INFLORESCENCE BLIGHT OF THE DATE PALM

By J. G. Brown, plant pathologist, and Karl D. Butler, research assistant, Arizona Agricultural Experiment Station

INTRODUCTION

In 1935 a blight of the inflorescence of the date palm in university date garden at Tempe, Ariz., was called to the attention of the senior author. The disease was present on the Sayer and Khadrawi varieties. In 1936 Khadrawi palms were not attacked, but the Khir variety, hitherto not observed to be affected, had flower clusters killed by the blight. A survey of the palms showed the following blighted inflorescences, all pistillate:

<table>
<thead>
<tr>
<th>Variety</th>
<th>Blighted inflorescences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iteema</td>
<td>1</td>
</tr>
<tr>
<td>Maktoom</td>
<td>2</td>
</tr>
<tr>
<td>Sayer (31 years old)</td>
<td>7</td>
</tr>
<tr>
<td>Sayer (31 years old)</td>
<td>5</td>
</tr>
<tr>
<td>Sayer (11 years old)</td>
<td>1</td>
</tr>
<tr>
<td>Khir (31 years old)</td>
<td>4</td>
</tr>
</tbody>
</table>

The occurrence of the blight in the date garden suggested the advisability of examining the date palms on the campus of the University of Arizona at Tucson. A survey of these palms showed the disease to be present on staminate inflorescences.

The date palms with which the writers worked in university date garden are chiefly known varieties imported from Africa and propagated by means of offshoots. The history of the garden is given in Arizona Agricultural Experiment Station Bulletin 149 (1). Palms on the campus of the University of Arizona, which are mentioned in connection with the present study, are seedling in origin and non-descript in variety, and were planted primarily for ornamental purposes.

Until 1936 inflorescences infected with blight fungi had been found only on palms 30 to 31 years old, but during the flowering season of 1936 an inflorescence blighted on a palm only 11 years old. Most infected inflorescences in the date garden have been found on pistillate flowers, but blighted staminate inflorescences have also been collected there and on the university campus. Hilgeman (4) states that a blight which occurs generally on staminate flower clusters in the date garden and throughout the Salt River Valley in Arizona has been popularly attributed to *Thielaviopsis paradoxa* on the basis of work done on palms in California (4). The present work (the first investigation of inflorescence blight to be undertaken at this station) appears to indicate that more or less of the blight in Arizona date palm orchards is caused by fusaria.

---

1 Received for publication February 28, 1938; issued August 1938.
2 This survey was made by Robert H. Hilgeman, assistant horticulturist.
3 Italic numbers in parentheses refer to Literature Cited, p. 318.
4 Personal communication.

Journal of Agricultural Research, Washington, D. C.  
Vol. 57, No. 4  
Aug. 15, 1938  
Key No. Ariz.-14

(313)
SYMPTOMS

Initial infection of date inflorescences may occur anywhere on the rachis from the base to the branches, on the branches, or in the flowers. Primary infection of the rachis results in water soaking of the tissues and subsequent discoloration of the stalk, the color ranging from wood brown (6) to fawn to bone brown, with shrinking of the infected tissues (pl. 1, A, a). Disease of the branches, which are discolored like the rachis, results in the death of the flowers above the infected spot. Attacked flowers (pl. 1, E, F) are a discolored brown.

Stalks of pistillate inflorescences often are so weakened by infection that they break under the increasing weight of the fruit. The break across the stalk is at right angles to the axis, often resembles a cut made by a sharp instrument, and is deep enough to permit the distal part of the branch above the break to bend back against the basal part. Although this breaking of the stalk following infection is common, apparently sound stalks occasionally break. The writers have cultured some that gave no parasitic organisms.

CAUSE

Blighted parts of the date inflorescence, sometimes in the field and regularly in the laboratory when kept moist, become overgrown with a gray to buff mycelium, or with a covering of pale purplish to pale Congo pink filaments, or with a mycelium in which these colors are mixed. Blocks of tissues from infected parts, which were surface-sterilized and cultured on 2-percent potato-dextrose agar, steamed yellow corn meal, and steamed rice, yielded two species of Fusarium and one species of Helminthosporium. One Fusarium, in 10-day cultures on potato-dextrose agar, was a pale grayish vinaceous above and pale grayish vinaceous to brownish vinaceous in streaks below. On steamed rice in 6-day cultures it was light vinaceous gray above and light vinaceous lilac with rocellin purple lines around the lighter areas below.

The other species of Fusarium, in 2-day cultures on potato-dextrose agar, was sea-shell pink to salmon buff above, and gray to ochraceous orange (margin of colony to center) below; 10-day cultures on the same medium were pale ochraceous salmon to salmon buff above (the lighter color in the margin and between the concentric growth rings), and gray to orange below. On steamed rice, 9-week cultures were pinkish buff above and pinkish buff to hazel below. This species often gave concentric growth rings 2 to 4 mm wide on potato-dextrose agar.
A, Culture of *Fusarium moniliforme* from blight of date inflorescence, on steamed rice 39 days at 28° C.: a, Upper surface, light vinaceous gray; b, lower surface light vinaceous lilac with rocellin purple borders around lighter areas. B, Culture of *Fusarium semitectum* (*F. lateritium* var. *fructigenum*) from blight of date inflorescence, on steamed rice, 39 days at 28° C.: a, Upper surface, pale ochraceous salmon to salmon buff; b, lower surface gray to ochraceous orange.
Inflorescence Blight of Date Palm

Aug. 15, 1938

inflorescence blight of date palm

agar. Plate 2, A and B, shows the appearance of older cultures of the two fusaria.

The vinaceous culture of Fusarium was identified by Dr. C. D. Sherbakoff, of the Tennessee Agricultural Experiment Station, as Fusarium moniliforme Sheld., which agreed with the report on the same fungus received from the Centraalbureau voor Schimmelcultures, Baarn, Netherlands. The buff culture was identified by Sherbakoff as Fusarium semitectum Berk. et Rav. and by the Centraalbureau as Fusarium lateritium Nees var. fructigenum (Fr.) Wr.

The species of Helminthosporium found by the junior author and by him proved capable of causing decay of the flower clusters of the date palm is not considered in the present paper.

INOCULATIONS

On April 19, 1935, three spadices of Phoenix dactylifera L., whose spathes had been open a few days, were inoculated by spraying the exposed flowers with a heavy suspension of spores of Fusarium moniliforme; and a small hole was cut through an unopened bract of a fourth inflorescence into which a spore suspension of the fungus was injected, so that the spathe formed a natural moist chamber. On the same date four rachi were inoculated by inserting small pieces of a pure culture of the fungus from potato-dextrose agar into small incisions made with a sterile scalpel and afterward moistened with sterile distilled water. Both staminate and pistillate inflorescences were used in the inoculations. On May 4 many diseased flowers were evident in the inoculated clusters (pl. I, E), but the controls were normal. A series of 12 isolations was made from the inoculations, and all but 1 culture gave the Fusarium species used in the inoculations of the inflorescences. Too rigorous surface sterilization of the tissues used in culture may account for the single failure.

Again on April 21, 10 rachi on 2 palms were wound-inoculated as previously described; 13 days later the inoculations had water-soaked margins and presented the appearance shown in plate 1, C, although the controls showed no infection. Pieces of the water-soaked tissues were surface-sterilized with a 1:1,000 mercuric chloride solution and cultured, with the recovery of Fusarium moniliforme in 11 of the 15 tubes.

Two large pieces of rachi, which were scalpel-inoculated with Fusarium moniliforme and placed under a bell jar in the incubator at 27° C., showed good fungus growth on the wounds in 3 days, although no growth occurred on control pieces similarly wounded but not inoculated. One piece was then transferred to the refrigerator and kept at a constant temperature of 5° in a similar moist chamber. At the end of 8 days the two pieces were photographed (pl. 1, D, a and b). Growth at the lower temperature was slight, but at the higher temperature it was luxuriant.

The piece of rachis from the incubator was afterward removed to a moist chamber in the laboratory and there it produced numerous perithecia. The perithecia were dark blue, ovoid, contained asci with eight ascospores arranged in two series, and agreed well with the measurements of perithecia, asci, and ascospores given by Wollenweber (7) for Gibberella moniliformis (Sh.) Wineland. Ascospores from the perithecia were cultured on malt agar from which transfers
were made to potato-dextrose agar; the resulting mycelial growth appeared to be identical with \textit{Fusarium moniliforme} and produced similar microconidia.

On May 24 a rachis which had been inoculated with a culture of \textit{Fusarium moniliforme} on April 21 was found to have a long, depressed, grooved lesion (pl. 1, B) which had resulted from the coalescence of the lesions initiated by inoculation. Blocks of the infected tissues from this piece of rachis were killed and sectioned for histological study.

On May 24 a natural infection of a staminate inflorescence was found on a date palm on the university campus. The spathe had been open for a few days only, yet the top of the flower cluster was very brown and the infection appeared to be progressing downward (pl. 1, F). From cultures of the infected flowers \textit{Fusarium moniliforme} was isolated.

Inoculations of date palm parts with \textit{Fusarium semitectum} (\textit{F. lateritium} var. \textit{fructigenum}, according to the Centraalbureau voor Schimmelcultures) were made as follows: Wound inoculations on five rachi and two petioles and spore-suspension sprayings on two inflorescences, all made on May 15 with proper controls. On June 15 lesions were present on all inoculated parts except the petioles, but none were present on controls; the lesions developed much more slowly than those caused by inoculation with \textit{F. moniliforme}. From the inoculated tissues 20 cultures were made with surface-sterilized pieces; 12 of the cultures gave the \textit{Fusarium} used in the inoculations—the only pathogen recovered. Green, surface-sterilized date fruits from palms on the campus, placed in Petri dishes, were vigorously attacked by \textit{F. semitectum} (\textit{F. lateritium}?) and by \textit{F. moniliforme}, after being sprayed with spore suspensions of these species (pl. 1, G, I).

**PATHOLOGIC HISTOLOGY**

Preparations for microscopic investigation were made from the tissues of rachi and other parts infected with \textit{Fusarium moniliforme}. The fungus infects both fibro-vascular bundles and parenchyma cells, which are more or less discolored as a result of invasion. In the bundles the filaments are located chiefly in the tracheae (pl. 3, A and B); in the parenchyma tissue they are both intercellular and intracellular (pl. 3, C). Infected parenchyma cells in slides stained with carbol fuchsin-light green (clove oil) acquired a deeper red than healthy cells in the same preparations. The vacuolar structure of the hyphae in the vessels was clearly evident under high magnification (pl. 3, B).

**CONDITIONS AFFECTING THE BLIGHT**

Although a study of the effect of environmental conditions on the prevalence of the blight of date inflorescences has not been made, observations indicate that the weather in the Salt River Valley during the flowering season is usually favorable for its development; hence the general occurrence of the disease. Viable cultures of \textit{Fusarium} from old inflorescences show that the heat of summer, the dryness of autumn, and the cold of winter do not injure the fungus, which continues capable of producing abundant spores.

How the spores of the fusaria of inflorescence blight are disseminated remains to be determined. Insects are frequently very numerous in
A. *Fusarium moniliforme*: Parts of hyphae in trachea of fibrovascular bundle of rachis. × 621.4. B. Vacuolate structure of a part of a hypha of *F. moniliforme* in a trachea of date rachis. × 2,571. C. Parts of hyphae of *F. moniliforme* in a parenchyma cell of rachis of date palm. × 621.4.
the tops of date palms, especially during flowering and fruiting. Possibly they are the important agents of dissemination. The practice among date growers of carrying flower clusters from staminate palms into their exclusively pistillate plantings no doubt facilitates the spread of the inflorescence blight.

The effect of spraying on fusarium blight of date flower clusters has not been specifically investigated, although the trees in university date garden have been sprayed for several years in an effort to control fruit rot. In these sprayings copper acetate, lime-sulphur, and instant bordeaux mixture (4-4-50) have been used. Sprays for fruit rot usually have been applied later in the season than they should be to control inflorescence blight. Perhaps the first step in the control of the blight should be the removal of all staminate flower clusters after pollination is effected, and the removal of all pistillate rachi after the fruit is harvested. With these sources of infection out of the way, a thorough spraying of the palms before the spathes break open should go far toward eliminating the blight.

**DISCUSSION**

In some respects the blight of date inflorescences herein discussed is similar to the decay described by Cavara (2), and later by Chabrolin (3), under the name "Khamedj," for palms in north Africa. Both diseases are parasitic, both attack staminate and pistillate flower clusters and related parts, both originate externally, and both cause browning of the affected tissues. Also, the Khamedj parasite has been proved to attack uninjured tissues just as the fusaria in inflorescence blight attacked uninjured green date fruits. However, there should be no possibility of confusing the Khamedj parasite with the fusaria, for the former, *Mauginiella scaetiae* (2, 3), belongs to a genus having affinity with *Septocylindrium* and *Geotrichum*; it produces a white efflorescence, becoming pulverulent over reddish spots which later become black; the external mycelium disappears from the infected spots; and conidia are borne in chains. Except for a somewhat pulverulent appearance, the fusaria differ from the Khamedj parasite as described, and no pathologist would have difficulty in distinguishing the parasites.

The blight described in this paper may be the same inflorescence decay mentioned by Fawcett and Klotz (4) in their bulletin on diseases of the date palm, although they do not give the species of *Fusarium* which they isolated in their studies. They state (4, p. 23): "Fusarium sp. is sometimes found mixed with either Thielaviopsis or Diplodia, or it may be alone." In another publication (5, p. 157) they say: "A species of Fusarium was later found as the primary cause of a decay of certain male inflorescences of the date palm." The fact that they obtained less injury from their inoculations with *Fusarium* species may have been due to their use of a different species from those employed by the writers, or to different environmental conditions. Inoculation with *Fusarium moniliforme* in the writers' experiments soon resulted in extensive decay. From brief description of the *Fusarium* rot given by the California investigators it is impossible to determine whether the inflorescence decay which they mention is identical with the blight observed in the Arizona plantings.
That the blight may affect the inflorescences of a comparatively wide range of varieties and ages of date palms is indicated by the list given in the introduction to this paper, and this probably means a spread of the disease unless steps are taken for its control. Persistent blighted flower and fruit clusters may easily become serious sources of infection from year to year. One suspicious case found on the campus strongly suggests this means of carry-over. A rotted cluster of flowers from the preceding year, within a partly opened spathe, was covered and interspersed with a powderly mass of *Fusarium* spores; on the same palm several blighted inflorescences were found near the old blighted flower cluster.

**SUMMARY**

An inflorescence blight attacks several varieties and ages of date palms in southern Arizona.

Primary infection results in water soaking and discoloration of the infected parts; flowers may be killed by direct attack or indirectly by the infection of parts below them; green fruits decay when sprayed with a spore suspension of either of the fungi concerned.

Two species of *Fusarium* cause the blight, working together or separately. One of these is *Fusarium moniliiforme* Sheld.; the other is either *F. semitectum* Berk. et Rav., (as identified by Sherbakoff) or *F. lateritium* Nees var. *fructigenum* (Fr.) Wr. (as indicated by Centraalbureau voor Schimmelcultures).

The results of numerous inoculations with the two species of *Fusarium* on different parts of the date palm are given.

A brief description of the pathologic histology is presented.

Conditions affecting the blight are discussed, and suggestions for its control are given.

**LITERATURE CITED**

6. **Ridgway, Robert.** 1912. COLOR STANDARDS AND COLOR NOMENCLATURE. 43 pp., illus. Washington, D. C.