UNIVERSITY OF KENTUCKY

COLLEGE OF AGRICULTURE

Extension Division

THOMAS P. COOPER, Dean and Director

CIRCULAR NO. 89.

Wildfire and Angular Leaf-Spot of Tobacco

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Lexington, Ky.

February, 1921

Published in connection with the agricultural extension work carried on by co-operation of the College of Agriculture, University of Kentucky, with the U. S. Department of Agriculture, and distributed in furtherance of the work provided for in the Act of Congress of May 8, 1914.

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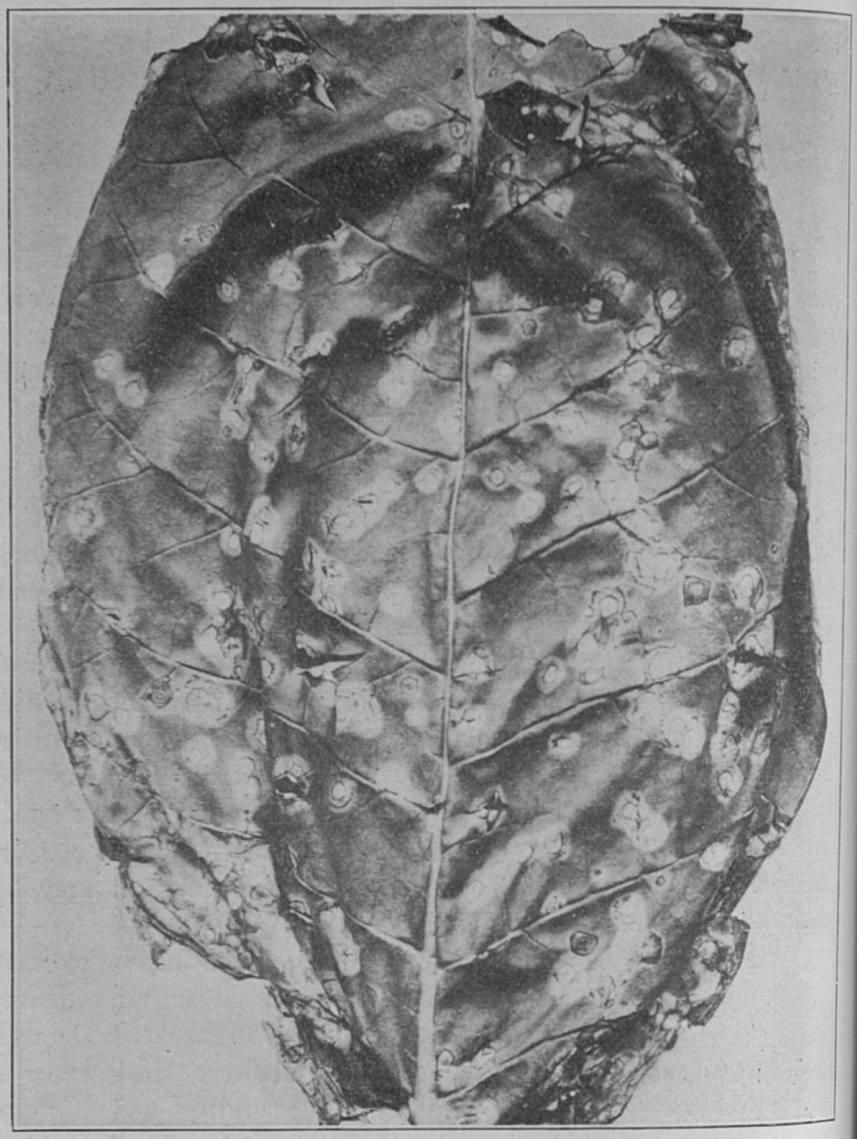
Because of the widespread distribution of the leaf-spot diseases of tobacco in Kentucky in 1920, and because of the serious losses which resulted thruout the tobacco growing districts, it is desirable that a brief account be given of the diseases concerned and what is known concerning their control.

HISTORY OF THE DISEASES IN KENTUCKY.

Little is known concerning the leaf-spot diseases in this State other than what has been gathered from conversations with tobacco growers concerning previous outbreaks and what was learned in studying the diseases the past season.

During 1920 three distinct leaf-spot diseases of Burley and black tobacco contributed to the damage. Each is due to a different cause and represents a distinct disease. The three diseases are wildfire, angular leaf-spot, and a third disease, not so well recognized, which we will speak of as mosaic speck spot. The last is of comparatively little economic importance as a leaf-spot disease, but will be described here because it may be confused with one of the others.

Wildfire caused serious injury in the seed beds the past season, appearing first about the fifteenth of May and continuing to do serious damage for two weeks. Further trouble was not reported until the middle of July, about a week after a severe rain and wind storm. At that time wildfire and angular leaf-spot caused very serious losses in several fields in which the tobacco was making very rapid growth. Practically no injury was caused on small tobacco at this time. In August, following a rainy period, both diseases spread very rapidly and caused serious losses thruout the Burley section. In the latter



Typical wildfire spots showing the broad, yellow halo surrounding the dead interior.

Late stages of wildfire on Burley tobacco which was nearly ripe when infected. Natural size.

part of August the diseases spread rapidly in the dark tobacco section. From this time on they continued to cause serious losses following every rain storm where wind was present.

As far as could be learned, wildfire appeared for the first time in the Burley district of Kentucky in 1920, at least as a serious disease. Conversations with many growers failed to bring forth evidence that the disease had been present before. Angular leaf-spot, on the other hand, appeared to be quite well

known by many growers, who called it "rust." Serious losses have been caused in isolated localities by this disease for at least twenty years; in some cases reports were obtained of the loss of entire crops, undoubtedly due to the anglar leaf-spot organism.

In the black tobacco section a little evidence was gathered which might indicate that wildfire had been present there, causing a part, at least, of the losses from the disease popularly known as "black fire."

Angular leaf-spot undoubtedly has been present in the dark tobacco section for a long time, causing part of the losses from "black fire" and the leaf-spot troubles spoken of as rusts.

WILDFIRE.

Cause.

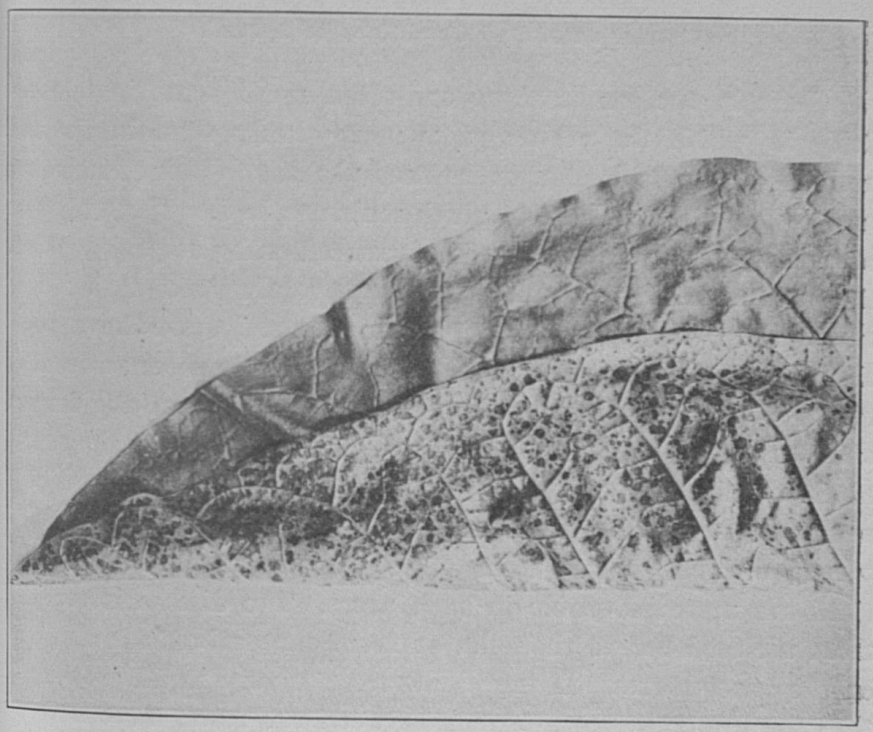
Wildfire is caused by a definite plant organism spoken of technically as a bacterium (*Bacterium tabacum*) and is not caused by weather or soil conditions, as many growers have been led to suppose. There is, however, a very definite relationship between certain soil conditions in a field and the severity of the disease and there is also a very definite relationship between weather conditions and the spread of the disease. If the specific organism is not present, however, the disease will not appear, in spite of weather conditions favorable to the disease.

Wildfire appears first in the seed bed as very typical, small, water-soaked spots about 1/8 inch or less in diameter, on the leaves. Very soon a wide, yellow border or halo appears around the dead area of the spots, giving an appearance quite similar to the well known frog-eye spot. If many spots develop on a leaf at one time, the whole leaf may take on a water soaked appearance and fall to the ground, where it very soon disappears completely. Severe infection in a seed bed may kill practically all the larger leaves, causing the plants to become gradually smaller and smaller until only the smallest leaves at the growing point remain. These small leaves generally take on a yellow or whitish appearance and the plant may die. The plants may recover if favorable growing conditions follow an attack.

If diseased plants are set in the field and favorable conditions develop for the spread of the disease, it may spread from leaf to leaf and from plant to plant and injure or destroy the entire crop.

Relation of Weather to Spread.

The weather most favorable for spreading the disease is a rainy period with considerable wind, followed by a damp period of about 24 to 48 hours. The bacteria which cause the spots live in large numbers in the old spots. When these become soaked with water the bacteria swim out into the drops on the leaves and are then blown about by the wind. This explains why the disease always spreads more rapidly if wind accompanies rain and why plants on the windward side of a field and plants protected by hedges or buildings, even those situated in the middle of large plantings, are always freer from spots than those exposed to the wind.



Angular leaf-spot infections on the lower side of a leaf about four days after a severe wind and rain storm. The wind turned half of the leaf over, exposing the lower side to infection. Infection did not take place thru the upper surface, altho it, too, was exposed.

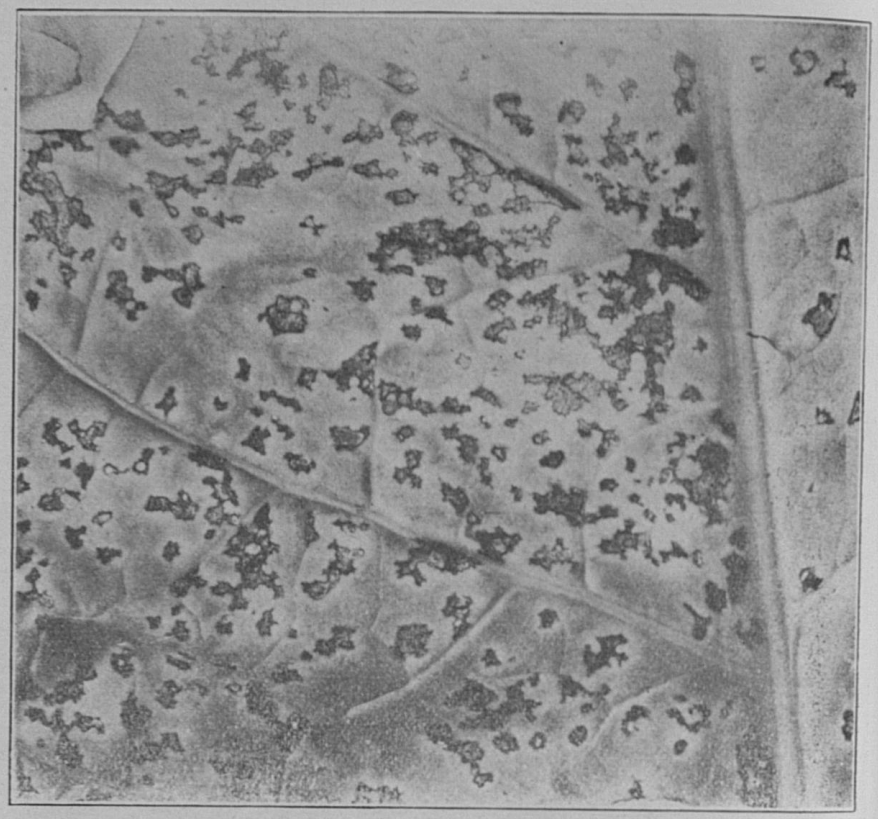
Wind is also a factor in the spread of the disease because infection takes place more readily on the under side of the leaf than on the upper. The writer has determined this point by numerous field observations in which leaves were folded over, exposing a portion of the lower side as well as the upper, in which case the spots were always more abundant on the exposed under surface than on the remainder of the leaf. He also made inoculations in the greenhouse, putting the organism of either wildfire or angular leaf-spot on the lower side of one-half of a leaf and on the upper side of the other half. Spots always develop in greater numbers on the half of the leaf inoculated on the under side, few ever developing from the upper surface. Wind causes the under surface to be exposed more to the wind-blown bacteria than if all of the leaves remain quiet, as during a gentle shower.

Relation of Soil Conditions to Spread.

Late in the season there are often small areas in tobacco fields in which the plants grow more slowly than in the remainder of the field. Slow growth may be due to lack of moisture in the "pebbly" soils or to much moisture in low spots. It has been observed many times and commented on by several farmers that plants in these areas are more severely spotted than the surrounding larger, more vigorous plants. Some have concluded that the soil is the cause of the disease in these areas, and others that such plants are more susceptible than the larger ones. It is obvious that the soil conditions cannot be the cause of the disease, and we believe that the plants in these areas are not more susceptible than the larger plants. The more rapid spread on such plants seems to be because mechanical conditions are more favorable in such areas. The disease is carried from the seed bed to the field, or from one outbreak to another on the lower leaves. If the plants make a very rapid growth so that the upper leaves interlock between the rows, there is very little chance of the disease which is only on the lower leaves

Angular leaf spot on Burley tobacco. The twisted leaves became infected before growth was completed. Expansion of the live portions of blade following infection caused the twisted and irregular appearance.

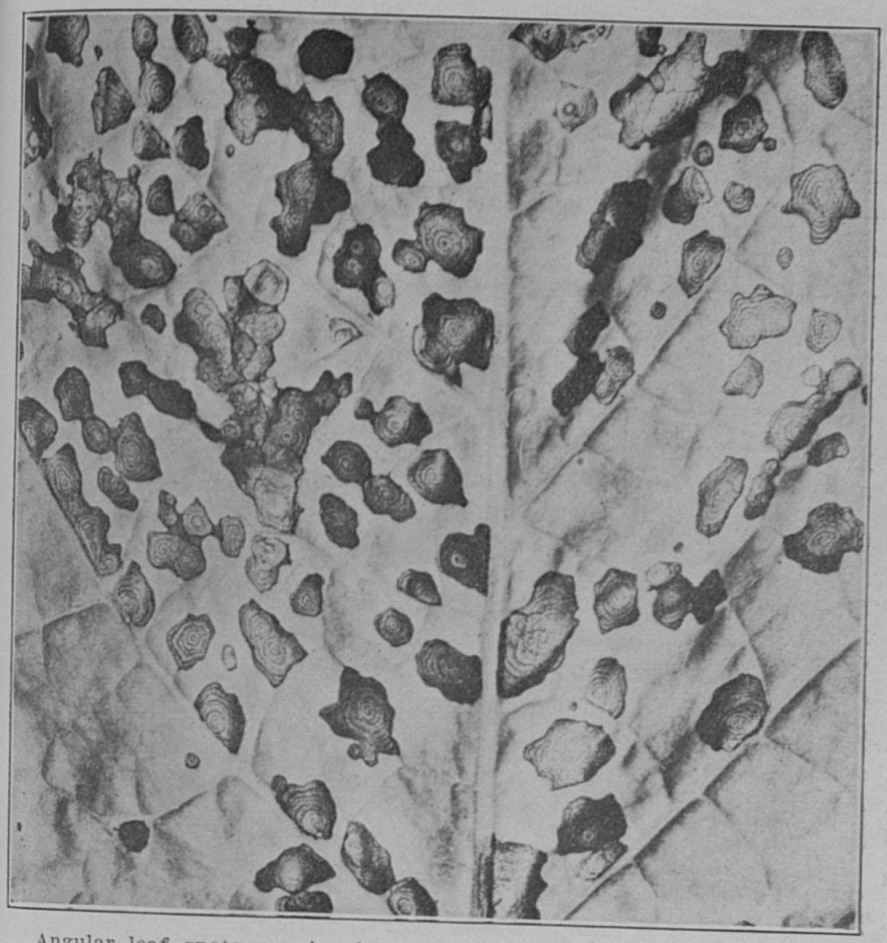
spreading to those higher up, whereas if the plants are small all the leaves will be whipped about by the wind during a storm and so all will be exposed to infection. In the early part of the season the disease is more likely to be found on the largest, most vigorous plants because at that time they are not protected from the infection by the leaves interlocking and the large, tender leaves naturally are blown about more by the wind than the small leaves of the slow-growing, less vigorous plants.



Typical angular leaf-spots on a young, green leaf of Burley tobacco. The very narrow, yellow margin may be seen in contrast to the broad halo about the wildfire spots. Natural size.

Wildfire in the field, as in the seed bed, is characterized by the large, yellow halo spots, often ½ to ¾ inch in diameter, surrounding a small center of dead tissue. If the attack on a leaf is very severe, the whole leaf may become water-soaked and dry up on the first dry day without showing any of the halo spots. This is a common condition in very severely diseased fields.

On black tobacco wildfire in its early stages shows the broad, yellow halo, but later this may disappear, making it difficult to distinguish from angular leaf-spot.



Angular leaf spots on ripe leaves of Burley tobacco. If the tobacco has completed its growth the disease does not cause the leaves to become twisted as in the case of infections on young, growing leaves. Natural size.

ANGULAR LEAF-SPOT.

Angular leaf-spot, or "rust", is similar in its nature to wildfire but causes slightly different effects on the leaves. It, also, is caused by a specific bacterium (*Bacterium angulatum*). On Burley tobacco the angular leaf-spots appear first as water-soaked areas which gradually turn brown. The line between the brown, dead area and the green leaf is dark and water-soaked in appearance as long as the spot is spreading. There may be a very narrow, yellow halo surrounding the water-soaked band. but it is seldom conspicuous. The spots often take on an angular

shape as a result of killing all of the tissue between certain veins. In the early part of the season, on green, young plants, the spots are generally about ¼ inch in diameter, but spots on tobacco which is ripening may be much larger, often attaining a diameter of ½ to ¾ of an inch. On ripe tobacco the angular leaf-spots and wildfire spots are often hard to distinguish. This is never the case in the early part of the season.

Mosaic speck-spot on Burley tobacco. This disease is distinct from either wildfire or angular leaf spot and seems to be a secondary effect of the mosaic or calico disease. Natural size.

On black tobacco the angular leaf-spots are often much larger than on Burley tobacco and are generally not angular. Spots which were determined definitely to be angular leaf-spots have been seen which were over one inch in diameter.

The remarks concerning the effect of weather and soil conditions on the spread of wildfire also apply to the angular leaf-spot. It has been observed often in seed beds but has not been, in our observations, the cause of serious seed bed troubles.

MOSAIC SPECK-SPOT.

Mosaic speck-spot is a disease which appears in some cases much like the angular leaf-spot, but is not due to a specific organism which can be isolated and grown. The spots appear as small, dead, brown or white spots, generally about 1/8 inch in diameter or less, and have been found only on plants which show the characteristic mottling of the mosaic disease, or "calico", sometimes incorrectly spoken of as "frenching". These spots, as far as we know, are the result of the mosaic disease. They do not yield an organism when cultured and therefore cannot be caused experimentally as can the wildfire and angular leaf-spot.

CONTROL OF WILDFIRE AND ANGULAR LEAF-SPOT.

Practically every outbreak of these diseases studied in the field could be traced to seed bed infections. These, in turn, are evidently the result of seed infections. Seed-pod infections were quite common in badly diseased fields in the fall of 1920. The infected spots appeared as water-soaked areas and later as dead, brown spots on the seed-pods. Seed pods were readily infected in the greenhouse by wetting them with a pure culture of the wildfire organism.

Selection of Seed From Disease-Free Fields.

In view of this fact, control, it seems, must consist in obtaining disease-free seed. It is doubtful, in view of the experiences of the past season, whether selecting seed from apparently disease-free fields will be of any value as a control measure.

The tobacco crop of 1919 was very free from leaf-spot troubles and from such fields most of the seed for the 1920 plantings was obtained. Seed from the 1918 crop also produced wildfire in at least one case. In spite of the fact that the 1919 crop was very free from all leaf-spot troubles, one or the other or both of these diseases were present in practically all plantings in the State. *It seems obvious that selection of seed from what appears to be a disease-free field cannot be considered a safe means of obtaining disease-free seed.*

Protection of Seed-Heads.

Protection of the seed-pods from infection in fields which appear to be free from infection gives promise as a means of control. Bagging seed heads (tieing a 16-pound paper bag over the seed-head as soon as the flowers begin to open) for the purpose of keeping the seed free from crossing with other less desirable plants is widely used in some sections where care is taken in the selection of desirable strains. Seeds from such bagged heads, planted at the Experiment Station the past season, produced plants remarkably free from infections. Plantings from such seed, when grown side by side with plantings from seed which was left exposed the previous season, were free from spots, whereas those from the exposed seed were spotted badly following the first severe storm. Later in the season the diseases spread to all the plots, from the infected ones. It is recommended that all seed heads be protected with paper bags and that the bags be left on until after the seed is harvested. It may be necessary to replace the bags from time to time if grasshoppers or other insects eat holes in them. The changes should be made only when the plants are perfectly dry because accidental infection may take place if the heads are handled when wet.

Seed Treatment.

A seed treatment which gives promise of being of value in the control of these diseases has been developt by the Virginia Agricultural Experiment Station. It has not been widely tried under field conditions, but as it is simple, cheap, does not

injure the seed, and gives promise of complete control under field conditions, it should be widely tried as a control measure.

It consists in soaking the seed in a solution of 1 ounce of commercial formalin (40 per cent) to one pint of water, or in the proportion of 1 to 16. The seed should be stirred constantly in this solution for fifteen minutes, washed thoroly in several changes of clean water and dried in a place entirely free from tobacco dust and litter. As formalin sometimes causes injury to seeds, washing should be thoro, especially when the seed is not to be planted immediately.

Bichloride of mercury or corrosive sublimate may be substituted for the formalin, using 1 part of bichloride to 1000 parts of water. The seed should be soaked in this solution for 15 minutes and washed thoroly. The seed may be dried quickly if they are put into a small cheesecloth bag and swung around at arm's length several times to remove surplus water and then spread in a thin layer.

It is important that seed be treated even tho it has been obtained from a field which seemed to be free from disease the previous year.

Other Precautions.

Care should be taken to prevent infection from other sources. It is necessary that new canvas or canvas which has been boiled in water or soaked in formaldehyde solution be used because there is a possibility of infection being carried from one season to another on dirty canvas. It is desirable that steaming be substituted for burning beds, because it kills weeds more thoroly than burning. If a small, infected area is present in a bed and weeding is done the disease may be spread over the entire bed on the hands of the weeder. If weeding is not necessary the infected area may remain small and be avoided entirely at planting time.

DISEASED TOBACCO AS A FERTILIZER.

In view of the large amount of low grade leaf the past year much of this is likely to be used for fertilizer. The extent to which this will carry the disease into an otherwise clean field of tobacco is not known. It is probable that if all such material is well covered in plowing, there will be little danger to a tobacco crop planted in land fertilized with tobacco waste. Until further evidence is procured on this point, however, it is to be recommended that fertilizers made from tobacco be put on land to be used for other crops and that other fertilizers be put on the tobacco land. These diseases are only known to attack tobacco.