Yellowing of Garbanzo Beans

aphid-spread yellowing virus needs different control though visibly similar to Fusarium wilt caused by soil-borne fungus

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Garbanzo bean—*Cicer arietinum*—an edible crop grown in California in the south coastal areas, is ordinarily planted in April on nonirrigated land and harvested in July or August.

Since 1935 California's production of garbanzo beans has averaged about 25,000 100-pound bags per year. The total digestible nutrients of the garbanzo —known in India as gram and in Europe as chickpea—are about the same as in other beans.

The crop is subject to several diseases, but the two most serious are virus yellowing and Fusarium wilt. Because they are similar in appearance—in the field—they are often considered to be the same disease. However, the cause of Fusarium wilt is a soil-borne fungus and the cause of yellowing is an insect-borne virus. Therefore, the approach toward control of the two diseases is entirely different and it is of prime importance to distinguish between them.

Virus Yellowing

Several aphid-spread viruses—such as the pea enation, yellow bean mosaic, alfalfa mosaic, and perhaps other viruses —infect the garbanzo plant under California conditions. The yellow bean mosaic virus has been a dominant factor in the garbanzo virus yellowing disease over a period of many years. Although this virus produces a yellow mottling, advanced symptoms consist of an over-all yellowing of the garbanzo foliage. The leaf symptoms are accompanied by a dark brown discoloration of the phloem tissue just below the bark of the stem both above and below ground. However, the discoloration does not involve the central cylinder of the xylem as in the case of the Fusarium disease, and when cultured, yields no organism.

Because virus yellowing is spread by aphids, the diseased plants usually are scattered through the field with no relation to disease incidence in previous years. In contrast, Fusarium wilt usually occurs in solid patches. These may enlarge, and start new centers of infection.

Distribution of virus yellowing in a field or in an area is dependent upon the movement of infective aphids. Therefore, its presence is unpredictable, but would be expected in greater amounts near the source. With the movement of infective aphids from a single center, the disease could appear in spots in the field as does Fusarium wilt.

Wilt Symptoms on Plants of Nine Varieties of Garbanzo Bean One Month After Inoculation with *Fusarium lateritium* f. *ciceri*.

Variety	Average wilt value per plant*
1. E-1 California Selection	0.2
2. PI Ethiopia 226943	0.9
3. PI Ethiopia 226944	0.9
4. PI Ethiopia 226945	2.0
5. PI 176894 (Selection A)	3.8
6. 5402 (Smith; commercial type)	4.4
7. 5403 (Smith)	4.6
8. PI 176894 (Selection B)	4.8
9. PI 177310	4.9

* Graded as follows: 0 = no wilt; 1 = slight streaking in xylem; 2 = slight, ¼ xylem streaked; 3 = ½–¾ xylem streaked; 4 = ¾ to all of xylem discolored; 5 = plant dead. Statistically at the 1% level of significance, varieties 1–4 inclusive showed greater resistance than the varieties 5–9

Fusarium Wilt

Because the causal fungus is soil-borne, the spread of Fusarium wilt occurs from the same centers each year. During the latter part of May or early June affected plants turn a grayish green to yellow and eventually wilt and die. A dark brown discoloration of the woody tissues—xylem—can be seen by cutting a stem or root longitudinally or diagonally. The discoloration can often be traced up to the top of the plant, and may be one-sided, causing one side of the plant to wilt while the other side appears unaffected. The fungus can be spread in pieces of diseased stems or

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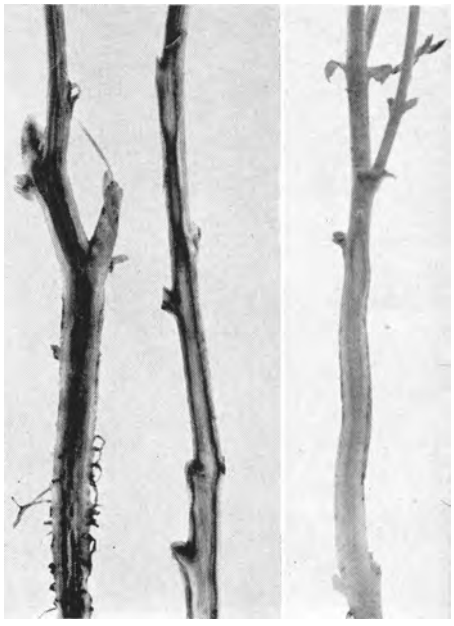
Sections of three garbanzo bean plants. *Left)* Inoculated with *Fusarium lateritium* f. *ciceri* (note xylem discoloration); *Center)* Naturally infected by the yellowing virus (note phloem discoloration); *Right)* Noninoculated, healthy plant.



General appearance of a healthy garbanzo bean plant.

GARBANZO

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roots. The surface of the seed may become infected in the threshing operation.

Fusarium wilt has been known previously in India, but this is the first time the disease has been noted in the United States. In tests conducted since 1954 the fungus—*Fusarium lateritium* f. *ciceri*—has been isolated consistently from the stems of plants affected by the disease. Numerous tests conducted in the greenhouse have shown that the disease could be induced by infesting sterilized soil with spores of the fungus into which garbanzo bean seeds were later planted.

Seeds from three healthy plants—probably White Spanish variety—from a field affected by Fusarium wilt were tested for resistance to Fusarium. The plants from these seeds—labeled E-1—in many greenhouse tests showed a high degree of resistance. This selection appeared to be a type similar to the commercial variety but has not been tested for yielding ability. Three other varieties imported from Ethiopia—through the United States Department of Agriculture—also possesed some resistance but not as much as that shown by E-1. Seed of the variety E-1 is being increased for future testing. The finding of resistance within the commercial variety encourages further endeavor to control the disease by seeking a resistant variety.

Although it is possible to distinguish between the foliage symptoms of Fusarium wilt and virus yellowing, especially under favorable conditions, it is not always possible to do so with certainty in the field. However, the diseases are readily differentiated, even in the field, by the location of internal discoloration; that under the bark being due to virus disease, while that in the central cylinder being due to the Fusarium disease.

Control of virus yellowing depends on the control of the aphid vectors; control of Fusarium wilt depends on the development of resistant varieties.

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