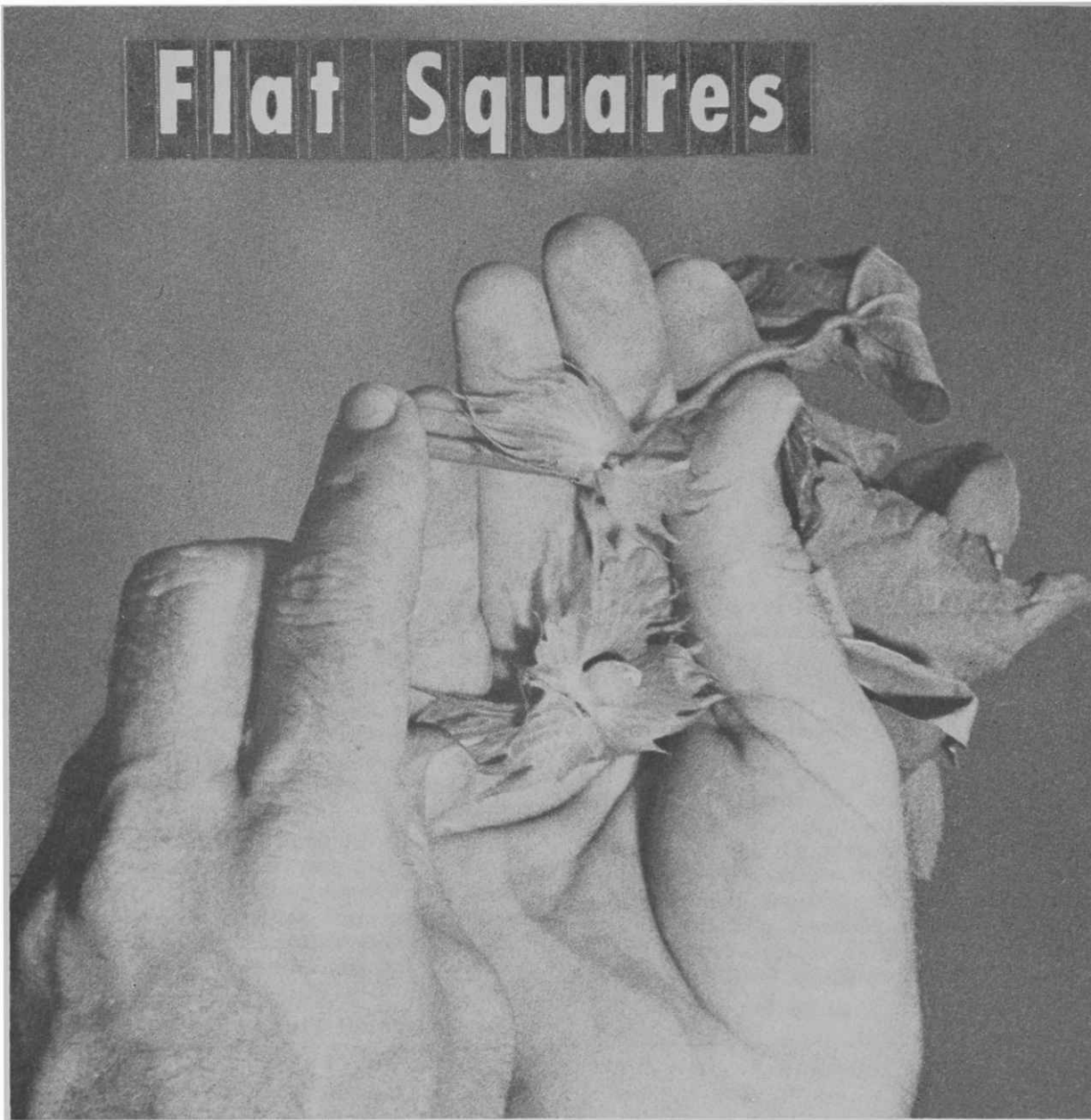


Mystery Malady of Cotton



Ivan J. Shields and G. A. Gries

IN THE PHOTO, the hands are holding two cotton squares, the top square "flat," and the lower square normally filled.

A British general complained after his first skirmish with Indians, "You can't fight an enemy you can't see." Arizona's cotton growers and scientists had a similar complaint this year. They can't fight "flat square" because they don't know what causes it or where it may show up.

Dr. Shields is Extension Plant Pathologist and Dr. Gries is head of the Department of Plant Pathology.

A normal flower bud of cotton is enclosed by three bracts. This complete structure is called a square. In Arizona this past season some of the cotton flower buds failed to form, so that the bracts were empty or blank. As the bracts continued to grow in the absence of flower parts they often became elongated and flat, with two bracts usually much larger than the third. These two bracts became tightly pressed together giving rise to the descriptive term "flat square."

First Reported Last June

About the middle of June, several fieldmen noted this deformity on Delta-pine cotton in a field near Marinette, northwest of Phoenix. Two or three bracts were in the usual position but flower parts were lacking.

Later that week J. H. O'Dell and James Carter, county agents in Maricopa County, were called to diagnose the problem. Because a few insects were in evi-

dence, they sought the opinion of Extension Entomologist Leon Moore.

Due to absence of feeding punctures, and no tendency for the flat square to shed, Mr. Moore felt that the cause was not insect injury. Flat square samples were taken to The University of Arizona's Department of Entomology to check further into the possibility of insect or mite injury. No pests or feeding injury were found. Meanwhile more fields were located with the same problem.

Over 15,000 Acres Affected

In response to a survey conducted by the Extension Plant Pathologist, reports of flat squares were received from all cotton areas in Maricopa County; from Coolidge, Eloy, Casa Grande, and Stanfield in Pinal County; from Marana and the Avra Valley in Pima County; and from Cochise and Santa Cruz counties. In Maricopa County 4,000 acres were seriously affected and it was a decided problem in 10,000 additional acres. Another thousand acres were affected in Pinal, Pima, Santa Cruz and Cochise counties. It was most prevalent in an area northwest of Phoenix, particularly the Deer Valley and Beardsley areas.

It was found on most varieties to some extent, but was most severe on Delta-pine. Several fields had large areas where 90 percent of bottom and middle crops were lost. Most of these set a heavy top crop during August. It was most pronounced in the more vigorous growing plants in an affected field. In sandy hot spots or where cotton was short, flat squares were not evident.

While it was more common and severe in the earlier plantings, it was also found in some fields planted as late as June 1. Flat squares were still being formed in September. It was more prevalent in the fringe areas of the irrigated valleys, where the cotton was closer to the open desert, and where the irrigation water was supplied by pumps.

Symptoms Most Evident

In plants having flat squares, a number of other abnormalities were frequently present.

Proliferation. Extra lateral branches were formed on some affected plants.

Two or three fruiting branches or leaves grew out from each node. The bracts were frequently multiple, with only a keel or three to six additional bracts.

Shortened Internodes. On some plants where this proliferation occurred, the internodes were severely shortened. The plant might be only half the height of its neighbors. The most extreme stunting appeared at the growing tips. Often strong lateral branches grew from near

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PORTION OF COTTON plant with leaves removed to show some of the growth abnormalities associated with flat square. Note that the terminal buds have failed and have been replaced by strong but barren laterals.

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the base and rose as high as the terminals, giving the plant a flat-topped characteristic.

Thickened Stems. In these shortened plants, the stem became thickened and swollen at the nodes, assuming at least twice its normal size.

Tall Plants, Too. In other plants, the internodes appeared normal or maybe slightly elongated.

Leaves Are Distorted

Leaf Deformity. In many fields where flat squares were evident, the leaves had wide sinuses, not unlike a 2,4-D effect. The middle "lobe" of the leaf was frequently reduced in its width and the veins in these lobes had a varicose appearance.

Flower Deformity. In many flat squares no flower parts formed, but all degrees of partial formation were present up to a larger than normal flower. In some cases the flower bud was pointed. In other cases, the formation of one calyx and petal were arrested, and the flower bud opened only on one side. Partially opened flowers might have all the stamens on one side and the stigma on the other. Often the style was recurved.

Disturbed Physiology

All of the symptoms associated with flat square suggest a persistent growth effect induced by some agent or condition early in the development of the plants. In areas where the problem was most severe, this apparently occurred in late May or early June. *The nature of the agent which caused the disturbed physiological condition to develop is not known.*

No one knows whether flat square will be serious next year or even whether it will appear at all. Researchers and extension specialists hope they will be ready with some of the answers.

A variety of possible causes has been suggested. At present it cannot be associated with any cultural practice, such as cropping history, or fertilizer or pesticide applications. Cotton plants grown from the same seed lot developed flat squares in one field and were entirely normal in another, suggesting that it is not a seed-borne problem.

At first it was thought that the abnormal spring weather in 1962 might have induced an imbalance in the growth hormones of the plants, but as flat squares were subsequently found in fields planted as late as June 1, this theory was weakened. In the belief that this disturbance might be related to "crazy top", several growers applied sprays of urea, choline or gibberellic acid. None of these were effective. One affected cotton field which was accidentally exposed to 2,4-D continued to produce flat squares at the same rate as before. That the condition was not due to a minor element deficiency was clearly shown by one commercial company which established elaborate field

tests in fields with severe flat squares.

Possibilities that insects or a virus disease might have triggered the abnormality have not been completely eliminated and are being investigated.

Studies in Progress

University of Arizona and U. S. Department of Agriculture research personnel, both in Tucson and at The U. of A. Cotton Research Center, are continuing to study the problem. Once the cause of flat square is known and the abnormality can be reproduced at will, it should be easier to avoid the problem or to develop control measures.

Botanists are studying the abnormal tissues microscopically, hoping to pin down the stage of growth at which the condition was triggered. The plant pathologists are attempting to prove or disprove whether a virus or other type of disease agent is involved. Plants are being grown under abnormal environments in an attempt to try to duplicate some or all of the symptoms.

To determine whether insects are responsible, the entomologists are subjecting plants to insect attack at various early growth stages. Insecticide trials starting at the time of emergence next spring may indicate whether insects not now suspected of damaging cotton may be involved.

New Voc-Agriculture Teachers Start Out



These future teachers of vocational agriculture were all smiles as they left The University of Arizona campus to begin their work as student teachers in Arizona high schools.

The first phase of their work was completed September 12. During April and May of 1963, they will return to their practice schools for further teaching experience.

Left to right: Scott McEuen from Thatcher, teaching at Willcox High School; David Parks from Prescott, teaching at Douglas; Lou Burleson from Tucson, teaching at Coolidge; Denton Barney from Duncan, teaching at Benson; James Claridge from Safford, teaching at Tolleson; Phillip Lewis from Coolidge, teaching at Amphitheater, Tucson; Charles DeSpain from Navajo, teaching at Casa Grande. These men are seniors in Agricultural Education at The University of Arizona.