depth of 4 inches into the seed row at the same time each day. Vermiculite was sprayed with polyvinylacetate to keep it from being blown away by the wind or washed away by rain or sprinkling. The table shows planting dates and the average soil temperature at 8:30 a.m. during the germination period.

Emergence

Besides the obviously better handling characteristics of coated seed, the emergence percentage and mean emergence period of coated seeds are important. More uniform seedlings came from seed lots with the lowest mean emergence period. When plants emerged fast, they were not as subject to stand problems as slower emerging plants. Faster emerging seedlings appeared to be larger and more uniform, whether because of covering material or seed type.

In these tests, total emergence of minimum-coated seeds was equal to or better than raw seeds in all experiments. Fully coated seeds emerged in significantly lower numbers in all three experiments. Minimum-coated seeds always required more time to emerge than raw seed, but less time than fully coated seeds. There was no significant difference between 5-to-1 and 10-to-1 coatings. The grower objection to the poorer emergence of fully coated seed was overcome by the use of minimum-coated seed. The inventor of a synchronous thinner that is now being marketed pointed out that definite space is needed between single plants for such a machine to operate efficiently. This could be more easily accomplished with minimum-coated seed. Another researcher reported 10 per cent fewer doubles when minimum-coated seeds were used in precision planters in comparison with raw seed. Minimum-coated seed should, therefore, permit more accurate single placement of lettuce seeds without lowering emergence percentages. The delayed emergence occurring with minimum-coated seed was not as great as with coated seed.

Mulching

These data show that, regardless of seed type used, coverings of stabilized vermiculite and coke greatly enhanced the total emergence and lessened the mean emergence period. Lettuce emerged three days earlier when covered with the porous materials than when covered with soil alone. Petroleum mulch over the soil improved the emergence percentage, but not nearly as much as vermiculite or coke. Since crusts did not form where petroleum mulch or the porous materials were used, it seems that seedlings emerge more rapidly through vermiculite or coke because of lessened resistance, or perhaps other improved environmental conditions. Crusting was definitely a factor in the soil covering treatment, and this restricted the emergence more than with the other materials. The improved stands resulting from the use of vermiculite and coke should prove of significant practical value in mechanization. No significant interactions between covering materials and type of seed coating were measured.

David Ririe is Farm Advisor, and J. W. Huffman is Farm Advisor and County Director, Agricultural Extension Service, Monterey County. *Germain's Inc. contributed seed for these tests; Spreckels Sugar Co. contributed land; Western Rain Bird contributed sprinklers; and Collier Carbon and Chemical Corp., California Zonolite Co., and Moyer Chemical Co. contributed the covering materials.*

Reinfection Possibilities for Angular Leaf Spot Pathogen in California Cotton

W. C. SCHNATHORST

ANGULAR LEAF SPOT of cotton (*Gossypium hirsutum*), caused by the bacterium *Xanthomonas malvacearum*, became established in California in about 1951. By 1962, however, sanitation had eradicated it from cotton fields, and attempts in 1966–67 to demonstrate cotton-gin-contamination failed even though contamination had been readily demonstrated in 1958–60, when the disease was widespread.

It was then suggested that the disease could be re-established in California only by contaminated seed introduced from other cotton-growing areas. However, *X. malvacearum* was imported in 1967 on cotton seed from South Carolina even though the seed had been acid-delinted and fumigated before arrival here, as required by state permit.

Acid-delinting has been used for many years for the control of *X. malvacearum* and other seed-borne cotton pathogens in the United States, but a low percentage of the seed can be infected internally. Although acid-delinting removes external bacteria, it apparently has little effect on the pathogen within the seed, and is not completely effective in controlling the disease or preventing its introduction into disease-free areas like the San Joaquin Valley. This report presents details of the 1967 occurrence in California, and suggests methods for preventing re-establishment of the disease.

Field occurrence

Many cotton varieties from other states have been grown recently in California for comparison with the variety (SJ-1) now grown in the San Joaquin Valley. The seed was brought in under restrictions and with the approval of the California Department of Agriculture. Plants suspected of having angular leaf spot were found in early September, 1967, in a sprinkler-irrigated variety trial at Arvin, California. The infection was later found in three varieties from South Carolina—all exhibiting angular leaf lesions, systemic spread in leaf veins, black arm on stems, and boll lesions. Counts of infected plants indicated 1 to 2 per cent infection in all of these varieties. There was no apparent spread to adjacent varieties, or to commercial cotton.

The same varieties were also observed at locations near Tulare and Madera, California, where furrow irrigation was used. Since expression of the disease in these instances was expected to consist of only the black arm phase, observations

TRANSMISSION OF XANTHOMONAS MALVACEARUM IN COTTON SEED OF THREE VARIETIES INTRODUCED INTO CALIFORNIA IN 1967

Variety	Trial 1	Trial 2	Trial 3	Trial totals	Transmission
	Infected plants/healthy palnts				%
PD 2165	0/48	0/158	7/134	7/340	2.1
PD 0259	0/149	0/144	2/149	2/442	0.5
PD 3307	2/112	—	—	2/112	1.8
				Average	1.5

were confined primarily to the lower stem. Several examples of black arm were seen at Tulare, but collections at Madera could not be considered typical, since the density of the plants there made observations difficult. Samples were taken for isolation from all three locations, however.

Isolation and race determination

Isolations were made from diseased tissue that had been dried for four to seven days in the laboratory. Race-differentiating varieties were inoculated with several isolates from the Arvin and Tulare plots. Isolates suspected of being *X. malvacearum* were pathogenic and proved to be Race 1. The pathogen was recovered from collections at Arvin and Tulare but not Madera.

Seed transmission

Seed samples were obtained of the varieties suspected of carrying the pathogen. Several unhealthy-appearing seeds were taken from each sample for direct isolation of the pathogen. *X. malvacearum* was not recovered from any of the nine selected seeds. Two hundred seeds were taken from each sample and soaked for 18 to 19 hours in 60 ml of sterile glass-distilled water. (Soaking facilitates detection by increasing the percentage of diseased seedlings that result from an infected seed lot, particularly if there is external contamination.) Although this seed had been acid-delinted and fumigated—making the chances of external contamination small—it was hoped that soaking would enhance disease expression from internal infection. The seed and suspension were agitated periodically and then poured onto autoclaved soil, covered with autoclaved soil, and held at 80–85°F. Readings for disease began two weeks later and continued for another two weeks. Two of the varieties required several trials before disease transmission could be demonstrated.

Approximately 1.5 per cent of the plants of the three varieties exhibited typical blight lesions on cotyledons (see table). Isolations made from the lesions, and subsequent inoculation to susceptible varieties, proved that *X. malvacearum* was seed-borne. The low transmission percentage indicates that the seed-borne infection was internal; with external seed-borne contamination the techniques described generally result in infection ranging above 10 per cent.

Conclusions

It was concluded that although bacterial blight occurred on imported cotton varieties planted adjacent to commercial cotton, there was no spread into the commercial growing crop. Since infected plants in variety trials were destroyed and the seed was not processed in a commercial cotton gin, it is unlikely that the disease will become established as a result of its introduction.

Since the pathogen was recovered from plants at the Arvin and Tulare plots, it can be assumed that it was introduced at Madera also, even though it was not isolated from plants at that location.

The occurrence of bacterial blight in 1967 demonstrates how easily the pathogen can be introduced in seed. *X. malvacearum* has probably been introduced into California many times, although only five introductions are documented. Introductions could go undetected when plants are furrow-irrigated, though it is generally detected where sprinkler irrigation is used. The difference between the two types of irrigation in the development of the disease was well illustrated in 1967. Only the black arm phase on the lower stem was observed where furrow irrigation was used, but all of the typical blight symptoms were present under sprinklers.

Screening advisable

Even though acid-delinted and fumigated cotton seed can be brought into California legally, it seems advisable to screen introduced cotton varieties in the greenhouse for bacterial blight transmission before planting in the field, especially if sprinkler irrigation is used. Greenhouse screening might also detect other seed-borne pathogens of cotton. To eliminate virtually all risk of establishing bacterial blight in the future, introduced varieties should be grown only in furrow-irrigated plots.

W. C. Schnathorst is USDA Research Plant Pathologist and Associate in the Experiment Station, Department of Plant Pathology, University of California, Davis. *California Planting Cotton Seed Distributors, Bakersfield, cooperated in this study, and Barbara Koepsell gave technical assistance.*

Control of

BOTRYTIS or "fire" in Easter lily foliage and flowers is a devastating disease in the lily growing areas of southwest Oregon and northwest California. Botrytis foliage blight is caused by the fungus, *Botrytis elliptica.* The disease causes a tear-drop shaped lesion on the leaves and may completely defoliate plants not protected by a suitable fungicide. Through a magnifying hand lens the mycelium of the fungus can be seen growing on the surface of the leaf. The fungus is especially prevalent during periods of cool, wet weather.

Bordeaux mixture is usually applied about 22 times per season and is the standard protectant fungicide. Rates of application vary from grower to grower but are generally in the range of 6-6-100 to 10-10-100. The lower concentration is usually applied during the early part of the season but when Botrytis becomes severe later in the season the higher concentration is used. Numerous other materials have been tried with limited success during the past 20 years. The carbamate materials, such as maneb, give good control of mild blight, but must be applied at least every seven days. Unfortunately rainy weather may limit applications, so growers have reverted to the Bordeaux mixture. Botrytis blight was extremely serious during the 1968 season and 100 per cent control was not obtained even with the Bordeaux treatment.

Systemic fungicides

New systemic fungicidal materials have been developed during recent months and two of these materials were tried under experimental conditions in a grower's field near Smith River, Del Norte County. Benlate 50W—formerly Du Pont 1991—(methyl 1-(butylcarba-