking insects, destruction of any considerable part of its roots, and the deadening or destruction of any large percentage of its leafage, all have similar consequences, which may be classed as starvation effects, and when two or more of them coincide, each serves, of course, to intensify the effects of the others.

One common result of these starvation injuries to corn is the failure of the plant to form the ear; the stalk itself, perhaps, making a fairly vigorous growth, but remaining barren, and hence useless except for fodder. Injury to the roots, if continuous and severe, has, however, another effect, of a more special character, in so weakening the hold of the plant on the earth that the stalk readily falls after it has become top-heavy with growth, and is not able to rise again. This happens after soaking rains have softened the ground, especially if accompanied by heavy winds. It is sometimes a consequence of the destruction of the roots by the corn root-worm and the white grubs, and is sometimes due to chinch-bugs, which, by sucking the sap from the base of the stem, prevent the formation of the strong "brace-roots"—the upper circle of roots—put forth during the last stages of the growth of the stalk. Actual loss of roots sometimes also delays the development of the plant, acting in this respect like an unusually cool summer. Thus, a field infested by grubs or root-worms may remain green after uninjured fields are practically ripe. Such backward fields are especially exposed to injury by frosts, and hence are likely to yield an unusual amount of soft corn.

Besides this class of general injuries, which diminish the vitality and lessen the size or delay the growth of the whole plant, there remain only the more local injury to the ear, caused almost wholly by the caterpillar known as the corn root-worm, and the damage done to the ear in the crib or to the kernel in the bin by the weevils and other insects of similar