Scientists are Studying

Hollow Boll, Crazy Top In Cotton

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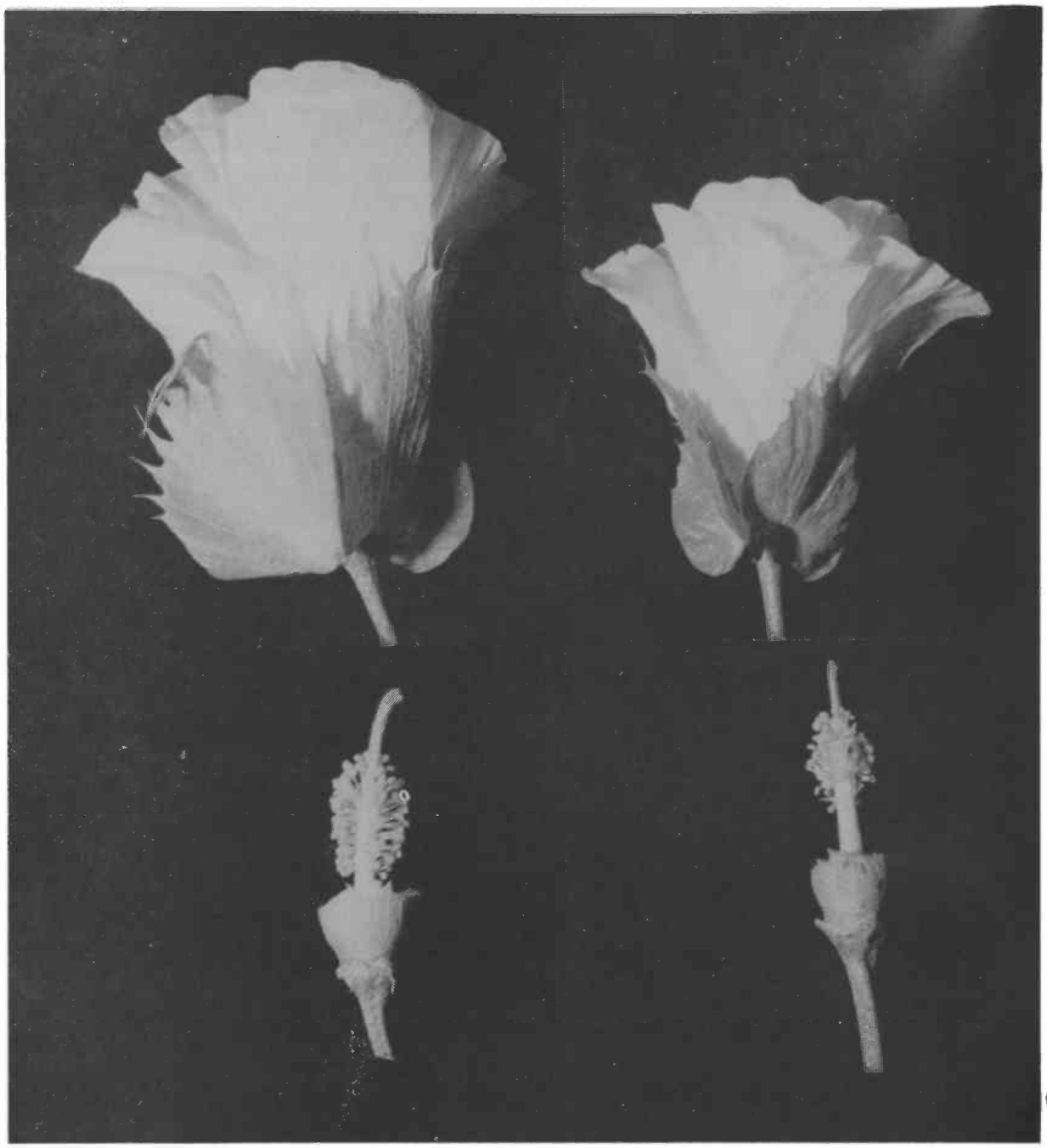
Crazy top, or acromania, of cotton is a growth disorder frequently observed in parts of the cotton-growing areas of Arizona. It is believed to have been first observed in a field of extra-long staple cotton near Scottsdale, Arizona, in 1919.[1]

The first symptoms of the disorder usually occur during the latter part of July and only in the new growth. These symptoms include reduction in size and distortion of the leaves, stems, bracts and flowers, and partial or complete lack of pollen shedding. The fruiting branches are reduced in size, and the vegetative branches are irregular. Thus the top of the plant has a very characteristic appearance to which the name "crazy top" is applied. Crazy top is found predominantly on soils where water penetration is difficult, primarily on soils with a hardpan or caliche layer near the surface.



ABOVE are shown, at the left, the external and internal views of normal Pima S1 flowers, while at their right are external and internal views of Pima S1 flowers from plants having hollow boll.

Hollow Boll and Pima S1

Crazy top as such has not been observed in Pima S1, the present commercial extra-long staple variety. Another disorder, however, referred to as hollow boll, has been observed in this variety under conditions similar to those where crazy top is found in Upland. The name "hollow boll" well characterizes the most obvious symptom of this disorder. Bolls form on the plant, but they contain only a few or no seeds. Hollow boll apparently is a response peculiar to Pima S1, since no other commercial variety of extra-long staple or Upland cotton has been observed to retain bolls containing no seeds.

This hollow-boll disorder may occur any time during the growing season and may last for only a few days or throughout the entire season. The flower symptoms are distinct and striking. The flower size is reduced, the petals are faded, and the pollen either does not shed or only partially sheds. When bolls develop from these flowers, they are shrunken and have a leathery appearance.

Certain other plant symptoms may or may not accompany the hollow-boll disorder. In very severe instances the appearance of the leaf may be similar to, but not as striking as, that found in crazy top. The leaves may be smaller, asymmetrical, and not as deeply lobed as normal leaves.

Where Water Doesn't Penetrate

In 1958, many fields of Pima S1 were observed in areas where the hollow-boll disorder appeared in 1957 as well as in areas where it had not been found. The areas surveyed included fields from Yuma, Arizona, to El Paso, Texas. The hollow-boll disorder was found at lower altitudes in Arizona on soils where water penetration seemed to be a problem. These areas were located in the Salt River Valley, in the Maricopa-Stanfield area, and near Queen Creek. Hollow boll was not observed in the planting on the Experimental Station at Yuma but was observed in commercial fields in the Wellton-Mohawk area. At the higher altitude in the Safford area, the hollow-boll disorder was not found, nor was it found in the still higher altitudes in New Mexico and west Texas.

In 1958, hollow boll on Pima S1 was quite prevalent northwest of Phoenix. To determine the relative susceptibility of various extra-long staple strains to the hollow-boll disorder, 84 experimental strains were grown in that area. All strains but one, Sacaton Short Internode 131, showed hollow bolls. All strains, including Sacaton Short Internode 131, produced flowers which did not shed pollen at various times throughout the growing season.

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[1]Reported by C. J. King and H. F. Loomis in 1927, in USDA Bulletin 1484, "Factors Influencing Severity of the Crazy-top Disorder of Cotton."

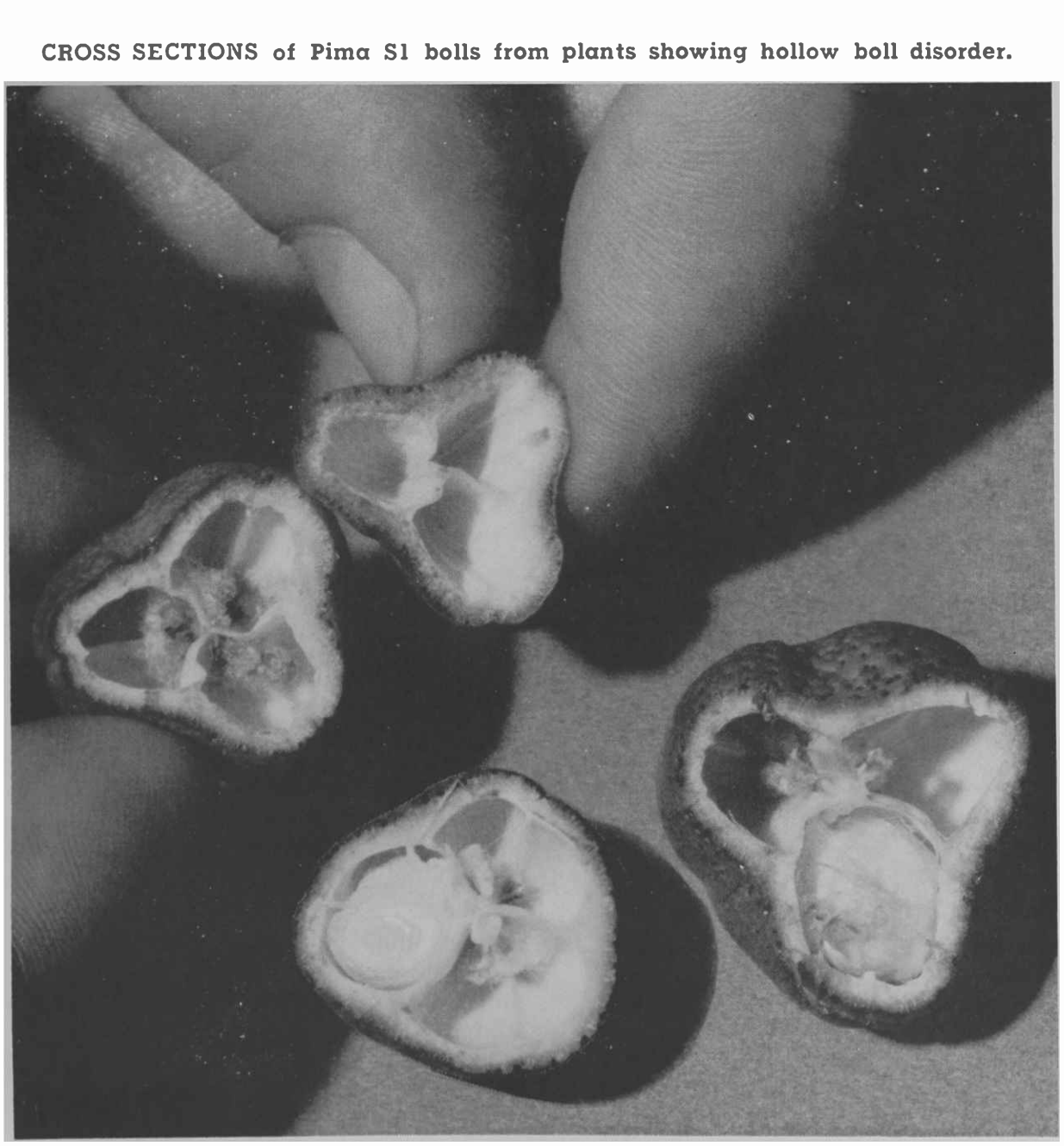
Checking The Boll Set

In this same area, the relationship of flowers not shedding pollen to hollow boll was studied. Fifty flowers that were shedding pollen and fifty that were not were tagged at regular intervals during the growing season at two locations in a field of Pima S1 showing severe hollow boll. The number of bolls formed and the seeds per boll were determined. The boll set and seeds per boll were much lower from flowers not shedding pollen.

These results did not necessarily indicate, however, that lack of pollen was the only cause for the reduction in boll set and seeds per boll, which is typical of the hollow-boll disorder. In two adjacent locations in the same field, pollen shedding and non-pollen shedding flowers were tagged and hand pollinated with apparently good pollen from the Cotton Research Center in an effort to determine whether the female portion of the flowers is also affected. No appreciable change in boll set or number of seeds per boll was noted between the non-pollen shedding flowers receiving or not receiving hand pollination with good pollen. Likewise there was no appreciable difference in boll set or number of seeds per boll between pollen-shedding flowers receiving or not receiving good pollen by hand pollination. This indicates that the female as well as the male portion of the flower is affected.

In surveying the prevalence of hollow boll, it was apparent that altitude had some bearing on its occurrence. Altitude has possibly a temperature effect, the higher altitudes having cooler temperatures, but temperature alone cannot explain the occurrence of adjacent fields showing or not showing the disorder or its spottiness in a given field. To study this observation further, an irrigation-fertilizer test was made to determine whether irrigation practices or fertilizer rates might influence the prevalence of hollow boll. This test was conducted cooperatively with the Western Soil and Water Management Research Branch of the Agricultural Research Service[2] and the Department of Soils, University of Arizona,[3] at the Boswell Ranch northwest of Phoenix. Three irrigation schedules were used in combination with nine levels of fertility, including no treatment, phosphorus alone, three rates of nitrogen alone and in combination with phosphorus, and nitrogen in combination with phosphorus, potash and trace elements. The rates of nitrogen ranged from 40 to 160 pounds per acre.

CROSS SECTIONS of Pima S1 bolls from plants showing hollow boll disorder.



Not Based on Fertility

No differences in the prevalence of hollow boll were noted among the fertility levels. Likewise, very little difference was noted among irrigation levels. It should be noted that the irrigation levels were based on frequency and number of irrigations and not on amount of water intake. On soil with poor penetration, these two measurements may be entirely different. The greatest differences in occurrence of flowers not shedding pollen and having hollow bolls appeared to depend more upon location in the test (soil spots) than upon fertilizer treatment or irrigation schedule. The areas within the test showing the highest percentage of flowers not shedding pollen and having hollow bolls were those areas having low water-holding capacity.

Pima S1 grown on soils of this nature would become water-stressed much more rapidly in the lower valleys, which have higher temperatures, than at the higher altitudes. The normal metabolic processes in the plants in a water-stressed condition under extremely high temperatures may be affected so much that sterility results. If an altered metabolism is involved, then the lower temperatures at the higher altitudes might offset the effect of water stressing so that sterility does not occur. It is possible that the sterility associated with the hollow-boll disorder is a result of too high internal plant temperatures in the water-stressed plants grown under high temperatures.

Get Moisture to the Roots

All observations to date indicate that where hollow boll is a problem, a logical corrective measure would be to follow cultural practices which increase water penetration and water-holding capacity of the soil. Adequate soil-moisture storage may tend to offset the possible detrimental effects of extremely high temperatures.

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[2],[3]Investigations in cooperation with L. J. Erie and T. C. Tucker, respectively.

Trade names used in this magazine do not endorse products named nor imply criticism of similar ones not mentioned.