

SURVEYS TO ASSESS PLANT DISEASE LOSSES

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This title brings together three separate concepts: surveys, losses, and assessment or measurement. I will discuss each of them briefly before attempting to put them into relationship with one another.

Surveys

Organized plant disease surveys on a national basis have been in existence since 1917, when, during the First World War, countrywide surveys were initiated in both Great Britain and the United States. Canada followed the trend in 1920 with the establishment of the Canadian Plant Disease Survey and, as was the case in the other two countries, proceeded to collect, identify, and catalogue the diseases occurring on crop plants. The founders of our Survey hopefully included in their terms of reference "the obtaining of accurate knowledge of the losses due to commoner plant diseases" (W. H. Rankin and W. P. Fraser, in litt, 1920). They further stated, "in no other way can pathologists approach the public for obtaining recognition of their professional work than by accurate data concerning such losses."

Insofar as building up an inventory of plant diseases in Canada our Survey has done an admirable job. The extent to which it has succeeded is now a matter of public record with the publication, in a few weeks' time, of I. L. Conners' Annotated Index of Plant Diseases in Canada. As its title suggests, it is much more than a list of diseases since the author, using the published records of the Canadian Plant Disease Survey, discusses the history, the fluctuations, the relative importance, and the geographic distribution of our major crop diseases from 1920 to 1960.

The publication of this Index could and, I firmly believe, should mark the beginning of the end of our emphasis on purely qualitative surveys. I hope that, as a result of the discussions here today, Canadian plant pathologists and those who direct policy will reevaluate their concepts of disease survey work and encourage surveys with a purpose. The purpose may be the evaluation of losses, the accurate forecasting of disease outbreaks, or the acquisition of a better understanding of the etiology and epidemiology of major diseases.

Survey resources in Canada

Three distinct plant disease survey organizations now exist in Canada. The one with which we here are most familiar is the Canadian Plant Disease Survey. It has one full-time employee in Ottawa

who depends on the voluntary survey efforts of 150 plant pathologists, other plant scientists, and extension specialists in all parts of Canada. Approximately one-half of these volunteers submit their disease observations on an annual basis, and at Ottawa an attempt is made to interpret the status of plant diseases in Canada for that particular year.

You will immediately say that the observations of 75 qualified observers each year should be more than adequate to furnish all the information needed to give a complete picture of disease conditions. However, these are all part-time observers, and one man may report on 10 to 20 separate diseases encountered in a one-day excursion into the field. This is hardly reporting in depth. More important is the fact that these regular contributors tend to be concentrated in a very few areas resulting in extremely good coverage of conditions on one crop in one district and absolutely no records on other crops or from other districts. Coverage, then, as it exists can only be described as partial and spotty. I can envision no way, under the present organization of the Survey, to obtain complete coverage.

The second organized survey activity is that of the Plant Protection Division. Their surveys for both diseases and insect pests are carried out for regulatory purposes having to do mainly with the export of produce. You will be familiar with the surveys and inspections made on the seed potato crop, undoubtedly the most intensively surveyed crop in Canada. This activity consists of a four-man staff at Ottawa backed up in the field by 100 potato inspectors at various centers across the country. Their main function is to certify freedom from specific diseases of plant material moving in export, import, and interprovincial trade. Special surveys, when made, are usually limited in scope to determining the presence or absence of specific diseases in a given locality.

The third survey activity is that of the Forest Disease Survey. This activity was established in 1951 in the Department of Agriculture but now operates within the Department of Forestry and Rural Development. It employs the full-time services of 15 professional and 100 non-professional workers at seven locations across Canada. Its professional staff includes specialists in several fields of mycology. Although much of the survey work is qualitative in nature, the program is designed to yield information on losses and advice on forest management.

Losses

The extent of plant disease losses on a world basis is a matter of conjecture. In a 1963 publication from California (4), it is stated that world crop losses from plant diseases are estimated at three billion dollars annually; and it has been estimated that the annual average loss in the United States

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from diseases and air pollution, excluding nematodes, exceeded three and a half billion dollars for the years 1951-1960 (3). There are no comparable figures for Canada. I am going to break tradition and depart from what seems to be an inborn reticence among Canadian plant pathologists to mention losses and suggest that the annual crop losses in Canada from plant disease are probably between one quarter and one third of a billion dollars. These figures were derived following the method outlined by LeClerc (2).

Types of losses - Losses attributable to plant diseases may be categorized in more than one way. The simplest way is to consider them as direct losses and indirect losses. Direct losses are the most obvious and consist of visible reductions in the yield or quality of the crop, or both. Indirect losses may be very costly as well. The mere presence of some diseases, although they are the cause of little concern in crop production, may bar the crop from the export market; for example, Monilinia laxa in British Columbia, and Pseudomonas pisi in southern Alberta. The presence of certain soil-borne pathogens, such as Sclerotium cepivorum, Plasmiodiophora brassicae, or Verticillium dahliae, on certain farms may force the owner to shift production to non-susceptible but less profitable crops.

We should also consider, in the same context as losses, the increased costs of producing, grading, and storing produce as the result of the presence of diseases which, in themselves, have little effect on yield.

If the quarter-billion dollar figure for losses from disease is a valid one, and if this was added to losses caused by insects, inclement weather, and other causes, and if these losses were borne every year by growers, we would very shortly have no growers. Fortunately, the law of supply and demand takes over and it is not unusual for the grower to receive more cash income from a short crop than from a normal or bumper one. This does not mean that individual growers or groups of growers don't suffer substantial losses in some years, but decreased yields are often compensated for by higher per unit prices. Generally speaking, losses are borne by the economy of the country as a whole.

The economy of this country, in contrast to that of many others, is such that the consumer will pay the price asked for the product he wants. Furthermore, disease losses in this country rarely affect the availability of produce. Food distribution is organized on a continental basis and the chances of an epidemic affecting the potato crop, for instance, in all producing areas of North America at the same time is very remote.

Assessment of losses - Let us assume that, with some notable exceptions to be discussed by the other speakers, little attention has been paid in this country to the matter of disease losses. Little, that is, in comparison with a country like Britain where

losses in crops are a matter of national concern. Everything Britain can't grow she must import and imports are a drain on depleted foreign exchange reserves.

Is it because we in Canada are so well off we can choose to ignore or shrug off losses of more than a quarter of a billion dollars annually? Is it because we are compensating for losses with great advances in productivity? Is money for research so easily available that the research does not have to be justified on a dollar return basis? I think that there is probably just enough truth in each of these premises to make us complacent. We face no impending food crisis as was the case in Great Britain in 1917, when they recognized the need of plant disease surveys, and again in 1941, when they formed a Disease Measurement Committee. There is, however, a global food crisis that will affect us either directly or indirectly in a few decades. Should we take steps now, through purposeful surveys, to learn something of the extent and nature of our disease losses, or should we continue to ignore them? This question can only be answered at a policy-making level.

Disease losses can be measured. This has been amply borne out by our colleagues at Harpenden in England. I cite the paper by Large and Doling (1) on the measurement of the intensity of cereal mildew and its effect on yield. This study conclusively proves that yield losses can be accurately predicted by the degree of infection by this disease at a specific stage of growth of the host plant. The necessity of standardized surveys is also evident from the data presented in the paper.

I submit, in conclusion, that there is a need in Canada for firstly, as I mentioned before, a change in attitude toward the value of disease survey activities; secondly, an active program of research into methods of determining disease losses; and finally, a recognition of the fact that one person, even when supported by the volunteer efforts of others, cannot possibly draw an accurate picture of the yearly impact of plant diseases on the Canadian economy.

literature cited

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3. United States Department of Agriculture. 1965. *Losses in agriculture*. U.S. Dep. Agr., Agr. Handbook 291. 120 p.
4. University of California, Committee on Plant Disease Losses. 1965. *Estimates of crop losses and disease-control costs in California, 1963*. 102 p.

DISCUSSION OF THE PAPER BY D.W. CREELMAN

- W.P. Skoropad: Do the figures that you cite include storage losses?
- D. W. Creelman: I used a blanket 10%. Storage losses can be considerable. Regrading and re-packaging may be involved. Two years ago 'shrinkage' was serious with the potato crop, yet we do not know what causes 'shrinkage'.
- T. G. Atkinson: The impressive U. S. D. A. publication "Losses in Agriculture" to which you referred does not, if I remember correctly, indicate in any detail the way in which loss figures were determined. Do you know what procedures were used?
- D. W. Creelman: I think greater detail is given by LeClerg in a paper presented to an American Phytopathological Society symposium on the same subject in 1964. It was the work of a committee which asked the opinions of leading pathologists and others concerned across the country, such as agronomists and persons in the trade, regarding the losses in a crop from a disease. Of course, it involved estimation. As E.C. Large pointed out in an excellent chapter in the Annual Review of Phytopathology last year, even the best of estimates are tentative and are subject to opinions and judgments throughout, and there has been little attempt to back them up with experimental evidence.
- D. J. Samborski: Would you agree that many of the loss estimates are nonsense? For example, I might say with little justification that last year there was a 10% loss due to leaf rust. How credible are these estimates?
- D. W. Creelman: Well, if you said it Dr. Samborski, it becomes authoritative. This situation is true for each of us. For example, in my position with the Plant Disease Survey, if I were to say that annual losses from plant diseases were a quarter of a billion dollars, this too becomes authoritative and no one can dispute me until work is done on the subject.
- W. E. Sackston: I believe the reference that Mr. Creelman cited is an important one. It is the 1963 A. P. S. symposium that was published in 1964. LeClerg makes the point that there is little factual information from which to draw objective conclusions on disease losses, with very few exceptions. Chester in a publication in 1950 also emphasized this point. We appear no worse off in Canada than elsewhere. I'm certain that Dr. Greaney's sulphur experiments are still referred to often.
- D. W. Creelman: Two years ago Dr. Paul Miller told me that the only group of pathologists that he believed knew their losses were those working with cotton. A comprehensive approach is used with pathologists from industry, state, and federal institutions meeting frequently. Dr. Miller thinks that this group comes up with figures very closely approximating the actual losses. I may mention that FAO is sponsoring a symposium on disease losses this fall in Rome. Canada is likely to be represented there. I hope that this current meeting will produce some ideas and information that will be valuable to the delegate from this country so that he may have something definite to say.
- T. C. Vanterpool: Can indirect losses be assessed better than direct losses? For example, the cost of plant quarantines may be exactly known.
- D. W. Creelman: This would be a very small amount, in the order of \$1.5 million. We know how much is paid out in compensation; we know how much is paid out in plant protection, but what are we protecting and what are we saving? This is what I hope will be discussed here today.
- E. R. Waygood: Are there any firm figures on losses in tobacco for Ontario?
- D. W. Creelman: I have not seen any report on tobacco losses other than the one by Dr. Patrick about the time he left Harrow, in which one disease caused by *Thielaviopsis basicola* was claimed to cause a loss in tobacco of \$1.5 million annually. Losses in quality rather than losses in quantity are very important in tobacco. As you know the leaf has to be unblemished; such things as weather speck caused by air pollution, and other leaf spots can reduce tobacco from top to bottom grade very quickly.