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AN OUTBREAK OF BROADBEAN DISEASES IN IRAN[1]

Walter J. Kaiser, K. E. Mueller, and Dariush Danesh[2]

Summary

In 1966 the broadbean crop in southwestern Iran was severely damaged by chocolate spot (Botrytis fabae), broadbean rust (Uromyces viciae-fabae) and bean yellow mosaic virus. These diseases reduced yields in this area by over 50%.

INTRODUCTION

Broadbeans (Vicia faba) are grown in many countries of the world primarily for their edible seeds (6). In Iran they are grown almost exclusively for human consumption, where the seeds, both green and dry, are prepared in a variety of dishes. They are grown principally in two areas of the country -- in the North around the Caspian Sea, and in the Southwest near the Persian Gulf. This report deals with the occurrence and importance of several broadbean diseases in southwestern Iran, especially in the area of the country known as Khuzestan.

The weather in Khuzestan is extremely hot during the summer, where maximum daily temperatures of 45°C and above are common. During the winter the temperature rarely goes below 0°C. Broadbeans are planted in October or November and harvested the following March through May.

In the spring of 1966, the broadbean crop in Khuzestan was severely damaged by three diseases. Some fields were almost completely destroyed, and seed yields were greatly reduced throughout the area. These diseases were later identified as chocolate spot (Botrytis fabae Sardiña), rust (Uromyces viciae-fabae (Pers.) Schroet.)[3] and bean yellow mosaic virus.

DESCRIPTION OF DISEASES

After these diseases reached epidemic proportions, it was common to find plants infected simultaneously by virus, rust, and chocolate spot. The most conspicuous and devastating disease was caused by the chocolate spot fungus. Both the "aggressive" and "nonaggressive" stages (3, 7) of the disease were found in the field. In the "aggressive" stage, the disease caused extensive necrosis of the leaves, stems, and pods (Figs. 1 and 2), which often resulted in death of the plant. The "nonaggressive" stage is much less destructive, and generally causes small, irregularly-shaped, reddish-brown lesions on the leaves (Fig. 3).

The symptoms observed in the field on bean yellow mosaic-infected plants were confined mainly to the leaves, although necrotic ring patterns were occasionally observed on green pods. On the leaves they consisted of dark green areas of various sizes confined to interveinal areas (Fig. 4).

Rust infection was generally confined to the leaves (Fig. 5), although in very susceptible varieties the fungus also infected the stems. The teliospore stage of the fungus was not observed. Without the teliospore stage, only tentative identification could be made of the pathogen based on the uredia and uredospores.

MATERIALS AND METHODS

Field studies on the etiology of these diseases were initiated on the Trial Farm of the Khuzestan Water and Power Authority (KWPA) at Dezful, Iran. Over 15 hectares of three local variety broadbeans were grown at the Trial Farm.

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[2]Research Plant Pathologist, Regional Pulse Improvement Project, Crops Research Division, Agricultural Research Service, United States Department of Agriculture, USAID, American Embassy, Tehran, Iran; formerly Director, Trial Farm, Khuzestan Water and Power Authority, Dezful, Iran, now Rice Specialist, Ford Foundation, Lahore, Pakistan; and Agricultural Engineer in Plant Pathology, Regional Pulse Improvement Project, Tehran, Iran; respectively.

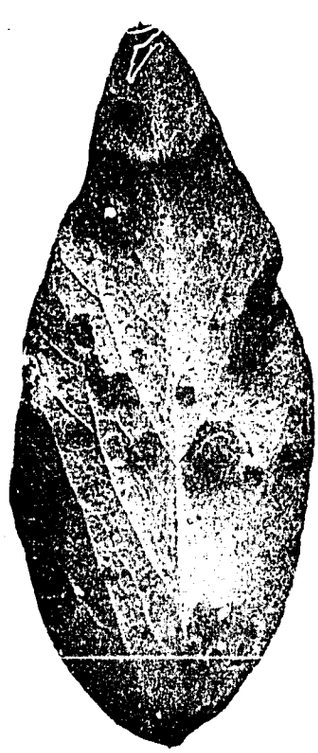
[3]Grateful acknowledgment is made to Dr. B. J. Deverall, Botany Department, Imperial College, London, England, for assisting in the identification of the fungal pathogens.

1

FIGURE 1. Leaves of a broadbean plant killed by the aggressive stage of Botrytis fabae.

FIGURE 2. A broadbean leaf with black lesions caused by the aggressive stage of Botrytis fabae.

FIGURE 3. A broadbean leaf with numerous reddish-brown lesions caused by the nonaggressive stage of Botrytis fabae.



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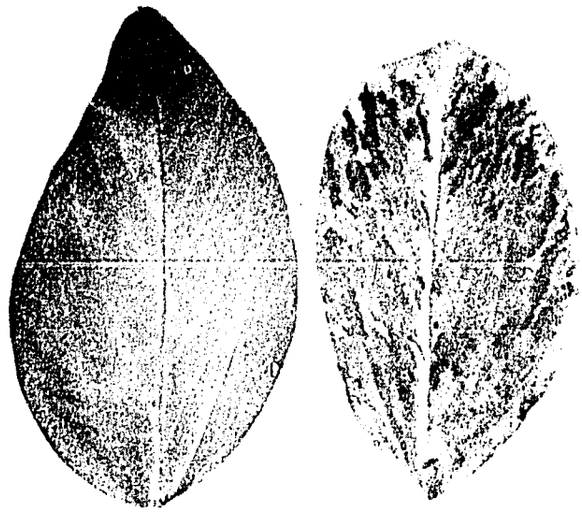

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FIGURE 4. Mosaic symptoms on a leaf of broadbean infected with bean yellow mosaic virus (right), and a healthy leaf (left).

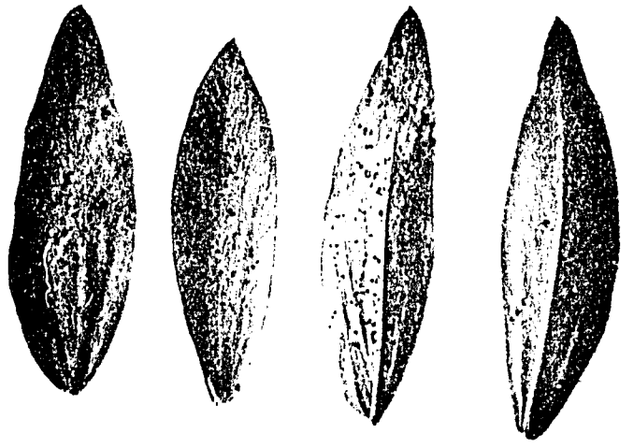

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FIGURE 5. Uredia of Uromyces fabae on the upper and lower surfaces of broadbean leaves.

The weather conditions prevailing in Khuzestan during the spring of 1966 were ideal for the disease epidemic to occur. Weather data were collected from several weather stations maintained by the KWPA in Khuzestan. Temperature and rainfall data from the Trial Farm before and during the disease epidemic are presented in Table 1.

Diseased plant material was collected from several broadbean fields in Khuzestan, placed in plastic bags, and transported to the laboratory, where isolation and inoculation studies were conducted.

Broadbean leaves with small reddish-brown lesions and black necrotic tissue were surface sterilized for 5 minutes in 0.5% sodium hypochlorite (10% Clorox) and plated on potato-dextrose agar (PDA). Leaves with similar symptoms were also placed in moist chambers. Plates were incubated at 18-26°C. For inoculation studies, Botrytis spores were collected from PDA slants or necrotic leaf tissue.

Broadbeans (bell bean) were grown in methyl bromide-fumigated soil in a greenhouse where temperatures fluctuated from 14-30°C. Plastic moist chambers containing single pots of growing broadbeans were used in the greenhouse inoculation studies. Spore suspensions were sprayed on plants with an aerosol bomb.

Leaves with mosaic symptoms were macerated in a mortar and pestle to which was added a small amount of 0.05M K_2HPO_4 buffer (pH 8.3). The plant sap was applied to carborundum-

Table 1. Temperature and rainfall data from the KWPA Trial Farm, Dezful, Iran, for the months of September 1965 through June 1966.

Month	Average monthly temperature (°C) minimum	Average monthly temperature (°C) maximum	Monthly rainfall (mm)
September 1965	19.3	41.2	0.5
October	12.0	33.3	28.0
November	6.5	25.7	67.5
December	2.5	21.5	5.5
January 1966	6.3	22.2	42.5
February	7.3	19.7	91.5
March	8.7	23.4	34.5
April	12.5	30.3	22.2
May	18.6	38.6	3.0
June	22.0	44.8	0.0

dusted leaves (320 mesh) with a sterile cotton swab. Control inoculations were always included. Indicator plants included in the inoculation studies were Chenopodium amaranticolor; cucumber, Cucumis sativus cv. National Pickling; jimson weed, Datura stramonium; globe amaranth, Gomphrena globosa; tobacco, Nicotiana glutinosa and N. tabacum cvs. Samsun and Xanthi; bean, Phaseolus vulgaris cvs. Bountiful, Pinto U.I. 111, and Stringless Green Refugee; pea, Pisum sativum cv. Laxton Progress #9; broadbean, Vicia faba var. minor (bell bean) and several local varieties; and cowpea, Vigna sinensis cv. Early Ramshorn. Inoculations were repeated several times with many of the test plants.

Serological studies that utilized the Ouchterlony agar-double diffusion test (2) were conducted with antiserum of bean yellow mosaic virus (BYMV). The BYMV antiserum was prepared by H. A. Scott, Plant Virus Laboratory, Crops Research Division, ARS, U.S. Department of Agriculture, Beltsville, Maryland, and R. Bercks, Biologische Bundesanstalt für Land-und Forstwirtschaft, Institut für Virusserologie, Braunschweig, Germany. Sap from healthy and virus-infected bean and broadbean plants was used in the serological tests.

No laboratory studies were conducted with the rust found infecting broadbeans in Khuzestan.

RESULTS

There was abundant sporulation of Botrytis in 24 hours when diseased broadbean leaves in the "aggressive" stage were placed in a moist chamber. There was little or no sporulation from the small reddish-brown lesions characteristic of the "nonaggressive" stage of the disease. Botrytis was consistently isolated from the advancing margin of black lesions, but less frequently from the reddish-brown lesions when cultured on PDA. The fungus grew rapidly on PDA, where it produced numerous black sclerotia in 5 days.

Intact plants or detached leaves of different ages were inoculated with spores of Botrytis collected from PDA or necrotic plant tissue and incubated in moist chambers. Within 24 hours, small reddish-brown lesions had formed on the intact plants and detached leaves with spores from both sources. Lesions appeared to form equally well on both surfaces of detached leaves, although the younger the leaf the more resistant it was to infection. The "aggressive" stage of the disease formed in 3 days on the older detached leaves, but did not develop in 15 days on the young detached leaves or intact plants. No lesions developed on the water checks which were included in each inoculation test.

In the virus inoculations, visible disease symptoms developed on inoculated beans, broadbeans, and Chenopodium. Within 9 to 12 days, small yellow spots began to appear on inoculated bean plants. The systemic mottle symptoms became more pronounced with time. No necrotic lesions developed on inoculated leaves. Systemic mosaic symptoms in broadbeans appeared initially in the youngest leaves 8 to 12 days after inoculation. The formation of darker green spots between the main veins of inoculated broadbeans was the most characteristic symptom of the disease. Virus symptoms obtained in greenhouse inoculations closely resembled those observed on broadbeans in the field. Diffuse, chlorotic spots appeared in 9 to 12 days on inoculated leaves of C. amaranticolor.

Sap from systemically-infected bean and broadbean reacted positively with the BYMV antiserum in the Ouchterlony agar-double diffusion test, which indicates that the virus is related serologically to BYMV.

DISCUSSION

Reduction in broadbean yields due to diseases was very high in Khuzestan during the spring of 1966. Yield records for approximately 1000 hectares (2500 acres) of broadbeans in this area indicated that, due to diseases, the production of green pods and dry seeds in 1966 was 50% less than the production in previous years when diseases were of no significance.

The disease which was most destructive to the broadbean crop in 1966 was caused by chocolate spot. Weather conditions in Khuzestan from January to April 1966 were extremely favorable for the rapid development of the disease over a wide area. The disease reached epidemic proportions in March and April. During this period, when the rains occurred frequently, the relative humidity generally remained high, with abundant dew formation on plants in the broadbean fields. Rainfall has been shown to be the most important climatic factor in the development of an epidemic of this disease in broadbeans (7). Although it has been reported on broadbeans from several countries (7), this is believed to be the first report of the disease from Iran.

The virus infecting broadbeans in Khuzestan was identified as bean yellow mosaic virus by the symptoms produced on test plants and confirmed by serology tests. Systemic mottle symptoms on inoculated beans (especially Stringless Green Refugee) were similar to those described by Smith (5) and Zaumeyer and Thomas (8) for the type strain of BYMV. By using BYMV antiserum from two different laboratories, positive reactions were obtained to sap from virus-infected beans and broadbeans, which indicates that the virus is related serologically to BYMV.

Almost all of the local Iranian broadbean varieties grown in Khuzestan during 1966 were 100% infected with BYMV. This virus is probably widely distributed throughout the Middle East. It has already been reported as infecting broadbeans (4) and gladiolus (1) in Israel. The authors have also found it infecting other leguminous plants in Iran.

In Iran, broadbean rust occurs in the wetter regions of the country, where broadbeans are generally grown during the rainy season. In 1966, rust was widespread in the two main broadbean-growing areas of the country, but appeared to cause greater crop damage in northern Iran around the Caspian Sea than elsewhere.

Several broadbean strains in a varietal trial showed varying degrees of field resistance to one or more of the three diseases that occurred in Khuzestan during 1966. After additional greenhouse and field testing, these varieties may be the nucleus around which a breeding program can be initiated in an attempt to incorporate disease resistance into local broadbean varieties which are preferred by the people.

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CROPS RESEARCH DIVISION, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, REGIONAL PULSE IMPROVEMENT PROJECT, TEHRAN, IRAN