AERIAL SURVEY FOR BACTERIAL BLIGHT, 1970[1]

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In 1968, the first plant disease survey of field beans by aerial infrared photography in Canada was conducted (7) as part of a national crop loss assessment program to relate the intensity of disease in crops to actual losses in the field. The survey revealed that with adequate ground truth and the ability to relate ground truth observations to film records, bacterial blight could be identified by means of the patterns of foci in the field; based on film records the % area affected in each field could be determined by a drum scanner technique (8).

To date, the best method of controlling bacterial blight in Canada is to introduce each year breeder seed stocks from Idaho and California. The resulting Select plots are usually free from common blight but sometimes contain traces of infection that are usually detected by plant pathologists during crop inspections. Any affected plots are discarded for future pedigreed seed stocks. However, despite stringent regulations, a gradual buildup of infection takes place in the following generations of seed crops produced in southwestern Ontario, and new breeder seed must be imported each year to keep infection at as low a level as possible.

Aerial photography is being used to ascertain the general incidence of bacterial blight in the field bean crop and to monitor the effectiveness of the program of importing disease-free breeder seed. In 1970, certain Select, Foundation, and Certified crops in two areas of southwestern Ontario near Hensall and Chatham were surveyed by aerial photography and by direct inspection on foot. Bacterial blight is also being used as a model in an attempt to develop better plant disease survey techniques.

Methods

During August 1970, extensive ground-truth studies were carried out in bean fields under two flight paths. Forty-two fields of white beans (Phaseolus vulgaris L.) in the Chatham area and forty fields in the Hensall area were examined prior to August 10 in the first survey and prior to August 24 in the second survey for the presence of bacterial blight. As bacterial blight is seed-borne, producing foci of varying size based upon secondary spread of the pathogen, field infection varies throughout the fields and no set pattern of field survey and no realistic estimate of disease percentage are possible. The survey here was conducted to obtain a visual knowledge of the location and approximate size and severity of infection foci so that this information could be correlated with aerial photographs for disease interpretation. Select plots of 1 to 2 acres were completely surveyed and larger fields were surveyed until the disease pattern in the field was evident. Diagnosis was confirmed by sending leaf samples from affected plants to the Ottawa laboratory where the causal organisms, Xanthomonas phaseoli (E.F. Sm.) Dows. and Xanthomonas phaseoli var. fuscans (Starr. & Burkh.), were isolated and identified (9). The first survey was conducted to locate initial foci and the second to indicate the extent of secondary infection.

Kodak Ektachrome Aero Film 8443 was used in conjunction with a Zeiss B (yellow) filter and processed as a positive from which reversal prints were made. A Zeiss camera with a 12-inch focal length lens and an exposure of 5.6 at 1/300 of a second was used. Flights were made on August 16 and 23 at two altitudes to produce scales of 1:3600 and 1:9600.

The photography of the Hensall area was chosen for a more detailed study and after disease interpretations were made field infection percentages were determined by the drum scanner method (8).

Results and discussion

There was excellent correlation between the ground truth survey and the aerial photography survey. In both the Hensall and Chatham areas all affected fields detected by ground truth and confirmed by laboratory identification of the organism were similarly detected on film by infrared aerial color photography (Table 1). Two fields detected on film but not by ground survey contained 0.1% and 0.4% infection. Otherwise the only differences were in the amounts of infection detected in the fields. Field notes taken during the ground truth survey did not indicate as much infection as was shown by photography. Fields 1, 8, and 19 in the Hensall area showed, respectively, 37%, 21%, and 30% infection by aerial photography (Fig.

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Table 1. Incidence of bacterial blight of field beans in the Hensall and Chatham areas, 1970

Area	No. fields surveyed	Acreage	No. fields affected		Causal organism*	
			Ground truth survey	Aerial IR photography	*X. phaseoli*	*X. phaseoli* var. *fuscans*
Chatham	42	836.21	18	18	14	7
Hensall	40	882.7	29	29	16	14

* In four fields both *X. phaseoli* and *X. phaseoli* var. *fuscans* were isolated.

1), but did not appear to be infected to this extent by visual observations.

X. phaseoli and X. phaseoli var. fuscans were isolated from infected leaf samples in approximately equal numbers from the Hensall area and in a ratio of 2 to 1 in the Chatham area (Table 1). This is in contrast to the epiphytotic years of 1961-62 when X. phaseoli var. fuscans was the predominant causal organism (10).

In 1970, 72.5% of the 40 fields in the Hensall area were affected with bacterial blight. The extent of infection ranged from less than 0.1% in some fields to 37% in others. On an area basis 57.9 acres of a total 882.7 acres were affected (Fig. 1). In 1968, 76.5% of the fields or 33.5 out of 809.93 acres were affected. In 1970 in the Chatham area, 42.9% of the fields were affected. It would appear from these figures that there was little difference in the overall infection level between 1968 and 1970, ranging from 4% to 6% of the crop. This level of infection occurred despite the importation of Breeder seed. It will be some time before the full effects of the program are known.

Beginning in 1957, the variety Sanilac was introduced because of its resistance to anthracnose, and subsequently a steady increase in the incidence of bacterial blight occurred in Ontario until in 1961 and 1962 it reached epiphytotic proportions. This increase coincided with the increasing acreage of the blight-susceptible variety Sanilac and a decline in acreage of the anthracnose-susceptible variety Michelite (1,2). In 1963, bacterial blight was at a low level primarily because of unfavorable conditions for blight development and spread, despite a high level of seed infection (3). In 1964, essentially the same situation prevailed because of a lack of seed-borne inoculum, and only 3 of 27 registered fields inspected showed symptoms of bacterial blight (4). In 1965, the plan to import Breeder seed free from bacterial blight was initiated. In that year, infection was found in 80% of the fields originating from Ontario-grown Seaway seed, but in only 20% of the fields originating from Michigan-grown Foundation Seaway seed (9). In 1966, none of the plots originating from imported Breeder seed were affected, and low infection levels were recorded in Registered and Certified crops (5). However, in 1967, 16 of the 24 Select plots produced from imported Breeder seed were affected by bacterial blight (unpublished data). This unusually high incidence of blight in imported seed resulted from a blight epiphytotic that flared up in Idaho the previous year. The infection in the Select plots in 1967 resulted in infection in all registered fields inspected in 1968 (6). Despite the high level of seed infection in 1968, the 1969 crop was relatively free from blight because of extremely dry growing conditions. It seems obvious that if bacterial blight is to be maintained at a low level or eliminated, Select seed plots must be kept free of bacterial blight by careful inspection and roguing. The major changes in blight incidence since the beginning of the program are a reduction in the percentage of plants affected and a reduction in pod infection. By 1970, fewer foci were present in the fields initially and, while secondary spread and infection resulted in leaf infection, the incidence of pod infection was much less, and yield was not affected. However, the 4% to 6% crop infection figures appear high, and should be reduced through a vigorous program of continually monitoring Select plots for disease.

Prior to 1968, fields were surveyed and rated primarily for the presence or absence of bacterial blight together with estimates of disease severity. Aerial photography can be used successfully to determine the percentage of field infection and to aid in determining not only year-to-year changes in incidence of disease, but also the practical success or failure of long range control measures.

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Figure 1 AERIAL SURVEY FOR BACTERIAL BLIGHT
Nominal scale of figure 1:19,200 ▶
NAPL Roll No. A30287, frames 7 to 37