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Results Of The Tobacco Disease Survey, 1930

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RESULTS OF THE TOBACCO DISEASE SURVEY, 1930

A Report of the Plant Bed and Field Surveys Conducted by the Divisions of Mycology and Disease Survey and Tobacco and Plant Nutrition, Bureau of Plant Industry, in cooperation with agents and collaborators in various states.

Prepared by

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OBJECTS OF THE SURVEY

At the Conference on Tobacco Diseases and Nutritional Problems held at Washington, D. C., December 10 to 12, 1929, the need was frequently expressed for more accurate information on the occurrence and severity of tobacco diseases, as well as on cultural and control practices. Dr. James Johnson in his suggestions for cooperation in tobacco work submitted for use at that conference pointed out that "Each pathologist should have more definite current information than is now available about the occurrence and extent of damage resulting from each tobacco disease in the various districts", and suggested that more attention be given to the collecting and reporting of survey information.

With these needs in mind the Plant Disease Survey and the Division of Tobacco and Plant Nutrition of the Bureau of Plant Industry made arrangements with state collaborators and plant pathologists particularly interested in tobacco diseases, for seed bed and field surveys in the tobacco states.

PLAN AND METHODS

Special forms for recording information on conditions in plant beds and fields were prepared and distributed to cooperators together with an outline of methods to be followed. It was suggested that the most intensive and also the most typical tobacco sections be selected for the survey in each state. It was the aim to make the observations in such a way, and in such localities, as to be fairly representative of the actual average conditions. It was requested that record blanks be filled out not only for fields and beds where disease was present but also for those that were disease-free. Average conditions in all beds or fields belonging to one grower were ordinarily recorded on a single sheet, but if locations, treatments, varieties, or other conditions differed, surveyors were asked to make out separate sheets for each.

The number of reports varies with the different states and in some cases is too small to make the results significant. All have, however, been included in the tabulations for the sake of completeness.

A few additional notes have been added to this report from information contained in the annual report cards of the collaborators.

COOPERATORS

The following persons cooperated in the survey. The names marked with an asterisk are of those who were in charge in the different states.

Massachusetts
O. C. Boyd
*W. H. Davis
W. L. Doran
J. P. Jones

Connecticut
*P. J. Anderson

New York
*Charles Chupp
F. M. Clara
*H. E. Thomas

Pennsylvania
*W. S. Beach
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Maryland
J. W. Heuberger
*R. A. Jehle
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West Virginia
*C. R. Orton

Virginia
S. A. Wingard
*James Godkin
R. G. Henderson

North Carolina
*F. A. Wolf
*S. G. Lehman
G. W. Fant

South Carolina
*G. M. Armstrong

Georgia
*J. G. Gaines

Florida
*W. B. Tisdale
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Kentucky
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*W. D. Valleau

Tennessee
J. O. Andes
*C. D. Sherbakoff

Ohio
*A. L. Pierstorff

Indiana
*M. W. Gardner
*R. W. Sampson

Illinois
*L. R. Tehon
G. H. Boewe

Wisconsin
*James Johnson

Minnesota
*James Johnson

Porto Rico
*J. A. B. Nolla

In Canada: *T. J. Major

VARIETIES

A record was made of the varieties grown in practically all of the seedbeds and fields. The list of varieties in the accompanying table (Table 4) will serve to show the popularity in each state in so far as the number represented indicates. It must be recognized that the variety occurring under the same name in different states may not be the same strain, for instance, the Broadleaf listed for Maryland is an entirely different strain from the Broadleaf in Connecticut. While the lists are given for the seedbed and the field separately and a total for the two, where both were reported, it is possible that the same growers may be represented in some instances.

Table 4. Varieties of tobacco grown in each state as given in the tobacco disease survey of 1930.

STATE Variety Strain	Number of times occurring		
	Seed bed	Field	Total
MASSACHUSETTS			
Havana			
---	40	51	91
Wisconsin 142	1	--	1
Broadleaf	1	3	4
Cuban	--	3	3
CONNECTICUT			
Havana	17	--	17
Broadleaf	25	--	25
Cuban	10	--	10
NEW YORK			
Havana			
Connecticut	10	14	24
Wisconsin	1	8	9
Native	--	1	1
Davis Hybrid	--	2	2
Wilson	--	2	2
Broadleaf			
Connecticut	--	1	1
PENNSYLVANIA			
Havana			
Swaar	6	--	6
Red Rose	1	--	1
Broadleaf			
Weaver	1	--	1
Slaughter	2	--	2
Hibsman	1	--	1
MARYLAND			
Broadleaf			
---	72	13	85
Medium	8	16	24
Thickset	1	6	7
Maryland Mammoth	1	1	2

STATE Variety Strain	Number of times occurring Seed bed	Field	Total
WEST VIRGINIA			
White Burley			
---	13	--	13
Lockwood	8	8	16
Kelley	5	8	13
Pepper	2	2	4
Judy's Pride	1	2	3
Root Rot Resistant	--	1	1
VIRGINIA			
Adcock	6	5	11
Big John	1	--	1
Bonanza	--	1	1
Burley	12	16	28
Cash	13	8	21
Crutchen	--	3	3
Fawcett Special	1	1	2
Goldleaf	3	1	4
Jamaica	--	1	1
Kentucky Yellow	2	1	3
Lizard Tail	8	8	16
Long John	2	--	2
Orinoco			
---	2	2	4
Green's Wildfire Resistant	1	--	1
Henry	1	--	1
Silky Pryor	4	--	4
Warne	4	4	8
White Pearl	--	1	1
White Stem Orinoco	2	3	5
Yellow Pryor	1	--	1
NORTH CAROLINA			
Adcock	4	--	4
Bonanza	8	5	13
Cash	15	3	18
Easton Special	1	--	1
Fawcett Special	1	--	1
Gold Leaf	8	--	8
Jamaica	4	14	18
Lizard Tail	1	--	1
Longleaf Gooch	1	--	1
Red Willow	1	--	1
Silk Leaf	4	--	4
Tilley	2	--	2
Virginia Bright Leaf	6	1	7
Wadkins Selection	1	--	1
Warne	11	2	13
White America	2	--	2
White Stem Orinoco	1	2	3
Willow Leaf	1	--	1

STATE Variety Strain	Number of times occurring Seed bed	 Field	 Total
NORTH CAROLINA (CONTINUED)			
Yellow Crutchen	1	1	2
Yellow Mammoth	1	--	1
Yellow Stem Orinoco	1	1	2
SOUTH CAROLINA			
Adcock	2	3	5
Bonanza	--	2	2
Cash	2	3	5
Clarks Special	1	--	1
Farmers Delight	--	2	2
Fawcetts	--	1	1
Gold Leaf	5	--	5
Huggins Wrapper	1	--	1
Imperial Hickory Pryor	4	4	8
Jamaica	16	15	31
Lewis Special	--	1	1
Perkins	1	--	1
Turkish	2	--	2
White Pearl	1	--	1
White Stem Orinoco	--	6	6
Willow Leaf	--	1	1
GEORGIA			
Bonanza	36	47	83
Cash	6	4	10
Gold Leaf	1	1	2
Hickory Pryor	5	6	11
Jamaica	4	6	10
Virginia Bright Leaf	6	11	17
Warne	2	1	3
Yellow Mammoth	6	1	7
Yellow Pryor	8	10	18
FLORIDA			
Cash	2	--	2
Connecticut Roundtip	6	--	6
Jamaica	1	--	1
Type 301	8	--	8
Type 94	6	--	6
KENTUCKY			
One Sucker	7	--	7
Turkish	1	--	1
White Burley			
---	48	--	48
Carr	2	--	2
Judy's Pride	23	--	23
Kelley	7	--	7
Kentucky Station			
Root Rot			
Resistant	8	--	8

STATE Variety Strain	Number of times occurring Seed bed	 Field	 Total
TENNESSEE			
Dark Pryor	1	1	2
Madole	21	32	53
Orinoco	--	1	1
White Burley			
---	7	1	8
Judy's Pride	7	17	24
OHIO			
Broadleaf (Seedleaf)			
---	8	1	9
Lancaster	--	1	1
Pennsylvania	1	3	4
Weaver	--	2	2
Dutch	10	10	20
Havana			
Dark Spanish	26	9	35
White Burley			
---	8	--	8
Canadian	3	--	3
Golden Seedleaf	1	--	1
Kelley	8	4	12
Pepper	2	--	2
Standup	3	4	7
INDIANA			
One Sucker	5	3	8
White Burley			
---	2	9	11
Judy's Pride	10	--	10
Kelley	5	4	9
Shipps Root Rot Resistant	1	1	2
ILLINOIS			
White Burley			
---	6	--	6
Judy's Pride	1	--	1
Shipps Root Rot Resistant	1	--	1
WISCONSIN			
Havana			
---	19	17	36
Comstock Spanish	2	5	7
38	--	12	12
142	--	11	11
MINNESOTA			
Broadleaf	--	1	1
Havana			
---	--	4	4
38	--	2	2
142	--	1	1

PLANT BED SURVEY

Source and Age of Seed

Most of the growers used home-grown seed but about 40 per cent purchased it, mostly from local growers. The seed used ranged in age from one to seven years but as a rule it was from the previous year's crop. The accompanying table (Table 5) gives the details as to source and age of seed in the instances reported.

Table 5. Source of tobacco seed, whether home-grown or purchased, and age of seed as given in the tobacco disease survey of 1930.

State	Number of farms reporting	Home-grown	Purchased	Age of seed
Massachusetts	22	14	9	Apparently all one-year.
Connecticut	36	32	5	6 two-year, 1 four-year, 1 seven-year.
New York	11	6	5	1 four-year, 1 five-year, 1 six-year.
Pennsylvania	66	46	20	38 one-year, 4 two-year, 2 three-year, 2 - 4 several several years.
Maryland	74	60	16	60 one-year, 1 two-year.
West Virginia	23	8	14	13 one-year, 2 two-year.
Virginia	67	46	22	8 one-year, 6 two year.
North Carolina	27	30	20	9 one-year, 1 three-year
(Dr. Wolf)	11	9	2	No information
South Carolina	34	25	9	17 one-year, 4 three-year, 1 four-year.
Georgia	75	23	52	69 one-year.
Florida	16	9	14	All new seed.
Kentucky	61	26	37	58 one-year, 3 two-year.
Tennessee	24	14	10	10 one-year, 2 two-year.
Ohio	50	42	8	19 one-year, 1 three-year, 1 four-year.
Indiana	20	10	10	8 one-year.
Illinois	6	5	1	No information
Wisconsin	17	9	8	4 one-year, 1 two-year.
Totals	640	414	262	

Note: The reason this does not total exactly is that some growers used both their own and purchased seed.

Seed Cleaning

The majority of the growers reported some form of seed cleaning. The method varied from wind blowing and sieving to machine cleaning. It is doubtful if windblown or sieved seed are to be considered as having been cleaned very thoroughly.

Table 6. Seed cleaned, yes or no, and method of cleaning as given in tobacco disease survey, 1930.

State	Number farms reporting	Yes	No	Method of cleaning
Massachusetts	42	8	15	5 machine, 1 hand cleaned, 17 doubtful
Connecticut	-	40	2	Machine blown
New York	14	1	13	Not given
Pennsylvania	70	47	15	30 machine, 8 sieve
Maryland	80	46	34	2 machine, 40 air
West Virginia	28	20	1	Not given
Virginia	63	34	29	15 fanned, 4 blown, 1 machine
North Carolina	93	60	12	13 wind blown, 2 by hand, 20 machine, 25 method not given
North Carolina (Dr. Wolf)	8	8	0	5 fanned
South Carolina	39	20	19	10 electric machine, 3 sieve
Georgia	75	75	-	All by air except 2 used fan
Florida	17	16	-	15 machine, 1 by hand, 1 doubtful
Kentucky	67	43	21	40 separator, 1 fanned
Tennessee	57	17	7	Fanned
Ohio	59	20	37	4 sieve, 2 blown, 3 fanning mill, 3 machine
Indiana	17	11	6	Not given
Illinois	5	1	4	1 by wind, 4 rubbed out by hand
Wisconsin	22	10	1	Majority blower, 10 doubtful
	748	468	217	

Seed Treatment

Seed treatment for the control of bacterial leaf spots was employed to some extent by growers in most of the states. The chemicals used included silver nitrate, formaldehyde, corrosive sublimate, and semesan. Apparently formaldehyde and silver nitrate were the most popular materials. Approximately 40 per cent of those who treated used formaldehyde, 33 per cent silver nitrate, 15 per cent semesan, and 12 per cent corrosive sublimate. Sectional differences in the chemicals used were very evident. In New York and Pennsylvania all those who treated seed used silver nitrate, while in Maryland, semesan, and in Virginia, corrosive sublimate were the materials used. The amount of seed treatment practiced in states in which treatment was reported is shown in the following table. (Table 7)

Table 7. Number of farms using tobacco seed treatment in the various states and the materials employed.

State	Number of farms using							
	Silver nitrate	Formaldehyde	Corrosive sublimate	Semesan	Total treated	Seed not treated	Per cent treated
Connecticut	1	-	-	1	2	37	5.1
New York	3	-	-	-	3	10	23
Pennsylvania	12	-	-	-	12	50	19.3
Maryland	-	-	-	21	21	56	27.2
Virginia	-	-	11	-	11	70	13.6
North Carolina	-	42	-	-	42	29	59
South Carolina	1	15	-	-	16	24	40
Georgia	31	-	1	-	32	41	43.8
Florida	-	-	2	-	2	15	11.8
Tennessee	-	-	2	-	2	20	9.1
Ohio	-	-	1		1	57	1.7
Indiana	-	-	-	-	9	12	42.3
Totals	48	57	17	22	153	421	

The reports from the various states show that ten minutes was the length of time usually employed for seed treatment. It will be noted that 59 per cent of the growers reporting in North Carolina treated their seed, 43.8 per cent in Georgia, 42 per cent in Indiana, 40 per cent in South Carolina, and 27 per cent in Maryland. Seed treatment was practiced most extensively in the southeastern states where the bacterial leaf spots first made their appearance and were first described. Recommendations for tobacco seed treatment are to treat for ten minutes, then wash thoroughly in water, and dry before planting. No instances were reported of seed injury resulting when treatment was performed in accordance with these directions.

The Location of Plant Beds

Tobacco growers locate their plant beds both in open fields and in the woods. A preference for wooded areas is indicated by the fact that of the 622 plant beds concerning which reports were available, 262 were in fields, while the remaining 360 beds or approximately 58 per cent of the beds reported were on the edges of woods or in wooded areas. Where suitable soils can be found, growers in southern states appear to prefer locations in woods because of the fresh soil, protection from winds, proximity to a wood supply for burning the beds, and comparative freedom from weeds.

The Rotation of Plant Beds

Most growers choose new sites for their plant beds from year to year. Reports were made with reference to plant bed locations on 668 farms. Of the 668 reports, 467 beds or approximately 70 per cent were in new locations, while an additional 16 per cent were in use for the second year. A relatively large proportion of the plant beds which were used for the second time, or which were in use for longer periods, were sterilized with steam or by burning before they were sown. (See also under wildfire, rootknot.)

Seed Bed Sterilization

Some form of seed bed sterilization was practiced by growers on more than half of the farms visited. While in many instances the primary purpose is weed control, numerous cases were reported where the treatment was instrumental in controlling black root rot and other troubles which may originate from the soil in the seed bed. In portions of Pennsylvania, New York, and Connecticut, seed bed sterilization with steam was reported as being almost a universal practice. In Pennsylvania, 68 out of 70 beds examined were sterilized with steam. In all of the states, reports from 842 beds inspected showed that 498 or approximately 59 per cent were either burned or steamed. Of this number 238 were sterilized with steam. Where beds were burned it was found in general that two hours or less was much less effective than a longer period.

Spraying and Dusting

Spraying and dusting the plant beds for the control of bacterial leaf spots was practiced most extensively in sections where these troubles have been encountered commonly in the plant beds in recent years. In the State of Maryland approximately 40 per cent of the beds inspected were sprayed with Bordeaux mixture or dusted with copper-lime dusts. In Connecticut 32 out of 47 beds were either sprayed with Bordeaux mixture or dusted with copper-lime. In New York State more than 50 per cent of the beds inspected were sprayed or dusted. In the southern states the bacterial leaf spots were not reported as being prevalent in seed beds, and consequently the spraying that was undertaken was primarily for the control of insects. In the following table a summary is given of spraying practices for the control of both insects and diseases. Only those states are included which reported spraying practices.

Table 8. Spraying and dusting of tobacco seed beds, 1930.

State	Number of beds reported	Number of beds sprayed	Per cent sprayed	Materials used
Massachusetts	39	10	26	5 Bordeaux mixture 5 Copper-lime dust
Connecticut	47	32	68	15 Bordeaux 14 Copper-lime dust 3 sprayed
New York	14	7	50	7 Copper-lime
Pennsylvania	65	25	38	23 Bordeaux spray 1 Copper-lime dust 1 Calomel
Maryland	69	30	43	24 Bordeaux spray 3 Copper-lime dust 1 Arsenate of lead 2 Miscellaneous sprays
North Carolina	102	18	17	6 Arsenate of lead 8 Arsenate of lead and Paris green 2 Lime sulfur 2 miscellaneous sprays
South Carolina	42	4	9	1 Calcium arsenate 1 Arsenate of lead 1 Semesan 1 Semesan and Bordeaux
Florida	17	1	6	1 Paris green mixture
Kentucky	67	11	16	10 Arsenate of lead 1 Paris green
Tennessee	57	3	5	2 beds Bordeaux spray 1 Bordeaux dust
Ohio	44	1	2	1 Arsenate of lead

It will be noted that 50 per cent or more of the beds were sprayed or dusted with Bordeaux in Connecticut and New York, while a slightly smaller proportion were sprayed in Massachusetts and Maryland. As pointed out by Orton in the plant bed summary for West Virginia, growers could well afford to spray their plant beds with Bordeaux mixture not only for the control of bacterial leaf spots but also for flea beetles. The survey showed that rather satisfactory control of both angular leaf spot and wildfire in plant beds was being obtained both with this spray and with the copper-lime dusts. Anderson in Connecticut reports that only one case was found where wildfire was present in beds which had been either dusted or sprayed from the first, and this was one small spot infection. He comments further that in a number of cases the growers started an energetic campaign of dusting or spraying after the disease was found. Such measures, however, were found to be of questionable value after infection was well started. Beach in Pennsylvania reports that experimental plant bed spraying tests conducted in 1930 showed such effectiveness that there appears to be sufficient justification for this control measure both in respect to flea beetles and wildfire.

Covers and Frames Used on Beds

With regard to plant bed covers, it was found that both new and old cloth were in use to about an equal extent. Cotton cheese cloth used for covers varied in mesh from 24 x 24 to 40 x 48 strands per square inch. Undoubtedly the heavier grades are much better. Of the beds examined 46 per cent were covered with new canvas, 40 per cent were covered with old cloth unsterilized, 5.5 per cent with used cloth which had been sterilized by boiling in water, while slightly less than nine per cent were protected with sash covers.

Board and log frames were used almost entirely for the 982 beds examined. Several collaborators mentioned the failure of growers to construct tight beds. Openings in the beds permitted the entrance of cold air, insects, and animals.

Diseases in Plant Beds

Drought Effects upon Stands and Condition of Growth:

Approximately one-half of the states reported plant bed injury from drought. In some sections there was ample rainfall, however. Drought injury to plant beds was reported from Maryland, West Virginia, Virginia, North Carolina, Kentucky, Illinois, Indiana, and Ohio. Rainfall was normal during the spring in the other states, although injury was reported to poorly drained beds during extremely wet weather in March and the first week in April.

In North Carolina it was thought that drought together with the abundant use of fertilizers high in chlorine content was responsible for the prevalence of chlorine injury, a condition characterized by unusually thick and brittle leaves on young plants. The leaves, in addition to being thick, were more or less rim-bound, with the margins of the leaves turned upward and inward. In such instances the beds were found to have been fertilized liberally or excessively with potash salts containing chlorine which under conditions of drought resulted in the accumulation of chlorine salts in the soil.

Damping-Off and Bed Rot:

Damping-off injury to seed beds was reported from more than half of the states in which the survey was conducted, and was reported from more than nine per cent of the beds examined. Collaborators reported generally that the disease was less severe in beds in which the soil was sterilized by steaming or burning than in unsterilized beds, and that it was more severe in old beds than in new ones.

Severe injury to the roots of seedlings from fertilizers was reported in some beds in Massachusetts and Connecticut. Bed rot produced by a species of Rhizoctonia was very common and destructive in New England.

P. J. Anderson makes the following distinction between damping off and bed rot.

> "Damping off as applied here refers to the dying off of seedlings when very young (usually caused by Pythium). This disease was found in only a few beds and was not of very serious importance this year.

"Bed rot (caused by Rhizoctonia or Sclerotinia) rots the stalks of the plants in later stages and is usually most prevalent just before or at setting time. Where the plants are too thick in the bed, large areas of them may be completely rotted off. More serious than this however is the loss of plants which are only slightly infected when pulled but which either make a poor slow growth when set in the field or die outright. This means uneven stands, labor losses in restocking, and a crop which is not uniform at harvest time. The disease called 'sore shin' also frequently starts with such plants. Although the worst cases have been in unsterilized beds, it seems to be able to enter the sterilized ones and because of its rapid spread may cause serious injury.

"It is controlled best by avoiding too thick seeding and by keeping the beds well ventilated and not watering too often. Sterilizing the soil and keeping the plants protected by copper lime sprays or dusts are also to be recommended."

A similar trouble with the dying of young plants shortly after setting in the field was reported by Gaines in Georgia. In these cases a species of Rhizoctonia was commonly present, although in some instances other fungi were found. A similar condition was reported in North Carolina although no determination of the organism was made.

A bacterial soft rot of the stems of plants in plant beds was reported by Valleau and Johnson from Kentucky. The disease caused a rotting-off of smaller plants at the ground level but usually rotted only one side of larger plants. The organism was reported as being one of the soft rot organisms very similar to, if not identical with, Bacillus aroideae Towns. in its reactions on various media and in morphology. Plants 8 to 10 inches tall with lesions nearly girdling the stem were found often to survive when set in the field, since the tissues soon appeared to become resistant to the further penetration of the organism. Pure culture isolations inoculated into Turkish tobacco plants killed seedlings within two days. The growers were reported as being familiar with the disease which they said was worse during rainy periods.

Wildfire (Bacterium tabacum Wolf & Foster):

During the survey, wildfire was found to be rather prevalent in the plant beds in certain sections, while in others it occurred very sparingly if at all. The following table summarizes its occurrence as reported.

Table 9. The occurrence and prevalence of wildfire in plant beds.

State	Number of beds inspected	Number of beds with wildfire	Percentage of beds with wildfire	Notes on severity of infection in plant beds
Massachusetts	42	5	12	1 to 10 per cent
Connecticut	53	8	15	Trace to 100 per cent
Pennsylvania	70	23	33	Slight to 80 per cent
Maryland	101	26	25.7	Slight to 95 per cent
Virginia	96	3	3.1	Trace
Kentucky	67	1	1.4	Trace to 5 per cent
Ohio	63	1	1.6	Trace
Indiana	23	4	17.4	Trace to .5 per cent
Wisconsin	20	9	45	Trace to 90 per cent

In Connecticut, collaborators report that in two cases wildfire was considered sufficiently severe to warrant the abandonment of a whole set of beds on the farm, while in others it was necessary to destroy with formaldehyde certain beds of the series or sections of individual beds.

Davis and Boyd in Massachusetts report the transfer of diseased plants from plant bed to field to such an extent that over 30 per cent of the plants in a field of 14 acres were infected. In Maryland, Jehle found that 26 out of 101 beds were infected with wildfire. In Pennsylvania collaborators inspected 70 beds and found that 23, or slightly less than one-third of the beds were affected. Concerning infection in Pennsylvania, Beach states that several types of mulches are applied to seed beds beneath the cloth or glass covers to aid sprouting and the early establishment of the tiny seedlings in beds which are not sown until March. It is suggested that these mulches may provide a very common source of wildfire infection, since they frequently are used from one year to the next.

As previously pointed out (page 15), spraying and dusting plant beds with Bordeaux or copper-lime dusts was found to be effective in preventing the disease where applications were started sufficiently early. In Wisconsin, Johnson states that wildfire is to some extent confined to certain sections and farms, and that special effort has been made for the past several years to eliminate it from these areas. He reports, however, that owing to the dry weather the disease was found to be causing but little damage at the time of the field survey. Collaborators in Pennsylvania and Maryland report that the first infection appears on the plants around the edges of beds and is thought to come either from the aisles and the areas in the immediate vicinity of old beds, or to be carried to the beds during the weeding process. As a result of previous observations on this point, Beach states that in Pennsylvania no practice is so effective in preventing wildfire in plant beds in Pennsylvania as the rotation of sites from one season to the next.

To summarize the control measures with reference to wildfire, it was found that 103 of the 863 beds inspected, approximately 12 per cent, were sprayed with Bordeaux mixture or dusted with copper-lime dust for the control of wildfire and other bacterial leaf spots. One hundred and fifty-three beds,

representing approximately 18 per cent of all beds inspected, were planted with treated seed, while as stated previously more than half of the plant beds in use were in new locations and slightly more than half were covered with new covers. Perhaps the more general adoption of control measures of this nature would result in smaller losses from wildfire in the future.

Angular Leaf Spot (Bacterium angulatum Fromme & Murray):

Angular leaf spot was reported from 45 beds, or slightly less than 5 per cent of all beds examined. Apparently the disease was greatly reduced in prevalence by the shortage of rainfall. That it is well distributed is indicated by positive reports of its occurrence from Massachusetts, Maryland, Virginia, North Carolina, South Carolina, Georgia, Pennsylvania, Ohio, Kentucky, Tennessee, Wisconsin, and Minnesota. Angular leaf spot was reported by Sherbakoff as being more prevalent in the fields of eastern Tennessee, where there was somewhat more rainfall, than in central Tennessee where the drought was more severe. In addition to the reports received from the various states, the disease was also reported from Canada late in the season.

Since the same measures of control as for wildfire are recommended rather generally, no special reports were given with reference to control practices and the success met with in reducing or controlling outbreaks of the disease. It was frequently observed as making its first appearance in the field on plants attacked by the tobacco bud worm and horn worm, which suggested the possibility of insect transmission, although no exact data were at hand in this regard. In some sections in the bright belt, growers are of the opinion that Angular Leaf spot can be most effectively controlled by the use of resistant varieties, since some variation in varietal susceptibility exists. No information was at hand as to factors inducing or inhibiting this type of resistance.

Mosaic (virus):

Tobacco mosaic was found in only forty-one plant beds in nine of the states surveyed, yet the disease was reported later as being among the most common and destructive in the field. The states in which mosaic was found in the plant beds together with the number of infested beds are as follows: Massachusetts 6, Pennsylvania 4, Maryland 3, Virginia 3, North Carolina 17, South Carolina 1, Kentucky 2, and Ohio 5. The average was less than five beds out of 100, and indicates that in 1930, at least, the disease was not very prevalent in plant beds. However in several instances a mottling of the leaves of plants in beds was observed, which was not definitely diagnosed as mosaic until these same beds and the fields were visited several weeks later. It is evident that in some instances mosaic may be present in beds, and yet the symptoms may fail to appear to a pronounced extent until after transplanting in the field.

Root Knot (Caconema radicicola (Greef) Cobb):

The root knot nematode which affects a wide variety of host plants was also reported on tobacco. An unusually early infection was reported from Georgia where the disease was repoted from seven beds during the survey conducted between March 21 and April 17. The disease was reported from several other states later in the season. In the field it was reported as producing

a burning and firing of the leaves in the case of badly affected plants. In general the experience this year was in accordance with that of previous years, with regard to field infection, in that a two-year rotation with root-knot resistant crops in the field was found to be of some value as a control measure but a three-year rotation system or a longer one was more effective.

Other Plant Bed Diseases:

Several other diseases both of parasitic and non-parasitic nature were reported from plant beds during the survey. In North Carolina, chlorine injury previously referred to (page 17) was reported from 24 of the 84 beds examined. Direct injury to tobacco plants and rots by burning resulting from the excessive use of fertilizers was reported by collaborators in Massachusetts and Connecticut who briefly referred to this condition in their individual reports for the plant bed survey. Potash starvation was observed in plant beds in several of the states, although in only one or two instances were the plants reported as being seriously stunted and injured by potash deficiency. Frost injury to the plants in tobacco beds was reported from Pennsylvania and Georgia.

Among the virus diseases other than mosaic, ring spot was observed to occur in 5 beds in Virginia, while coarse etch was found to occur in one bed in Kentucky.

A leaf spot, which has been previously described as Phyllosticta leaf spot (P.D.R. 14:70, 78) was reported as occurring in beds in North Carolina, South Carolina, Alabama, and Georgia. Although the disease was found rather commonly in beds it was reported as producing no special damage.

Undetermined leaf spots. Bacterial leaf spots, not typical of any of the recognized diseases, were reported from one or more of the states. The following report from Chupp in New York concerns a spotting of this type.

> "On two farms there was very much injury from a leaf spot caused by some bacterium. Apparently it was not wildfire but a type which Mr. Clara of our Department has been working on for several years. He has made isolations and later may be able to determine exactly the type of organism. These two farms have had the same trouble for a number of years. In one case there was one seed bed of 14 sash where approximately 50 per cent of the plants had died or were dying from this spotting. The other bed of the same size had only a trace of the injury. In both beds where the trouble occurred it started from a given center and enlarged in a circular manner so that most of the spots ranged from ten inches to two feet in diameter with the plants in the center of the areas entirely dead and those at the margins more or less spotted with a rather soft rot of the leaves. On the neighboring farm there was the same trouble but only two or three small spots about one foot in diameter in a seed bed of 60 sashes."

In Tennessee a spotting of the leaves was reported as having been observed for several years in the plant beds in the flue-cured section, although it has not caused any special damage. The cause of the spotting has not been determined. The reports indicate that the disease is different from any of the known or commonly recognized leaf spots.

THE FIELD SURVEY

In the field survey collaborators inspected approximately 600 fields in 16 states. The total area included was approximately 5000 acres. The greatest acreage surveyed was in the states of Massachusetts, North Carolina, and Georgia, where it totaled slightly more than 2400 acres. As in the seed bed survey, data were obtained with reference to fertilizer practices, crop rotation, and other field practices. The survey started the latter part of June in the earlier section and continued during July and August in sections where the crop was later. In the accompanying table (table 10) are listed the states and counties in which the survey was conducted and the number of fields visited in each county.

Table 10. States and counties in which field survey was conducted and number of fields visited in each county.

State and County	Number of fields inspected	State and County	Number of fields inspected
Massachusetts		Georgia	
Franklin	21	Berrien	4
Hampshire	41	Brooks	2
Connecticut		Bulloch	10
New York		Candler	3
Chemung	20	Coffee	5
Onondaga	13	Colquitt	7
Pennsylvania		Cook	3
Chester		Irwin	7
Clinton		Jeff Davis	8
Lancaster		Lowndes	8
Maryland		Mitchell	8
Anne Arundel	4	Pierce	9
Calvert	8	Tattnall	3
Charles	10	Thomas	1
Prince Georges	3	Tift	11
St. Marys	11	Toombs	6
Virginia		Ware	1
Appomatox	7	Worth	4
Campbell	8	Tennessee	
Charlotte	4	Coffee	2
Halifax	4	Grainger	3
Lunenburg	2	Knox	14
Mecklenburg	27	Montgomery	27
Pittsylvania	7	Robertson	5
Washington	16	Kentucky	
North Carolina		West Virginia	
Edgecombe	8	Cabell	7
Johnston	6	Mason	6
Orange	8	Putnam	5
Robeson	3	Wayne	5
Wake	1	Ohio	
Wayne	19	Brown	9
Wilson	8	Darke	10
South Carolina		Miami	11
Darlington	7	Montgomery	9
Willow	5	Indiana	
Florence	8	Clark	5
Horry	13	Floyd	4
Lee	3	Spencer	6
Marion	12	Warrick	4
Sumter	5		

Table 10 (Continued)

State and County	Number of fields inspected	State and County	Number of fields inspected
Wisconsin		Minnesota	
Chippewa	1	Benton	4
Columbia	5	Sherburne	5
Dane	45	Stearns	2
Dunn	1		
Rock	1		
Trempealeau	1		
Vernon	1		

Crop Rotation

Information secured in the field survey showed that the largest portion of the crop was planted on land which had grown other crops the preceding year, since slightly less than 40 per cent of the fields inspected were reported as having been planted to tobacco during the previous season. Crop rotation appeared to have been practiced most extensively in tobacco sections in Ohio, West Virginia, and Georgia. It will be noted from Table 11 that in each of these states 80 per cent or more of the fields inspected had been planted to other crops during the preceding year. Rather uniform rotation practices with reference to tobacco fields were noted in the flue-cured belt in Virginia, North Carolina, and South Carolina in which the proportion of the fields inspected which had been planted to other crops the preceding year ranged from 45.3 to 51.7 per cent.

Table 11. Crop rotation practices in the various states.

State	Number of fields reported	Percentage of Fields: Tobacco last year	Tobacco past 2 years	Tobacco 3 or more years	Other crops last year	New ground
Massachusetts	6	66.6	16.6		16.6	
New York						
Maryland	34	17.7	2.9	8.8	70.6	
Virginia	63	22.2	4.8	14.3	49.2	9.5
North Carolina	42	21.4	14.3	19	45.3	
South Carolina	29	24.2	17.2	6.9	51.7	
Georgia	92	12	2.2	4.4	80.4	
Tennessee	41	22			78	
West Virginia	21	14.3			85.7	
Ohio	40	15			85	
Indiana	13		15.4	46.1	38.5	
Wisconsin	51	9.8	5.9	49	35.3	
Minnesota	6			83.3	16.7	

Diseases Observed in the Field

Weather Relations and Disease Occurrence:

Unusual weather conditions in 1930 supplied opportunities in several instances for the observation of interesting relations between weather conditions during the growing season and the occurrence of diseases in the field. The season in 1930 was more advanced than usual with the result that transplanting was done somewhat earlier than normal. It was observed by Valleau in Kentucky and Johnson in Wisconsin that early-transplanted tobacco was more subject to attack and injury from black root rot than late-transplanted. This was thought to result from temperature relations during the early stages of growth in the field. Later in the season it was observed that on account of the drought, the bacterial leaf spots were less frequent in occurrence than usual, even on farms and in localities where the leaf spots had been observed to occur with some prevalence in the plant beds. In fields where they did occur, infection was confined largely to the lower leaves, since it failed to progress to the upper leaves formed after drought conditions appeared. An additional weather relation was observed in the case of tobacco frenching which was found to be less prevalent than usual in Kentucky and Wisconsin. This lack of prevalence was thought to have resulted from the dry weather. In Maryland, however, where the drought was severe, frenching was about as prevalent as during an average year.

Virus Diseases:

Tobacco mosaic was reported as being the most common and severe of any of the diseases in eleven of the sixteen states surveyed. It is likely that this disease was more prevalent in tobacco fields throughout the entire United States than any other one disease. In Massachusetts it was reported as occurring in nearly every tobacco field, while in Maryland it was observed to occur in 32 out of 36 fields inspected. In Wisconsin, fields or parts of fields were inspected showing from 50 to 100 per cent infection. In Minnesota, fields were observed showing infections of as high as 90 and 100 per cent of the plants. Severe necrosis or "rusting" of the leaves of plants as an effect of heavy mosaic infection was reported from fields in Wisconsin, Massachusetts, and South Carolina. Mosaic was commonly present in Porto Rico, occurred in California, and was less prevalent than usual in Connecticut.

The spread of tobacco mosaic in the field was observed to be associated with the topping and suckering processes, although such infection appeared late in the season and in most instances did not produce as severe damage as outbreaks which appeared earlier. In some instances mosaic infections appeared to be attributable to tobacco refuse around plant beds, and also to the use of natural leaf by persons working in the beds. In other instances infection was thought to have been carried to the beds during weeding on the hands and clothes of workmen who were engaged in handling the crop of the preceding year, or the virus may have been spread from plant to plant in weeding the beds or in transplanting. As was stated above (page 20), difficulty was experienced in the diagnosing of mosaic in plant beds in some instances. Collaborators noted the occurrence of a faint mottling of the leaves, which could not always be definitely determined as mosaic until after transplanting. In the summary of the seed bed survey for Massachusetts, it was stated that "Our observations

lead us to believe that the initial symptoms of mosaic in seedlings are difficult to recognize and distinguish from other chlorotic disturbances."

In at least three states, mosaic-bearing weeds of the night-shade family and pokeweed were observed rather frequently in the close vicinity of plant beds or even in the plant beds themselves. The recent results secured by Johnson (Johnson, E. M., Virus diseases of tobacco in Kentucky. Kentucky Agr. Exp. Sta. Res. Bul. 306. 1930), in connection with host plant studies of tobacco mosaic, indicate that the solanaceous weeds are perhaps of greater importance as carriers of the disease than certain other wild plants.

Some evidence of soil transmission was reported in Wisconsin and Minnesota, where rather severe infestations were reported in fields which had been planted continuously to tobacco for a number of years.

Besides mosaic, ring spot was of rather wide occurrence and appears to be increasing in prevalence. This virus disease was reported as being of importance in more than half of the states in which the survey was conducted. It was observed as being prevalent in sections of Maryland where tobacco has been grown extensively for a number of years. In Indiana Sampson observed fields in which the extent of infection was as high as 50 per cent of the plants. In one instance tobacco ring spot was observed on petunia. No information on control was submitted, although seed transmission as a possible means of spread was reported as under investigation in Kentucky.

Vein banding, in Kentucky, spread rapidly in early set tobacco near potato fields. In one tobacco field, 30 to 50 per cent of the plants were affected.

Bacterial Leaf Spots:

As pointed out previously (page 25) the bacterial leaf spots were less common than usual on account of the drought. Wildfire appeared to have been most common in the states from Maryland, Ohio, and Kentucky northward, and was not reported as occurring in the field in any of the southern states. Very little damage was reported from the disease in most of the states surveyed. Under conditions of normal or excessive rainfall the disease in all probability would have been much more severe.

Angular leaf spot was reported from Virginia, North Carolina, South Carolina, Tennessee, Georgia, Wisconsin, Ohio, and Massachusetts. To all indications it was more prevalent in the southern states than elsewhere. This corresponds with experience in previous years. However, angular leaf spot, as well as wildfire, was reported as being less prevalent than usual as a result of the dry season, and consequently very little damage was recorded in the field.

Black Root Rot (Thielavia basicola (Berk. and Br.) Zopf):

Black root rot was reported in the field in Massachusetts, Connecticut, Maryland, West Virginia, Wisconsin, Virginia, Kentucky, and North Carolina. This disease is reported as having been observed in previous years in Minnesota,

although it was not encountered during the survey in 1930. As pointed out elsewhere (page 25) the early-transplanted tobacco was reported as being more severely affected than tobacco set in the field later. Apparently the importance of the disease is increasing in some sections where the soil acidity has been lowered by the application of lime. Marked reduction in the amount of black root rot was reported from Wisconsin and Kentucky from the use of root-rot resistant strains.

Other Diseases:

Black shank (Phytophthora nicotianae (Speg.) van Breda de Haan) caused heavy losses in North Carolina where it has existed for eleven to twenty years. It is sometimes severe as a seed-bed disease in Porto Rico but does not occur there in the open field.

Bacterial wilt (Bacterium solanacearum E.F.S.) was reported as being severe in North Carolina. It was also reported from Virginia, South Carolina, Georgia, and Ohio.

Fusarium wilt (Fusarium oxysporum nicotianae James Johnson), was of the usual slight importance in Maryland and was reported from two Indiana fields.

Sore shin. An additional feature included in the survey was the observation in North Carolina of an unusually severe development of sore shin which was found to be produced principally by Rhizoctonia solani Kühn and Sclerotium rolfsii Sacc. The occurrence of injury of this type apparently was much more prevalent than usual and it was not held in check to any extent by the dry weather.

Brown root rot (undet.) on tobacco planted on sod land was reported as being one of the more serious and menacing troubles in Wisconsin. Less damage resulted where the crop was planted on land which had grown tobacco during 1929. Brown root rot has been reported in past years not only from Wisconsin but also from Massachusetts, Connecticut, and Kentucky. It was not seen in Minnesota although special watch was kept for it.

Drought spot. A non-parasitic spotting of the leaves attributed to lack of an adequate water supply was reported from Virginia, Ohio, South Carolina and Georgia.

Sand drown (non-par.) was much more prevalent than usual in North Carolina and was especially severe on sandy soils of the Sandhill area. In one field the estimated loss was one thousand dollars. It was also reported from South Carolina where two outstanding cases were observed.

Potash hunger (non-par.) was observed in various parts of North Carolina. In South Carolina it was seen in a mild form in 18 per cent of the fields visited but probably occurs in many others, especially in Horry County. It was much more prevalent than usual in Wisconsin.

In general no other diseases of importance were observed in the field. It is likely that under conditions of wet weather tobacco diseases would have been much more prominent.

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North Carolina	98		94, 101, 150
Ohio		210	
Pennsylvania	111	194	100
South Carolina	151	150	
Tennessee	121	136	
Virginia	121		
West Virginia	90	163	
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