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ARIZONA COMMISSION OF AGRICULTURE AND HORTICULTURE

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TREATMENT OF COTTON SEED TO CONTROL THE ANGULAR LEAF SPOT OR
BLACK ARM DISEASE.

This bacterial organism was responsible for a loss of several hundred thousand dollars to the cotton growers of the state of Arizona during the season of 1913. Individual cases are known where the loss amounted to one-third and even one-half of the crop. The disease is distributed in all sections of the state where cotton is grown and is especially severe on light sandy or new soil.

The disease is carried over from season to season by means of the seed. The young seedling plant first exhibits infection in small circular, water-soaked areas upon the seed leaves. The infection spreads from these to the stem of the plant and when a height of six inches or more has been reached a marked constriction of the stem is noticed at or slightly above the soil surface. Plants at this stage frequently drop over and may lie prostrate on the ground but seldom die. Under favorable conditions an exudate, waxy and of a brownish yellow color appears just above the constriction. This exudate contains countless millions of the bacteria or germs responsible for the disease. These are easily spread from plant to plant by rain, dew and climbing or flying insects.

Leaf infections appear as the plant grows older and are in two forms. The angular leaf spot is first observed, wherein there appears a small water soaked spot upon the under surface of the leaf bounded by the small veins. This later turns brown or black and involves the entire thickness of the leaf killing all the invaded tissue. The other form is more conspicuous and confines its attacks to the larger veins or midribs of the leaves and the adjacent tissue. A water soaked appearance is first noted, followed by a darkening of the area infected and later the death of the tissue. This stage has been erroneously termed "rust" by some of the growers. Squares are affected in the same manner as the leaves and frequently shrivel and dry up.

The black arm type of infection is the more serious form of this disease. Conspicuous reddish brown areas are noticeable first which turn to a dark brown or black color as the disease advances. Infection occurs at any time during the season and usually the stems, branches, petioles of the leaves and the peduncles of the flowers are involved. The bacterial exudate is especially common when these parts are attacked. The effect is to cause a casting or shedding of the bolls or to so weaken the plant that the crop does not mature normally. Bolls are also attacked in the same manner as the other parts of the plant. The organism has been found penetrating the lint and even extending to the inter-

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ior of the seed coat. It is by this means that the disease is carried over to the following season.

Control measures.

The control of this disease may be considered to be in the experimental stage as yet. In experiments conducted in Georgia and South Carolina during the past two or three years it has been shown that the most practical method of control is through the treatment of the seed. Several Egyptian cotton growers in Maricopa, Pinal and Pima Counties are planning to treat their seed this season for a portion of the total acreage in each case in cooperation with the writer in experiments he is conducting in the capacity of Consulting Plant Pathologist of the Arizona Agricultural Experiment Station. The object of the treatment is to kill all dormant forms of the organism that might be on or within the seed coat. Two methods used most successfully so far are the hot water and bichloride of mercury or corrosive sublimate treatments.

Hot Water Treatment: This consists of immersing the seed in a tub or vat of hot water for a given period of time. The seed should be treated in lots of about a peck in order to quickly and uniformly reach the desired temperature. A perforated tin pail, a sack or a basket is used. The treatment will be greatly facilitated if two vessels are used. The first should be used to bring the seed to the desired temperature in order to not lessen the temperature when transferred to the second. Galvanized tubs or boilers heated over a kerosene or gasoline stove are most convenient. The temperature of both vessels should be kept as near constant as possible, 150 degrees Fahrenheit being the standard. A reliable thermometer (Standard dairy thermometer recommended) is therefore absolutely necessary. Should the temperature fall below 149 degrees F. or rise above 158 degrees F. the time of immersion should be increased or decreased accordingly. Dip the seed in the first vessel and thoroughly agitate for one minute, then transfer to the second vessel and leave fifteen minutes. When the time of immersion has elapsed drain quickly and spread the seed out to dry or plant within twelve hours. Seed treated in hot water germinate readily and under some circumstances might be planted while still wet. In case this is done the grower should allow for the increased weight of the seed due to the absorption of water. One pound of seed will absorb about one-fourth its weight of water.

Bichloride of Mercury or Corrosive Sublimate Treatment: This consists of treating the seed for one hour with a solution made of one part of bichloride of mercury to 1000 parts of water. One ounce of the material dissolved in seven and one-half gallons of water makes the required strength. It is necessary to use wooden, granite or earthen vessels as the solution corrodes metal. When making the solution dissolve the amount necessary to use in a small amount of hot water then dilute to the required strength. Any quantity desired may be made at one time and used later as the solution does not deteriorate with age. Not more than three lots of seed should be dipped into the same solution as the seed removes the bichloride of mercury thus weakening the strength. It

is advisable to have a fresh solution on hand and replenish after each dipping. After treatment drain the seed for a few minutes and spread out to dry or plant within twelve hours. Never treat a full sack of seed as the expansion is apt to burst the sack. A sack one-half or two-thirds full is much easier to handle and also allows for better agitation of the seed while immersed in the solution. Remember bichloride of mercury is a deadly internal poison but is not injurious to the external parts or to clothing.

Cost of Treatment.

Aside from the time and labor required the cost of treatment is not great. By use of the hot water method the cost is almost negligible. Facilities for heating water and such articles as tubs, boilers and pails are found in every farm home. The one item of expense is for a reliable thermometer as the average household instrument is not accurate enough for this purpose. A good dairy or chemical thermometer ranging sufficiently high on the scale and responding quickly is best.

To use the bichloride of mercury or corrosive sublimate treatment the outlay is necessarily greater. The cost of the material is quoted by a local druggist at \$3.50 per pound. In smaller quantities the price increases. A pound is sufficient to treat a ton or more of seed. Barrels or wooden tanks are absolutely necessary. A wooden vat, 40 inches long, 30 inches deep and 24 inches wide (inside measurements) capable of holding 125 gallons is made by a Phoenix planing mill for \$17.50. Sixty gallons of solution in a vat of these dimensions is sufficient to treat 250 pounds of seed at one immersion. At this rate a ton of seed can be treated in a day of eight hours, while with the use of a larger vat an increased amount could be treated with the same outlay for labor. Unless the treated seed is planted at once it should be spread on a piece of canvas to dry.

Cautions and Recommendations.

Care should be taken to see that every seed is wet whatever treatment is used. In the case of hot water a constant temperature is essential as below 149 degrees F. the treatment is of no value while if increased above 158 degrees F. serious injury to the seed is apt to occur.

Unless planted at once or within twelve hours from time of treatment all seed should be thoroughly dried. Wet seed if left in sacks heats rapidly and germination is impaired.

Laboratory tests show that treated seed increases in weight approximately one-fourth. If 30 pounds of dry seed to the acre are to be used it will be necessary to use 37 to 40 pounds of wet seed.

In using bichloride of mercury never make a stronger solution than recommended. Such action is a useless waste of material and might affect the germination of the seed.

Remember that bichloride of mercury is deadly poison when taken internally. Treated seed should never be fed stock or the solution left where stock or children would be apt to drink it.

In case injury to the seed by treatment is suspected a germination test should be made. This is done by placing one hundred treated seed between wet paper on a plate or pan and leaving in a warm place. The same is done with an equal number of untreated seed. After a few days the comparison can be made of the percentage of germination in the two lots.

For further information or directions consult the County Agent of the writer at the office of the State Entomologist, Phoenix, Ariz.

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Plant Pathologist.