CARIBBEAN FOOD CROPS SOCIETY

PROCEEDINGS

ELEVENTH ANNUAL MEETING

A PRELIMINARY REPORT ON ONION BLAST DISEASE IN BARBADOS

by

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SUMMARY

A leaf spotting and tip dieback disease of onions identified as Blast was first recorded in Barbados in early 1971. It re-appeared in 1972 and caused quite serious yield losses to some farmers. A preliminary study of this disease, in which parasites were eliminated as causal factors, indicated that the initial symptoms of blast in Barbados were not caused by incompatibilities between benlate and other crop protection chemicals, as was suggested by some observers, but were more likely incited by adverse weather conditions or by some other physiogenic agent.

Historical Background

Leaf blight or blast disease of onions was first described by Whetzel from America (7) in 1904. Whetzel considered the disease to be due to wet weather and poor drainage. Doran and Bourne (1) in Massachussetts 1931 and Jones (5) in Connecticut also concluded that the disease was incited by a non-parasitic agent because investigations prior to his own failed to show the presence of a living pathogen when the plants exhibited the first signs of injury, and because the disease developed in bright sunshine and low humidity, in marked contrast to the inception and spread of parasitic diseases. He concluded, in similar vein to Doran and

Bourne, that blast results from too rapid a loss of water from tissues exposed to the sun after an abnormal development in subdued light, high relative humidity and high temperatures.

In 1965, R. L. Engle et. al. (3) on the basis of:

(a) weather and disease measurement,

(b) anatomical studies of flecking and mechanical induction of disease,

(c) ozone fumigation of onion seedlings and fully expanded onion leaves and

(d) correlations of ozone with ambient rainfall,

provided evidence that a disease with symptoms essentially identical to onion blast was incited by high levels of ozone only in Wisconsin. He also found that onion varieties differed in susceptibility to blast (4).

Small (1970) found that an outbreak of blast disease on onions at St. Clothilde, Quebec, Canada, was due entirely to adverse weather conditions. The disease developed after a period of overcast rainy weather was followed by a few days of high temperatures, low relative humidity and low cloud cover. After the outbreak of the physiogenic blast disease the weakened onion leaves were infected with *Botrytis squamosa*, the agent of Botrytis leaf blight.

Symptomatology and Epidemiology of the Disease in Barbados

In 1971, symptoms of a leaf disease of onions were first noticed at Friendship Plantation, St. Michael and later at a number of other plantations in Barbados. The economic effects of the disease were negligible in that year. In early 1972 a more serious outbreak of the disease occurred and the author found that the morphological symptoms of this disease were identical to those of the blast/leaf blight disease of onions seen in Quebec, Canada.

In Barbados, as in Canada, the disease was evidenced in practically all cases by the sudden appearance of white spots on the leaves around the stomata. These spots generally enlarged and the leaves in addition, died back from the tips. Older leaves were in all cases more severely affected than younger leaves and the disease generally occurred after a period of rainy weather.

The Barbados disease differed from the Quebec one in that, in Barbados, in a few cases only, there were apparent foci of infection and in some of these cases the disease tended to move at a slow rate against the wind direction. In Quebec, on the other hand, the disease affected whole fields at its inception without any foci of infection. In addition, in Barbados, the spots tended to be concentrated on the sides of leaves facing the wind direction. Although no reliable estimates of losses due to this disease in Barbados are available one assessment from an estate in the Parish of St. Michael in 1972 placed losses at 50%.

Observations and Experiments on the Etiology of the Disease

In an effort to elucidate the etiology of the disease in Barbados, numerous samples of diseased leaves were collected and pieces of necrotic leaf tips and pieces of leaves with spots were cultured on potato dextrose agar. *Stemphylium* sp. and *Alternaria* sp. were isolated from the necrotic leaf tips on a number of occasions and *Oedacephalum* sp. was isolated on one occasion only. *Botrytis-squamosa* and other species of Botrytis were not isolated at any time. The fungi isolated did not produce blight symptoms on the healthy leaves of green house-grown plants. It was therefore concluded that fungi were not the causal agents of the initial symptoms of the Barbados leaf blight disease. Suspensions of macerated diseased leaf tissue were sprayed on healthy leaves in an effort to transmit the disease. No symptoms of the disease resulted.

Rhizosphere soil samples and roots of diseased plants were sampled for nematodes. No plant parasitic nematodes were found that were likely to have caused the leaf blight symptoms.

The Plant Virologist of the University of the West Indies, Dr. S. Haque, inspected affected plants and concluded that the leaf blight symptoms were not of pathogenic viral origin.

The Entomologist (Biological Control) of the Barbados Ministry of Agriculture, Science and Technology, Mr. M. Badar, examined diseased onions for possible causal insects and found none.

Nematodes, viruses and insects were, therefore, also eliminated as causal agents and it was concluded that the initial symptoms of the leaf blighting disease on onions in Barbados were most likely incited by a nonparasitic agent and the disease could properly be termed blast disease of onions.

The most likely non-parasitic factors which could have been influential in causing onion blast disease in Barbados were:

(a) soil nutrient imbalances,

(b) adverse soil and/or air temperatures,

(c) inadequate drainage,

(d) mechanical abrasion by relatively large dust particles,

(e) incompatibilities between chemicals used in the 1971 and 1972 spray programmes,

(f) toxic ozone or other air pollutant concentrations in the atmosphere and

(g) meteorological factors similar to those associated with the condition in the U.S.A., Canada and England.

Factor (a) was investigated by Dr. D. Norse (O.D.A. Plant Pathologist), Dr. B. Eavis (O.A.S. Horticulturist) and Dr. L. Smith (Ministry of Agriculture, Science and Technology Soil Scientist). They found that soil nutrient imbalances were unlikely to have been the initial cause of onion blast in Barbados (personal communications). Dr. L. Smith also investigated factor (b), the influence of adverse soil and air temperatures on onions and again got negative results. Factor (c) was thought to be unlikely as blast symptoms were seen on both well drained and poorly drained sites. Factor (d), the mechanical abrasion of leaves by

relatively large dust particles, would explain the wind oriented pattern of distribution of the spots on onion leaves. However this factor appears unlikely to be the cause of onion blast as in the majority of cases blast was noticed when the soil was damp and wind movements would not have been capable of projecting the soil particles against onion leaves. In addition blast did not appear under conditions of dry soil and high winds which would have been ideal for mechanical abrasion.

During the middle of 1972 it was thought by some workers that the 1972 spray recommendations for onions might have included some chemicals (notably Benlate or Benzimidazole) which could have been incompatible when mixed with others, thus giving rise to phyto-toxic blast like symptoms on onion leaves. In addition, some workers also felt that the stickers recommended in the 1972 spray recommendations could have caused phytotoxicity on their own accord.

In order to test for possible phytotoxic effects of chemical spray an experiment was laid down at the Central Agronomic Research Station, Graeme Hall, in which 19 different combinations of all the recommended crop protection chemicals for onions were compared with respect to the incidence of onion blast.

The rates of chemicals used were as recommended by Eavis 1972 (2). Insecticides were applied every 7 days and the foliar nutrients and fungicides every 14 days.

There was no incidence of blast disease of onions throughout the four months growth of the onions in this experiment. Onion blast was recorded, however, on other crops of the same variety in other parts of the island during this period. It was therefore concluded that incompatibility between the chemicals recommended by Eavis 1972 (2) was not responsible for the blast disease symptoms seen on onions during 1972 and that neither Benlate nor the Stickers were responsible for the inception of blast disease symptoms either by themselves or combined with other chemicals.

During December 1972 a number of plantations reported blast after experiencing a period of weather conditions similar to those stated as favouring the inception of blast. Some plantations recorded blast while others in the same general area did not. Also, in some cases, e.g. Fairy Valley Plantation, blast developed on one part of the field only and did not spread. Many of these plantations were advised to spray with a dithiocarbamate fungicide and those which followed this recommendation reported a check in the development of the disease.

CONCLUSIONS

A consideration of the facts presented above leads one to the conclusion that the initial symptoms of onion blast disease in Barbados are incited by a non-parasitic agent and that possibly either toxic concentrations of ozone or other air pollutants, or adverse weather factors, such as periods of rainy, humid, overcast weather followed by clear but non-humid days, might be involved in inciting the disease.

Observations on the onset and development of blast and the apparent control of its spread by the application of Dithane M 45 indicates that a likely hypothesis on the epidemiology of the disease in Barbados is as follows:

The development of blast symptoms on onion plants depends on the following factors.

1. The severity of adverse weather factors or air pollutant concentrations, i.e. a threshold value only of adverse weather or air pollutant concentrations will result in the appearance of minimal symptom expression on susceptible onion plants, while severe pollutant concentration or continuing adverse weather would result in extensive symptoms on the same plants.

2. The susceptibility of the onion phenotype to blast injury. (Engle et. al. (1965) stated that some varieties of onions

were extremely susceptible to ozone incited tipburn whereas others were resistant).

3. The health of the onion plant.

4. A possible cumulative effect of adverse weather factors and/or air pollutant concentrations in inciting disease symptoms.

Thus, adverse weather conditions or toxic air pollutant concentrations would initiate blast disease symptoms suddenly on an area-wide scale. On a field scale, where onion plants are homogenous with respect to predisposing conditions of susceptibility, health etc., the blast symptoms appear widespread over the whole field, with no apparent foci of infection. In other cases, where fields are heterogenous in terms of fertility, drainage etc., the weakest or most susceptible plants would show in symptoms. If weather and/or pollutant conditions are not suitable for disease development there is little spread of the symptoms. If conditions are suitable the disease advances slowly along a fertility or susceptibility gradient which in some cases could be against the direction of prevailing winds. In addition to the non-parasitic spread of blast symptoms there is also the possibility of a slow parasitic spread of dieback symptoms as a result of the weak parasite, *Stemphylium* sp., infecting weakened older leaves, again mainly along a fertility or susceptibility gradient. Applications of a dithiocarbamate fungicide would therefore, check the secondary parasitic spread of the disease by means of its control of *Stemphylium* sp.

FUTURE RESEARCH ON BLAST

Research on onion blast in 1973 and thereafter should include the following projects:-

1. Continuous monitoring of micrometeorological factors such as hours of dew duration, soil and air temperatures, rainfall, relative humidities, wind speed etc, in a number of onion fields to obtain accurate information on the weather conditions leading up to the onset of blast.

2. Continuous monitoring of the ozone content of the atmosphere above selected onion fields to investigate whether or not there is any correlation between the onset of blast and ozone concentrations in the atmosphere.

3. Growth chamber experiments in which onion plants at all stages of growth would be exposed to varying concentration of ozone and the type and extent of damage noted. The effect of Dithane M 45 and other fungicides including Benlate on blast development on onions exposed to ozone would also be studied in this series of projects.

4. Epidemiological studies on *Stemphylium* sp. and other isolates from necrotic onion tips to determine if these isolates are capable of infesting healthy onion leaves or increasing symptom expression on onion leaves with incipient dieback.

5. Field studies on various chemicals to control blast.

6. Field studies on the epidemiology of blast to investigate whether or not blast symptoms do start on weaker plants in heterogenous onion fields.

7. Field studies to determine whether or not some onion varieties are more resistant to blast disease than others and if so to select resistant varieties.

8. Field studies to determine the range of losses caused by this disease at different growth stages of the host.

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