

## THE ILLINOIS PLANT DISEASE SURVEY

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## INTRODUCTION

Wherever agricultural pursuits are followed to an extent that is nationally important, plant diseases demand a large amount of attention because of their destructive character. The establishment in July, 1921, of a Plant Disease Survey in Illinois is a recognition of this fact.

It is the purpose of this paper to present to the Academy of Science an outline of the problems which lie within the province of the survey, and to summarize the results of the first season's work.

The Plant Disease Survey is one of the activities carried on by the State Natural History Survey in its program of study of the biological phenomena of Illinois. The purpose of the survey may be outlined as being concerned with three chief tasks:

1. To ascertain what diseases occur within the state of Illinois.
2. To study their distribution throughout the state.
3. To determine how much damage they do.

So broad a generalization as this enumeration indicates may best be defined within its limits through a more detailed examination of the lesser tasks involved in each of the above.

## ASCERTAINING WHAT DISEASES OCCUR

Plant diseases may be classed, for our present purpose, as being either important, or unimportant, from an economic point of view. Whatever disease attacks a plant grown for its agricultural value whether or not it is, in itself, serious, must be considered as an economic disease, for it adds in some measure directly to the total crop loss of the state from plant diseases. It is essential, therefore, that all diseases of crop plants shall receive some attention. The amount of attention may, however, be distributed either in accordance with the value of the crop or the importance of the disease to the crop. One would expect to pay but little attention to the

lettuce or radish bed in the city garden, while much effort would be expended justifiably upon the group of diseases attacking more important crops such as corn, cereals, and fruits.

Diseases unimportant economically need to receive a reasonable amount of study because their study may lead to the development of facts applicable in an important way to the understanding of those diseases which are economically important. Such study also serves directly in the advancement of purely scientific knowledge which is, of course, the basis of all of our practical applications. In this category will be included all diseases occurring on all plants whether weeds, herbs, shrubs or trees, not usually grown as crops.

The scope of the survey must lie largely, if not entirely, within that group of disease caused by microscopic fungi and organisms of an allied nature. This is especially true since diseases of this type of origin constitute by far the greater number and variety of afflictions to be dealt with among plants, and because those morbid conditions due to the attack of predatory insects have long since been recognized as lying within the province of the entomologist.

#### THE STUDY OF DISEASE DISTRIBUTION

In its essential aspect, this phase of the survey work may be expressed briefly as determining in what localities diseases occur. In the practical application of control measures, as well as in the purely scientific consideration of plant diseases, a knowledge of geographic distribution is often of real value. In the application of control measures it may indicate to what extent the program is practical, or it may serve to determine the amount of territory to be included in the program. And in course of time it may serve to determine the degree of effectiveness which the control measure has attained. From a scientific view point, information of real value may be developed through the correlation of details of time, place and severity of infection with weather conditions, edaphic host relations, etc. The ultimate scientific use of these facts would be in the development of principles of an

ecological character, of important conclusions of an epidemiological nature, and may even lead to the possibility of predicting with reasonable certainty whether or not epiphytotics of any disease should be expected in a given season.

It is probable that some distinction exists between what should be considered as "survey" and what "inspection". The work of a survey may be said to be of a more extensive nature, concerned with the whole aspect of a problem, rather than with any small part. For the present at least the Plant Disease Survey finds it impossible to consider plant diseases in any greater detail than as to how they affect whole counties. Counties are chosen as an arbitrary unit for lack of any sufficient ecological or agricultural stratification of the state.

#### DETERMINING DAMAGE DONE

This is probably the most difficult phase of the work which the Plant Disease Survey plans to undertake. Under any circumstances, estimates of damage are bound to be merely relative. In the case of grains, for example, while one may determine rather accurately the damage done to a given plant by such diseases as smut and scab where it is considered that the loss is limited largely to the affected grain, these diseases which are of a more generally parasitic nature such as the rusts present problems in estimation that are difficult in the extreme. Arbitrary scales for judging the percentage of infection on a given plant might serve admirably for this purpose were it not for the numerous complicating factors. In the case of rust, where the ultimate damage is apparent mostly in the shrivelled grains, there are other factors tending toward the weakening of the plant and the smallness of grains, such as early ripening in dry and hot weather, the presence of minor parasitic agents such as *Helminthosporium*, glume blight, etc.

It is, nevertheless, very necessary that some sort of estimate of damage be made because it will have a very real value in pointing out, if only in a relative way, the true importance of plant diseases in limiting crop production, and in indicating where there is need either of

careful scientific consideration or the application of well-advised prevention or control programs.

Certain methods may be of use in this kind of determination. In the first place, there should be secured in large quantity data showing the percentage of infection upon individual plants. To this should be added data showing the percentage of diseased individuals in separate fields, and the percentage of diseased fields in a county. A correlation of this information, based upon expected yield, with the actual yield, will lead to relatively accurate determination of the damage done.

#### CORRELATED ACTIVITIES

While the importance of the Plant Disease Survey lies chiefly in its ability, through its attention to the distribution of disease and its other studies, to direct attention to those diseases which are of a particularly dangerous nature, so that proper control measures may be developed or applied at the proper time and in the proper places, according as the need may be, there are in addition a number of possibly less important but none the less vitally needed lines of endeavor which must of necessity fall within its scope. Several of these have been mentioned in previous paragraphs, but a grouping of them at this point will serve to emphasize them in their proper relation.

In bringing together observations concerning the origin of diseases and their relation to the weather, temperature, moisture, etc., there seems to be some justification in supposing that attempts, in a small way, may soon be made toward the forecasting of outbreaks of diseases, and that this may be increased as time goes on and data becomes more generally available. The coupling of this possibility with timely warnings concerning the preventive measures which may be advisably applied would render a service of real value from an economic standpoint.

Since the survey is concerned with all parasitic diseases of plants, it becomes its duty to develop an herbarium containing specimens of all diseases occurring



within the state, and from every county in which the disease occurs.

In connection with the study of diseases not having special economic importance, it becomes the duty of the survey to attend to the scientific study and description of all new diseases. It is also necessary to watch carefully the entire state for the presence of newly imported diseases, and have on hand information showing newly reported diseases in other places which might invade the state and cause additional crop losses.

#### SUMMARY OF THE FIRST SEASON'S WORK

Following the beginning of the work of the Plant Disease Survey early in July of 1921, the lines of work outlined above have been carried on to as large an extent as possible.

Attention has been given to as many crops as possible, and collections of specimens have been made, and estimates of damage arrived at, in co-operation with other agencies throughout the state.

While, at the time of the beginning of the work, the grains of the state were largely cut and harvested, it was possible to make a survey through several counties on the northern boundary of the state. The material gathered here was correlated with other information received from various sources from several parts of the state, and combined with the information on hand at the Department of Crop Production at the University of Illinois with the assistance of Mr. G. H. Dungan, to form an estimate of the damage to grains through the various parasitic diseases.

Fruit, vegetable and other crops were still available for a reasonable amount of attention following the establishment of the survey. As a consequence, a relatively larger amount of data was collected along this line than in the case of cereals. This data was combined with information on hand in the Horticultural Department of the University of Illinois, and the two sets combined in

co-operation with Dr. H. W. Anderson are presented in summary below:

Summary of fruit, vegetable, and ornamental diseases for 1921.

#### FRUITS.

##### APPLE:

*Bitter rot* (*Glomerella cingulata*)—Local damage averaging 1% in orchards planted to late varieties in southern part of state.

*Black rot* (*Physalospora cydoniae*)—Distributed throughout the state. Loss approximately 2%, chiefly through rotting of wormy fruit.

*Blister canker* (*Nummularia discreta*)—Generally distributed throughout the state, but more severe in southern Ben Davis orchards.

*Blotch* (*Phyllosticta solitaria*)—Distribution general southward, present locally northward. Reduction in yield about 5%.

*Brown rot* (*Sclerotinia cinerea*)—Appeared generally throughout the state, chiefly on wormy fruit, causing only a trace of damage.

*Blight* (*Bacillus amylovorus*)—Attacks were chiefly local and more severe northward. Damage about 1%.

*Cedar rust* (*Gymnosporangium juniperi-virginianae*)—Present chiefly south and westward. Damage only a trace, due chiefly to leaf injury. Occurring especially on Benoni, York, and Wealthy.

*European canker* (*Nectria galligena*)—Not generally distributed. Only one case reported. Little if any damage.

*Fruit spot* (*Phoma pomi*)—Present in the state but not generally distributed. No damage.

*Powdery mildew* (*Podosphaera leucotricha*)—Widely distributed throughout the state, but important only in nurseries. Crop damage little if any.

*Rough bark* (*Phomopsis mali*)—Probably widely distributed though not commonly reported. No appreciable damage.

*Scab* (*Venturia inaequalis*)—The most important apple disease. Distribution general, with 95% of the orchards of the state infected. An estimated reduction in yield of from 10 to 15%.

*Root rot* (*Xylaria* sp.)—Present locally in extreme south, not an important disease.

*Root rot* (*Armillaria mellea*)—Rare in Illinois. No appreciable damage.

*Jonathan spot*—A very important disease on Jonathan apples. Distribution general.

*Measles*—First reported last season. Not now important.

*Cracking* (due to weather conditions)—Serious locally on Stayman's winesap.

##### PEAR:

*Blight* (*Bacillus amylovorus*)—Loss very slight. Present mostly as twig blight which was checked by hot weather of June and July.

*Leaf spot* (*Fabraea maculata*)—Very important disease. Present in epiphytotic form in Marion and Union counties. Especially severe on French seedling stock in nurseries.

*Leaf spot* (*Mycosphaerella sentina*)—No loss. Appeared late in the season.

##### PEACH:

*Bacterial leaf spot* (*Bacterium pruni*)—Distribution general. Some losses locally resulting from defoliation.

*Leaf curl* (*Exoascus deformans*)—Distribution general. Damage slight if any.

*Scab* (*Cladosporium carpophyllum*)—Abundant generally on twigs. Loss undeterminable.

#### PLUM:

*Bacterial spot* (*Bacterium pruni*)—Distribution general, but damage slight.

*Pockets and leaf curl* (*Exoascus pruni* and *E. communis*)—Local distribution, resulting in leaf curl and deformed twigs. Damage none.

*Black knot* (*Plowrightia morbosa*)—Distribution general. Loss undetermined.

#### CHERRY:

*Leaf spot* (*Coccomyces hiemalis*)—Distribution general. Damage undetermined.

#### GRAPE:

*Black rot* (*Guignardia bidwelli*)—Generally distributed. Found in 95% of vineyards of the state, causing loss of approximately 20% of the state's crop. The most serious grape disease.

*Downey mildew* (*Plasmopara viticola*)—Distribution general. Appearance late, with the wet weather of August and September. Damage slight, mostly leaf injury.

*Powdery mildew* (*Uncinula necator*)—Distribution general. Damage slight if any.

#### BLACKBERRY:

*Anthracnose* (*Plectodiscella veneta*)—Generally distributed. Loss 2 to 5% of the crop.

*Crown gall* (*Bacterium tumefaciens*)—Present throughout the state, injuring between 5 and 10% of the plants.

*Yellows* (Physiological)—Distribution general, more severe northward. Loss approximately 2% of the crop.

#### CURRENT:

*Angular leaf spot*—Distribution general, damage slight.

*Anthracnose* (*Pseudopeziza ribis*)—Distribution general, serious only locally, causing defoliation. Damage slight.

#### GOOSEBERRY:

*Anthracnose* (*Pseudopeziza ribis*)—Serious locally, though generally distributed. Causing defoliation. Damage slight.

#### STRAWBERRY:

(Physiological)—Present in Champaign and Marshal counties. Not important.

*Leaf spot* (*Mycosphaerella fragariae*)—Distribution general, but serious only locally. Total damage about 2%.

*Leaf scorch* (*Mollisia earliana*)—Present in Champaign county and serious on the Bederana variety.

The cold wave, occurring over the entire state about the middle of April, 1921, did a great deal of damage to the fruit crop of the state. As a result, estimates of damage which should be based upon yield could not, in

many cases, be made because there was practically no crop on those plants.

#### DISEASES WORTHY OF NOTE IN 1921

It is worth while calling attention to certain diseases which, during the past season, were especially destructive either in state wide or in local epiphytotics.

At Libertyville, in Lake county, red raspberry plantings were suffering severely from an attack of physiological leaf curl. This disease is known commonly among growers as "yellows" and as "Marlboro disease". There is no known cause for the disease, and effective treatments are unknown. While this disease is not widely distributed through Illinois at present, wherever it has appeared it has been one of the most serious diseases of the raspberry. The losses from this disease in the severely infested raspberry plantings in Lake county has been estimated to be nearly 90% of the total crop.

Several patches of strawberries in Lake county were injured to the extent of a 50% crop loss through the attack of the strawberry leaf spot caused by *Mycosphaerella fragariae*.

The Physoderma disease of corn, while prevalent throughout the southern half of the state, was nowhere severe with the exception of an area around Eureka in Woodford county, where the disease was reported as doing considerable damage. Samples received and examined by us were so severely diseased that we feel justified in estimating a loss of at least 25% in this area. This is especially remarkable in view of its northness.

In all of the cabbage growing sections of the state, the disease known as cabbage yellows, caused by *Fusarium conglutinans*, was the cause of an important reduction in the yield of the cabbage crop. Damage was particularly heavy in the Peoria district, and in the small gardens of Champaign County.

In Coles county, black knot of plum, caused by *Plowrightia morbosa*, appeared in rather more than its usual destructive abundance. In the same county broom corn blight, caused by *Bacillus sorghi*, appeared to be damaging beyond use about 1% of the plants in the fields, but

the damage from the two smuts of broom corn appeared much less than that due to the bacterial disease.

One bad outbreak of alfalfa leaf spot, caused by *Pseudopeziza medicaginis*, appeared in St. Clair county, and Jonathan spot on apples appeared to be a serious problem in Vermilion county, as was also tomato wilt caused by *Fusarium lycopersicae*.

#### NEW DISEASES

During the season of 1921 there came to our attention several diseases not hitherto reported in Illinois. Several of these diseases occurring on fruits, vegetables and ornamentals are described in a paper by Dr. H. W. Anderson and need not be discussed here.

Along the lake shore north of Lake Bluff in Lake county, several greens on an expensively built golf course were being very badly damaged through the attack of *Rhizoctonia solani*. Often the loss would be as much as \$500 for a single green since great care was being exercised in caring for the course, and especially imported seed of the New Zealand fescue grass was being used for seedage. This troublesome disease has hitherto been reported only from the neighborhood of Washington, D. C., and it seems unlikely that in Illinois the disease will become of more than a local importance. The parasite causing the disease seems to be a normal inhabitant of forest soils, and is readily transplanted from woodlands to golf courses or grass plots in the neighborhood. The parasite seems to be spread from green to green on the golf course by the shoes of the players and caretakers, and its development and spread on the green itself furthered by the presence of abundant moisture. On greens not wholly level the course of the spread of infection corresponds strikingly with the course of water used for irrigation. Cool moist nights appear to favor the development of the fungus, and in the mornings it can usually be detected as a thin, cobwebby film of fungous hyphae running among the leaves of the grass. The collection of dew among its mycelial strands gives it the appearance of a fine cloud lying in the grass. The heat of the sun on a bright dry day seems sufficient to stop the advance of the fungus,

and it does not apparently spread farther from the one spot, all further damage to a green resulting from the new infections.

A stalk rot of corn made its appearance in some of the fields of Monroe and Jackson counties. This stalk rot appears to be of bacterial origin, is not grossly similar to Stewart's disease, and has certain points of similarity with a disease described by Rosen as appearing in Arkansas.

#### SURVEY SERVICE

The Plant Disease Survey has assisted in the quarantine area in Madison County, where a program of control and eradication is being waged by the State of Illinois Department of Agriculture against the recently introduced flag smut of wheat caused by *Urocystis tritici*.

There is also available, through the efforts of the survey, a complete list by parasite, by host, and by locality of every disease so far known to exist within the state. A bibliography, comprising about 325 titles, indexes all publications concerning the presence of plant diseases in Illinois.