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South Dakota State University Agricultural  
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12-1891

## Forestry and Fungi

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AGRICULTURAL COLLEGE  
AND  
EXPERIMENT STATION

BROOKINGS, S. D.

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BULLETIN NO. 29.

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DECEMBER, 1891.

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Department of Forestry, Horticulture and Botany.

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FORESTRY AND FUNGI.

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DUTCHER & BREED, BROOKINGS.

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Mail for the Station should be addressed to the Director, and that for any special department to the officer in charge.

## FORESTRY.

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C. A. KEFFER, Superintendent.

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The season of 1891 has been favorable for forest tree growth at the Experiment Station. The oldest planted plats begin to assume something of the nature of trees, and to illustrate characteristics of growth in the different species that seem to indicate their ultimate utility in this region. Observations have been made during the year upon the rate of growth of the different species, more especially with a view to determining what trees will quickest form leaf canopy and thus require least cultivation. This is a matter of supreme importance to the farmer tree planter. Unlike the nurseryman, or the forester, the farmer's tree planting must, in the nature of his vocation, be one of many operations; and it is usually the last to receive attention. In a very excellent bulletin recently issued from the Forestry Division of the Department of Agriculture on "What is Forestry?" Chief of Division Fernow proposes as an experiment, "to simply break the sod in June, and sow millet or oats thickly to make a close stand; this will secure a return for the labor of breaking. The millet should be cut with a high stubble, which may be expected to catch the winter snow, keep down weed-growth, and act as a mulching the next season. Plant next spring as early as possible, in trenches, without disturbing the ground between trenches, and most likely cultiva-

tion will not be necessary the first season, while the second season, with our dense planting, the trees should be able to help themselves." This method is suggested more for the Sand Hill region of Nebraska than for localities having a stiff clay subsoil. It is certainly very different from our ordinary practices, and if successful generally should act as a great impetus to tree planting, as it reduces the work to a minimum. The reason why it is introduced here, is not to recommend it, but only to indicate a fundamental principle in forest planting: the necessity of securing a shade for the ground at the earliest possible moment. So far as the method suggested by Prof. Fernow is concerned, it would seem impracticable in this state, where the grasses quickly take uncultivated ground, and where the ordinary rainfall is not sufficient to insure the vigorous growth trees would have to make to overcome the grasses and weeds. However, it is an experiment easily tried, and planters would get some interesting experience by devoting a small plat to the work.

# METEOROLOGY AND GROWTH.

## METEOROLOGICAL TABLE.

Month.	Rainfall.			Temperature.			Wind.	
	No. Days	Greatest in one day	Total	Highest	Lowest	Mean	Northerly	Southerly
1889.								
January	.....	.....	.3	41.0	-24.0	15.0	.....	.....
February	.....	.....	.5	43.0	-30.0	19.6	11	6
March	.....	.....	.16	55.0	4.0	32.0	17	.....
April	11	.27	1.025	83.0	12.0	51.20	10	15
May	9	.62	1.93	91.0	20.0	56.7	15	2
June	11	.54	1.485	93.6	36.1	64.2	15	14
July	9	.89	2.918	95.0	40.0	68.8	11	16
August	3	.53	.72	87.0	41.8	69.5	6	15
September	4	2.22	2.70	89.0	30.0	55.1	9	10
October	1	.005	.005	76.4	23.8	43.7	18	10
November	.....	.....	.....	28.0	-6.0	22.87	15	11
December	5	.475	.975	52.0	-11.0	26.78	13	18
1890.								
January	5	*2	*6.5	43.9	-28.0	7.56	15	16
February	1	*2	.....	47.0	-35.0	14.32	15	13
March	3	.31	.56	32.25	-4.0	19.69	13	14
April	4	.51	.787	84.0	10.0	46.71	10	12
May	14	.80	3.33	90.0	23.0	32.197	20	9
June	14	2	7.91	90.5	39.0	67.75	6	22
July	5	.54	1.535	94.5	41.0	71.06	10	19
August	5	.88	2.07	99.0	35.0	63.8	14	16
September	5	.19	.45	91.0	25.0	57.5	6	11
October	7	.12	.32	74.5	21.0	38.8	11	16
November	1	.....	.03	68.0	0	29.41	22	12
December	.....	.....	.....	53.0	-18.0	21.2	8	19
1891.								
January	.....	.....	.....	52.0	-10.0	.....	14	16
February	*3	*4	*10.	48.0	-28.0	6.95	11	17
March	*2	*4.	*6.	50.0	-24.0	17.94	13	15
April	9	.93	2.23	88.0	11.0	43.9	18	9
May	5	.38	.84	92.5	30.0	55.54	17	12
June	11	1.34	4.09	89.0	40.0	62.5	15	14
July	7	.7	2.01	80.0	60.0	69.5	13	16
August—Frost on 23rd	7	.44	1.38	99.5	30.5	66.3	15	14
September	5	.27	.48	98.0	23.5	65.1	24	6
October	2	.62	1.07	80.0	19.5	45.4	15	11
November	.....	.....	.....	.....	.....	.....	.....	.....
December	.....	.....	.....	.....	.....	.....	1	2

\* Snow. † Observations not complete.

Total rain fall during growing season.—

April to November inclusive—1889, 10.783 inches.

“ “ “ 1890, 16.402 “

“ “ “ 1891, 12.10 “

In the spring of 1891 eight half-acre plats were added to the forest plantation, making a total of thirty plats or fifteen acres, planted since 1889. Planting began April 23rd and was completed within two weeks. Copious rains fell April 13 and 16, with light showers on the four following days, and .26 inch rain on the 27th. These showers made the ground in good condition for planting, and in those plats that were set while the soil was moist a good stand was secured. Before the two last plats were set the weather had turned dryer, and, as during the entire month of May only .8 of an inch of rain fell, the stand in these plats is poor, the more so as a large proportion of the trees set in them were pines and spruces. All the trees that were planted early enough to be benefited by the April rains made good growth during the season, the months of June and July being especially favorable for growth. After July 21st only 2.63 inches rain fell the balance of the season, as against 2.87 inches for the same period in 1890. The extreme dry autumn of 1890, with the lack of snow in the winter, resulted in quite severe winter killing, the box-elders being most injured. The rainfall was a little better distributed this year, and it is hoped less injury will result.

The year's planting showed the great importance of having the ground in suitable condition as regards moisture when planting is begun. Had planting been begun a week earlier last spring a better stand would have been secured, as the trees would have thrown out young roots before the dry weather of May came. By having the land deep plowed in the fall, the planter will be able to take advantage of the first favorable spring weather to begin operations.

Following is a plat of the forest plantation, showing the varieties in each plat, and the number of trees alive in each in November, '91. As the blanks in several plats were filled in last spring and trees thus set were not included in the summaries of plats 1 to 10 made in another place in this bulletin, the totals in the diagram and in the summaries will not agree.

In order that the numbers of the plats may follow in order as the plantation is enlarged, a change in the numbering is made

from that which appeared in Bulletin No. 20. Plats 1 to 10 were planted in the spring of 1886, plats 11 to 22 in 1890, and plats 23 to 30 in 1891.



## SOUTH.

ROAD.—1 rod wide.

8 Rods.

17A	16	14	12	10	8	6	4	2
Populus certinensis	Silver Maple.	Green Ash	Box Elder	Black ( herry Yellow Birch White Birch White Elm White Ash	Soft Maple Cottonwood Scotch Pine White Ash White Birch	Populus certinensis White Elm White Ash	Box Elder Yellow Birch White Pine	Pop. (4 var.) Bl'k Walnut White " " Birch " Elm " Ash Box Elders
1346*	1160+	1195	1100	1247	1018	1309	1039	805
ROAD.								
17B	15	13	11	9	7	5	3	1
Populus certinensis	White Elm	Green Ash Seed	Box Elder Seed	Bl'ck Walnut Cherry Box Elder Wh't Walnut P. certinensis White Elm S'l'ix fragilis White Birch White Ash White Pine	Box Elder White Ash Bl'ck Walnut Black Wild Cherry White Elm Populus 2 varieties	White Elm Box Elder White Oak Bl'ck Walnut	European Larch Box Elder	Black Hills Spruce Box Elder Cottonwood Populus certinensis Scotch Pine
	1301	1182	1153	959	1113	1102	737	1035
ROAD.								
26A	25	24	23	22	21	20	19	18
Maple Box Elder Walnut Hickory Em Ash Cherry	Box Elder Maple Walnut Cherry Elm Ash	Box Elder White Spruce	Box Elder Cherry Ash	Populus certinensis	Green Ash	White Elm	Populus certinensis Soft Maple	Silver Maple Hickory
943*	1138	954	1008	1368	1165	1258	1062	1245

10 Rods.

ROAD.				
26B	27	28	29	30
Maple Box Elder Walnut Hickory Elm Ash Cherry	Maple Box Elder Elm Ash Cherry Black Walnut Butternut	Box Elder Elm Cherry Butternut Hickory P. certinensis	Elm Ash Cherry Spruce Hickory Butternut Box Elder	Elm Ash Cherry Spruce
	1151	1163	997	557
ROAD.				

\* No. trees in 17A and B, and 26A and B. † No. trees in plat.

NOTE.—The blanks in plats 1 to 10 were filled in in the spring of '91, and unless especial mention is made in the notes on these plats, the trees thus planted are not included in the totals of the table.

## THE MIXED FOREST PLATS.

The following notes on the ten oldest forest plats, which were planted with one and two year seedlings in the spring of 1889, are given as showing the present condition of the various mixtures, and their utility in shading the ground. The plats are numbered as indicated in the diagram published.

### PLAT NO. 1.

This plat, as will be seen by the diagram, has for its temporary trees (those that are to be taken out first as thinning becomes necessary) box elder and *Populus certinensis*, and for its permanent trees green ash, white spruce from Black Hills and Scotch pine. The spruce were used, not because they were regarded as especially suitable for permanents, but because, having but few specimens, it was thought they would have a better chance in this arrangement to show how well they would withstand exposure. The following diagram shows the position of the trees, which are four feet apart both ways.

			NORTH.				
B	S	B	A	B	S	B	A
B	P	B	P	B	P	B	P
B	A	B	S	B	A	B	S
B	P	B	P	B	P	B	P
B	S	B	A	B	S	B	A
B	P	B	P	B	P	B	P
B	A	B	S	B	A	B	S
			SOUTH.				

B—Box Elder.  
 S—White Spruce.  
 P—*Populus certinensis*,  
 A—Green Ash.  
 Scotch Pine substituted  
 in part for White Spruce.

At the time of setting, in the spring of 1888, the box elders used were one year seedlings, shipped in from nursery; the ash were two years old, having been grown in our nursery one year; the poplars were one year old, from cuttings set the previous spring: the spruce were from ten to twelve inches high, seedlings brought from the woods in the Black Hills. In a few rows Scotch pine, twice transplanted, were used in place of spruce. In a few cases cottonwood was substituted for poplar. A very poor stand of box elder was secured, the yearling trees not growing near so well as the two-year-olds set in other plats. In '90 the blanks in box elder rows were reset with yearling box elders. Last spring all blanks were set with yearling ash, the average growth of which for the season has been about two inches.

The plat is, with one exception, the most open in the plantation, it being easy to pass among the trees without touching the branches. The box elders will not average more than four feet high, though those of the original planting are seven feet high. The poplars average about seven feet high, and only one of the original setting has died. This poplar (*P. certinensis*) is erect in habit, though not quite as upright as Lombardy. The ash averages about four feet, only seven of the original setting being higher than six feet. The spruces have merely become established, somewhat more than half are promising, the rest being in bad condition.

The forest plats were cultivated twice the past season, the last time in June. As *certinensis* poplar is not a dense shading tree, and the remaining species have not made good growth until this year, the weed growth has been as great in this plat as in any other save the larch plat. No math of weeds has formed, and the land is now what would be called clean by many farmers. The weeds that have grown among the trees of this plat are *Agrostis major*, *Panicum capillare*, and *Setaria viridis*, grasses; *Chenopodium album*, lamb quarters; *Amarantus albus*, tumble weed; *Portulaca oleracea*, purslane or parsley; *Rosa blanda*, wild rose; of these the fox tail grass (*Setana viridis*) and purslane are most prevalent. In an adjoining plat in which the shade was dense

throughout the summer, soil and other conditions being identical, no weed growth remained (See Plat 4).

The average growth of the past season, for the different species, with the number of trees, exclusive of seedling ash planted last spring, is as follows:

79 Spruce ( <i>Picea alba</i> ).....	Average growth	1 inch
17 Scotch Pine.....	“	“ 3 inches
102 Green Ash ( <i>Fraxinus viridis</i> )... “	“	“ 12 inches
335 <i>Populus certinensis</i> .....	“	“ 33 inches
502 Box Elder—		

Average growth of '88 planting.....	36 inches
“ “ “ '90 “ .....	24 inches

Total in plat, 1035.

#### PLAT 2.

The following diagram will show the arrangement of the trees in this plat:

B	A	B	E	B	W	B	
C	B	C	B	C	B	C	B—Box Elder ( <i>Negundo aceroides</i> ).
B	E	B	W	B	A	B	C—Cottonwood ( <i>Populus monilifera</i> ).
C	B	C	B	C	B	C	E—White Elm ( <i>Ulmus Americana</i> .)
B	W	B	A	B	E	B	A—Green Ash ( <i>Fraxinus viridis</i> .)
C	B	C	B	C	B	C	W—Black Walnut ( <i>Juglans nigra</i> .)
B	A	B	E	B	W	B	
C	B	C	B	C	B	C	

In several rows *Populus nolester* was substituted for cottonwood, and in a few places black wild cherry was substituted for black walnut.

A much better growth has been secured in this plat than in plat 1, resulting in a denser shade and less weed growth. The tendency of weed growth to take possession of the ground is clearly shown in this plat, where a few blanks of considerable area have been formed. The cottonwood averages fully three

feet taller than any other species in the plat, many specimens being three inches in diameter at the butt. The cottonwood leaf beetle has been more prevalent this season than ever before. Appearing in July, it fed through the month of August, and severely checked the growth of the trees. Late in September a new growth began, and the trees now (Oct. 20) show young leaves at the ends of the branches. This new growth has been slight, only from one to three inches, but being unseasonable it may result in winterkilling.

*Populus nolester*, a Russian form, seems less successful than the more common *Populus certinensis*. It is a much slower grower than cottonwood, is not so strong, but seems less inviting to the leaf beetle. Of the walnuts planted, but two in the entire plat survived and these made poor growth. The blanks in this plat, and in plats 4, 6, 8 and 10, were planted with choke cherry seed last fall. The seed germinated freely but all the trees were destroyed by cut-worms. The weed growth differed from Plat 1 only in there being fewer weeds.

It will be noticed that the hard wood trees in this plat are elm and ash (the walnut having failed), and the temporary or nurse trees are cottonwood and box elder. Already the mixture is proving itself a poor one, for the cottonwood demands more light than any other species in the plat, and grows most rapidly, not only in youth but in age. Its foliage is thin, and its shade is not dense, so that it is the poorest species in the plantation for preventing weed growth. By overtopping the more valuable elm and ash trees it will tend to check their growth, and thus really hinder instead of aid their development. The box elders used in this plat were nearly all one year old when set (spring of '89) and a poor stand was secured, but the trees that made a good start the year they were set have made a good growth, and have winter killed very little, while those that made a feeble growth have winter killed quite badly, and are hardly yet in a thrifty condition.

This suggests the importance of *careful setting* at a time when *sufficient moisture for growth* is assured, and thorough cultivation the first season.

330 Cottonwood and *P. nolester*, average height 9 ft., highest cottonwood 12 ft., 6 in. 243 Box elder, av. height 6 ft., tallest tree 9 ft. 10 in. 111 White elm, av. height 3½ ft., tallest tree 9 ft. 6 in.; 28 elms over 6 ft. high. 121 Green ash, av. height 4½ ft., tallest tree 7 ft. 4 in.; 22 ash over 6 ft. high.

The average growth for the year was: ash 18 inches; box elder 38 inches (killed back in winter of '90-91, on average 12 inches); elm, 28 inches; cottonwood 33 inches (severely checked by leaf beetle). Total trees in plat, 805.

#### PLAT 3.

This plat consists of European larch and box elders, planted alternately throughout the plat. Larch trees 6 to 8 inches high were bought and grown in nursery rows one year, then transplanted in the plat. Yearling box elders were used, except a few two-year-olds. As will be seen by referring to our Bulletin No. 20, many larch trees were killed by a late storm in May 1890. The survivors have shown peculiarities in growth that are of interest. Only a very few of the trees have developed a leading branch, and made strong upward growth. Almost all have made good growth of lateral branches, which are horizontal and near the ground. The few that have begun vertical growth, first made a similar lateral development, so that it is probable the remaining ones will develop "leaders" during the next few seasons. The plat is the poorest in the plantation, both in the number and condition of its trees. The larch have grown slowly, and at the first a good stand of box elders was not secured, so that there has been nothing to catch the snow, and the ground has been bare during the winters. In the summer the slight shade has not been sufficient to keep down weed growth, and though the plat was cultivated two times more than the remaining ones of the planting of '89, it now contains the most weeds. The principal weed is *Setaria viridis*, fox tail grass; the wild licorice, *Glycyrrhiza lepidota*, and wild rose, *Rosa blanda* var. *Arkansana*, weeds with very tough underground stems, are more common in this plat than in any other. They are extremely difficult to exterminate, nothing but

continued scalping seems effective, and three years of this treatment has not entirely cleaned the forest plats of them.

Last spring the blanks in this plat were filled with yearling ash trees, almost all of which have lived. The plat contains 208 larch trees, average height 15 in., tallest tree 4 ft. 6 in; and 529 box elders, average height 3 ft., tallest tree 10 ft. Total in plat 737.

## PLAT 4.

B B B B

P B Y B

B B B B

Y B P B

B B B B

P B Y B

B B B B

Y B P B

B B B B

B—Box Elder.

P—White Pine (*Pinus strobus.*)Y—Yellow Birch (*Betula lutea.*)

This plat illustrates more graphically than any other, the importance of securing a good stand the first season. Six rows crosswise of the plat were set with yearling box elders, direct from a nursery, and in the next seventeen rows two-year-old box elders that had been once transplanted, were used. In the first six rows a very poor stand was secured, while of the two-year-old trees less than a dozen failed. This may not indicate the superiority of two-year-old trees so much, as it does the importance of having the plants in the best condition at the time of setting. The two-year-old trees were transferred from nursery row in the experiment grounds direct to the plats, while the yearlings were shipped in. The two-year-olds had much better roots, however, and presumably were better able to make a vigorous growth at once. Thus far at the Station the most vigorous seedlings have become more quickly established and have



grown better than the smaller ones; and this indicates that it pays to buy first sizes of yearling trees.

This plat also shows the value of rapid growing dense-shading trees. Among the two-year-old box elders mentioned the lateral branches were cut back in June, so as not to interfere with the cultivator, but by September the branches were slightly interlaced, and the ground was so shaded that no weeds grew, though the more open parts of the plat, with the same cultivation, supported a considerable growth of weeds.

The white pine is practically a failure. While there are forty-nine pines alive, none have made over five inches of growth in the three seasons they have stood in the plat. They merely send out a new tuft of leaves in the spring. Possibly they will do better after a few years, but from their action thus far they cannot be recommended. A few Colorado Blue Spruce were set last spring where pines had failed, and these have become well established.

The yellow birch has made satisfactory growth the past season, and no trees of the species have died since the first season. Being a native of much cooler and moister regions, it was feared this tree would not stand here, but thus far it has done well. The specimens that stand among the largest box elders are not doing as well as those that stand where they have more sunshine. The birches are light-demanding species, and succeed best in full sunshine.

SUMMARY.—The plat contains 877 box elders, those two years old when set now average nine feet high, the tallest being eleven feet. Yearlings when set average four feet high. Greatest growth of box elder for the year, 57 inches. Average growth for year 36 inches. 105 Yellow birch, average height, 54 inches; tallest, 8 ft. 2 inches; average growth, 30 inches. Forty-nine white pines; very little growth in three years. Eight Colorado blue spruce (*Picea pungens*), set spring of '91. Total number of trees in the plat, 1039.

## PLAT 5.

E B O B E B  
 B B B B B B  
 O B E B O B  
 B B B B B B  
 E B O B E B  
 P B B B B B  
 O B E B O B  
 B B B B B B

B—Box Elder (*Negundo aceroides*)  
 E—White Elm (*Ulmus Americana*)  
 O—Burr Oak (*Quercus macro-  
 caupa*).

In this plat, as in the last, box elder is used as a nurse tree, the permanent form being white elm and burr oak, both of which species are indigenous in this county.

The elm seems to be especially adapted for cultivation in prairie regions. It is hardy and a rapid grower. It has several peculiarities in youth which are apt to bother the grower. The first is a tendency to form forked branches, the two parts being of such equal strength that one is always tempted to begin pruning at once. In our plats this tendency is already apparent, but in the large trees, one branch always gets the lead of the other, and carries the trunk upward, so that there is but little danger of splitting. The most destructive pest that has yet troubled the elm is the jack-rabbit, which peels the trees from a point just above the ground. The inner bark of the elm seems a favorite food of the rabbit, and as it is tough and stringy, instead of breaking like the bark of the apple, for instance, it is pulled off in long strips. So that girdling this tree is much more destructive than the barking of other species. Very few elms have been killed, but they have been so injured that new shoots have sprung from crown buds, and thus many specimens consist of a number of shoots, instead of one upright trunk. Last year the rabbits commenced barking the

elms in October, and before anyone thought of danger to the trees a good deal of mischief had been done.

Less than half the oaks grew. Small trees, 12-24 inches, were planted. The first year many grew from stem buds, but in most cases the second spring the trees threw up shoots from the ground, and these will form the trees. The specimens are in fine condition. Their growth is slow, but they have large healthy leaves and promise well.

As in the other plats, wherever the box elders have stood well from the first their dense shade has prevented weed growth since cultivation ceased, but where the box elders are too small to shade the ground considerable growth of purslane, foxtail, and a few other weeds has appeared.

SUMMARY.—The plot contains 872 box elders, averaging 4 ft. 6 in. high, tallest 10 ft. 6 in. 164 elms, averaging 3 ft., tallest 8 ft. 11 inches. 46 burr oaks, averaging 20 inches, tallest 3 ft. 2 inches. Total 1102 trees, exclusive of ash, with which all blanks were filled in the spring of 1891.

## PLAT 6.

P A P A P A

E P E P E P

P A P A P A P—*Populus certinensis*, (A Russian Poplar).E P E P E P E—White Elm, (*Ulmus Americana*.)P A P A P A A—White Ash, (*Fraxinus Americana*).

E P P P E P

In this plat *certinensis* poplar is used as a nurse tree instead of box elder, and the permanent trees are brought closer together than in any of the plats before described. As has been said, the poplar is not well adapted for use as a nurse, because it is a light demanding species, and because its shade is not dense enough to entirely prevent weed growth. The leaf beetle has checked the growth of the poplars very seriously, but they have showed astonishing vitality. Notwithstanding

the trees have been badly injured by leaf-beetle (*Lina scripta*) for three successive seasons, very few have died, though the growth has been greatly checked. Owing to the excellent stand in this plat, a good shade has been formed, and weed growth has been less than in plats where the box elder has been used, but has not grown well. Certinensis poplar is more dense and upright than the cottonwood, and so makes a heavier shade. Both the elm and ash have thus far grown well with the poplar.

SUMMARY.—The plat contains 688 poplars (in a few rows the poplar was substituted for elm or ash), average height 6 feet tallest 8 ft. 2 inches, average growth this season 2 feet; 277 white ash, average height 3 ft. 9 inches, tallest 6 ft. 6 inches; 344 white elm, average height 5 feet, tallest 8½ feet, average growth this season 2½ feet; total 1309 trees.

## PLAT 7.

E	B	C	P	A	B	W	P	E	B
B	P	B	B	B	P	B	B	B	P
C	P	A	B	W	P	E	B	C	P
B	P	B	B	B	P	B	B	B	P
A	B	W	P	E	B	C	P	A	B
B	P	B	B	B	P	B	B	B	P
W	P	E	B	C	P	A	B	W	P
B	P	B	B	B	P	B	B	B	P
E	B	C	P	A	B	W	P	E	B
B	P	B	B	B	P	B	B	B	P

- E—White Elm, (*Ulmus Americana*).  
 B—Box Elder, (*Negundo aceroides*).  
 B—Black Wild Cherry, (*Prunus serotina*).  
 A—White Ash, (*Fraxinus Americana*).  
 W—Black Walnut, (*Juglans nigra*).  
 P—Poplar (Russian varieties).

In this plat the elm and ash have grown better than in any other, probably owing to the fact that the snow has drifted more among the trees and remained longer on the ground in spring. This is the only plat save one in which the walnuts have done anything at all. Only 14 walnut trees, two of which are white walnut (*Juglans cinerea*) and the remainder black, are standing. They seem to have become established and will probably grow without further trouble, though it has taken three years for most of them to gain a foothold. The mixture of poplar and box elder in the nurse-rows is not so satisfactory as box elder alone. As in other plats, where the box elder has killed back weeds have sprung up since cultivation ceased. No great weed growth has been made however, and the cultivation of next spring will easily overcome it. The soil throughout the plantation is in very fine condition.

SUMMARY.—The plat contains 75 elm trees, averaging 5 ft. high, 38 of which are 6 ft. high or more, the tallest being 10 ft. 2 in.; 55 black wild cherry, averaging 4 ft. high, with 9 over 6 ft., the tallest being 7 ft. 1 in.; 83 white ash, averaging 4 ft. 9 in. the tallest 7 ft. 8 in.; 14 walnut, averaging 18 in., the tallest being 3 ft. 7 in.; 573 box elder, averaging 5 ft. 6 in.; the tallest being 10 ft. 7 in.; 313 poplars averaging 4 ft. 6 in. Total 1113 trees.

## PLAT 8.

B C P C B  
 M C M C M  
 P C B C P  
 M C M C M  
 B C P C P  
 M C M C M  
 P C B C P  
 M C M C M

B—White Birch, (*Betula alba*).  
 M—Silver Maple, (*Acer dasycarpum*).  
 P—Scotch Pine, (*Pinus sylvestris*).  
 C—Cottonwood, (*Populus monilifera*).

As in other plats where different poplars have been used as nurse trees, the result here is not as satisfactory as where box elder has done well. It was thought the silver or soft maple might prove valuable as a nurse, but it is more tender than box elder, and thus far has not proven as satisfactory as that variety in any other way. Last winter the box elder killed back where not protected by snow, but the box elder, unless very much injured, will send up one stem from below the dead place, and thus form a single trunk; the maple is rather more tender, and it sends up a member of shoots from below the dead line, thus giving it a bush rather than a tree form. It may be, as the trees mature that one of these shoots will overcome the others, thus forming a good trunk, but the tendency is the other way.

The white birch thus far equals, if it does not surpass the yellow birch in hardiness and in growth. It is a beautiful tree, and a few specimens will be valuable for this reason, though the species is not considered a useful forest tree, not attaining large size.

Of 170 Scotch pines originally planted, 84, or about one half, are now standing. Not more than half of these are in good condition. Last spring the blanks in the pines were reset with fine trees from our own nursery. Great care was taken in transplanting, but extremely dry weather followed, and very few of the transplanted trees lived. The Scotch pines that are well established are making satisfactory growth and seem better adapted for cultivation on the prairies than any of the conifers yet tried at the Station.

The cottonwoods in this plat are similar in growth and condition to those already noted.

**SUMMARY.**—This plat contains 110 white birch, averaging 5 ft. high, of which 58 are over 6 ft. high, the tallest being 8 ft. 6 in.; 84 Scotch pine, averaging 18 inches, of which the tallest is 4 ft.; 165 maple averaging 4 ft., of which 17 are over 6 ft., the tallest being 7 ft. 3 in.; 99 green ash (substituted for maple); 560 cottonwood and other poplars, the cottonwoods averaging 9 ft. Total trees 1018.

## PLAT 9.

C	B	W	B	E	B	Bi	B	A	B
S	P	P	P	S	P	B	P	P	P
W	S	S	S	Bi	S	A	S	C	S
P	B	S	B	B	B	P	B	S	B
E	P	Bi	P	A	P	C	P	W	P
B	S	B	S	P	S	S	S	B	S
Bi	B	A	B	C	B	W	B	E	B
S	P	P	P	S	P	B	P	P	P
A	S	C	S	W	S	E	S	Bi	S
P	B	S	B	B	B	P	B	S	B

C—Black Wild Cherry, (*Prunus serotina*).

S—Red Willow, (*Salix fragilis*).

W—Black Walnut, (*Juglans nigra*).

P—*Populus certinensis*.

E—White Elm, (*Ulmus americana*).

B—Box Elder, (*Negundo aceroides*).

Bi—White Birch, (*Betula alba*).

A—White Ash, (*Fraxinus Americana*).

In this plat a Russian willow was used with a Russian poplar and the box elder as nurse trees, the three species alternating in the rows. The mixture has nothing to recommend it, the willow being the poorest form in the plantation. Instead of forming a trunk, the willow branched freely from the ground, growing in the form of a bush in which the diameter equaled the height. It will be noticed that the ash and elm, which in all the plats have stood better than the remaining hard woods, have made less growth in this plat than in any other. This is due in large measure to the willow, which has grown very rank, though not in tree form. This willow would make an excellent wind-break or screen, but it is infested with

the cottonwood leaf beetle (*Lina scripta*), though not to such a degree as the poplars. The willow makes a denser shade than cottonwood, but not so dense as box elder, which it only surpasses in hardiness. As a nurse tree box elder is to be preferred. In this plat ash and elm were substituted in part for walnut and birch.

The poplar has not grown as well in this plat as in plat 6, owing probably to the spreading roots of the willow. The box-elder has done better, relatively, than any of the other species. The general indications, however, are that this willow is not suitable for mixing with other trees.

SUMMARY.—This plat contains fifty elm trees, averaging  $3\frac{1}{2}$  feet, ten of which are over 6 ft. high, the tallest being 8 ft. 2 in.; 67 ash averaging 3 ft. 8 in., three over 6 ft. high, the tallest being 6 ft. 4 in.; 35 cherry averaging 3 ft. 6 in., of which only one was six ft.; 24 birch, of which 7 were over 6 ft., the species not in as good condition as in plat 8; 3 small walnuts; 235 red willow averaging 5 ft. high, very few being as much as 7 ft. high, much branched and bushy; 289 poplars, averaging  $3\frac{1}{2}$  ft., not thrifty; 256 box elder, averaging 5 ft., the tallest being 9 ft. 10 in. Total trees in plat 959.

## PLAT 10.

C B E A C  
 B E A B B  
 E A B C E C—Black Wild Cherry (*Prunus serotina*).  
 A C C E A B—Yellow Birch (*Betula lutea*).  
 C B E A C E—White Elm (*Ulmus Americana*).  
 B E A B B A—White Ash (*Fraxinus Americana*).  
 E A B C E  
 A C C E A

This is the only plat in the plantation that is composed entirely of hardwood trees. And while from the stand point of a quick soil cover the mixture is not so useful as one in which a rapid growing soft wood has been largely used, yet it is a question whether the greater value of the thinnings will not more than pay for added cultivation necessary. The plat has been freer from weeds, after being two times cultivated this year, than



plat 8, in which cottonwood is used for the nurse trees. The shade cast by birch and cherry is dense, and nothing grows beneath them, the ash at its best is a thin-foliaged tree, and makes but little denser shade than the cottonwood. The elm while young does not form a dense head, but its shade is quite thick as it grows older.

The arrangement of trees in the plat has already proven to be faulty. As planted, birch and cherry stand beside each other, leaving the two poorer shade makers together, and thus making a place where the soil will remain uncovered and grass and weeds will grow. A better arrangement would have been to alternate cherry, elm, birch, and ash, thus placing a light foliaged species between two dense foliaged kinds.

As regards the action of the hard woods when planted together, no difference has been observed in their growth between this and other plots, with the possible exception of the ash, of which fewer trees have reached the height of six feet. The black wild cherry has only developed the tree form in few instances as yet. Most of the trees of this variety consist of a mass of branches, which start from the trunk within a foot of the ground, making the tree as great in diameter as in height. A few specimens show leading branches, and these indicate the tendency of the species. Both white and yellow birch are spiral in shape, and they hold their foliage later than any other deciduous species. Thus far they have withstood the extreme drouth of our autumns as well as any species, though they are natives of a cool damp climate. Fewer birches survived the first year than any other species, but once established they have proven satisfactory. It is yet too early to recommend them without qualification.

SUMMARY.—The plot contains 252 wild cherry, averaging 4 ft. in height, of which 20 are 6 ft. or over, the tallest being 7 ft. 3 in.; average growth for the year 2 ft., greatest growth 39 inches; 171 birch, averaging 5 ft. 6 in., 90 over 6 ft., the tallest being 9 ft. 7 in.; average growth 2½ ft., greatest growth 56 in.; 329 elm, averaging 5 ft., 88 over 6 ft., the tallest being 8 ft. 6 in., average growth 2 ft., greatest growth 50 inches; 301 ash averaging 4½ ft., 13 over 6 ft., the tallest being 7 ft. 2 in., average growth 18 inches.

In addition to the hardwoods the plat contains 147 *Populus certinensis* and 47 evergreens, which have been set in blanks. Of the conifers the principal species used is *Pinus ponderosa*, set last spring, and hence only established. A larger per cent of it has lived after transplanting than any other conifer tried at the station.

Total trees in plat 1247.

#### THE SEEDLING PLAT.

In this plat, containing 2 acres, 49 rods, fourteen varieties of forest tree seeds were planted in the fall of 1887. The following varieties survive: walnut, black wild cherry, green ash, box elder, hard maple (*Acer saccharum*). The plat is high ground with a northern exposure, and but little snow lodged in it last winter. The hard maple and walnut were measurably protected by the snow, but the cherry, ash and box elder were practically without protection. The cherry killed back but very little. The ash came through the winter without injury, but the box elder was badly injured, in many cases all the growth of the previous season was killed. The tallest box elder in the plat is 9 ft. 6 in. high, average height 6 ft. 6 in., average growth for the year 3 ft. Compared with the oldest box elders in plat 1—10, which were brought when one year old in the spring of 1888, grown one year in nursery rows and then transplanted to their present position, the seedlings of '87 are not so large, but they average better than the yearling trees that were set in the other plats in '89.

The green ash trees in this plat average 4 ft. 3 in. high, the tallest being 7 ft. 2 in., and the average growth for the year 16 inches. The ash trees number several hundred, and they are all in fine condition.

The hard maples are few in number and have made but little growth, the tallest being 12½ inches high. Cherry and walnut are about equal in size and growth to the same species grown in the forest plantation.

In 1889 and again in 1890 the blanks in this plantation were filled in with box-elder, elm, *certinensis* poplar, laurel leaved willow, birch, Norway poplar (*P. tremuloides*?) and Scotch

pine. The *certinensis* poplar has not grown as well in the high, poorer soil of the seedling plat as it has in the plantation. Elm and the Norway poplar (a poplar received under this name from the nursery, but evidently one of the aspens, probably *P tremuloides*) have done well, and the laurel leaved willow has grown very well. Its glossy leaves make it a noticeable object in the plat. It is visited by the cottonwood leaf beetle, which does it less injury than either cottonwood or *certinensis* poplar.

The birches do not thrive in this plat as they do in the lower, richer soil of the plantation.

The small plat of Scotch pines, in which 342 trees were set in the spring of 1890, showed more than any other of the forest plants the effects of the very dry autumn and open winter. In the fall, as noted in Bulletin No. 20, 285 pines were in good condition. Of these not more than twenty-five survived, and less than a dozen are in good condition.

The land in which they stood is a gravelly knoll, and they were set there to test the adaptability of the species in the severest way. Evidently the tree requires a moister soil than the gravelly ridges furnish.

Comparing this seedling plat, which is on and near the ridge of a long northern slope, with the forest plantation, which is in low land at the base of a similar eastern slope, we find the trees in the lower land as a rule larger, and in better condition, having been less injured by winter-killing. The soil in the plantation is deep and contains little gravel. That in the seedling plat is comparatively thin and is underlaid with a gravel stratum, under which is the stiff clay, which also forms the sub-soil in the plantation.

It is of far greater importance, however, to cover the ridges of prairies with trees than to grow them in the richer lowlands. They are not only more effective as wind breaks when placed on ridges—protecting thus a far greater area—but they are immeasurably more useful in saving snow water when planted in the higher ground. And so, while observations thus far point to greater success with trees grown in the rich low lands, the plat in the higher ground demonstrates that, while growth is slower,

trees can be grown in the poorer soil of the knolls, and some varieties, notably the ash and aspen, seem to flourish there.

#### GROWTH FROM SEEDS.

The work with tree seeds has been very unsatisfactory the past two years owing to drouth at the critical time of germination, and to the pest of cut worms, which destroy the young seedlings. Last fall seeds of choke cherry (*Prunus Virginiana*) were planted in all the blanks of the even numbered plats from 2 to 16 inclusive. The seed germinated well in the spring, but while the little plants were less than two inches high they were all destroyed by cut worms. The choke cherry is a slow grower, and succeeds in partial shade, and it was thought it would make a more complete leaf canopy with the larger forms, besides attracting birds with its fruit.

Early in the spring a large quantity of box elder and green ash seed, which had been frozen over winter, were sown in drills, and germinated well, but all were destroyed while in the seed leaf by cut worms.

In districts where the cut worms are numerous, it would seem inadvisable to plant seeds, as there is no known way in which to prevent the destruction of the seedlings by the worms, especially if they are planted in drills or where the trees are to stand in the forest plat. It is probable that in the course of a few years the pest will pass away, when it will be again advisable to sow seeds. Meanwhile the planter will find it more economical to buy seedlings.

Conifer seed planted early, failed to germinate. Shortly after the seed were sown dry weather came on, and this was doubtless the reason.

For the purpose of comparison, a table of average growths of varieties in plats, 1 to 10 inclusive, for the years 1889, 90 and 91 is here given. All the figures are averages, determined by measuring a number of leading branches on the trees showing the greatest, least and average growth, and working from these data. They will not therefore correspond to the figures in the notes.

Variety.	Total Growth in Inches.								
	1889.			1890.			1891.		
	Max.	Min.	Avg.*	Max.	Min.	Avg.	Max.	Min.	Avg.
Populus pyramidalis.....	23	10	16	40	18	36	43	16	35
Populus Nolester.....	80	5	18 $\frac{1}{2}$	38	18	35	46	29	37 $\frac{1}{2}$
Black Walnut.....	7 $\frac{1}{2}$	1 $\frac{1}{2}$	4 $\frac{1}{4}$	9	3	6	20	6	18
White Walnut.....	9 $\frac{1}{2}$	3	6 $\frac{1}{4}$	.....	.....	.....	.....	.....	.....
Yellow Birch.....	10	3	6	30	7	20 $\frac{1}{4}$	36	9	21
White Oak.....	5	1	1 $\frac{3}{4}$	9	2	5 $\frac{1}{2}$	13	7	10
White Birch.....	7 $\frac{3}{4}$	2 $\frac{1}{2}$	5 $\frac{1}{2}$	29	12	16	40	10	23
White Elm.....	24	3	9 $\frac{1}{2}$	42	10	22 $\frac{1}{2}$	46	15	32
Black Wild Cherry.....	12	4	8	26	6	16	32	29	23 $\frac{1}{2}$
Soft Maple.....	12 $\frac{1}{2}$	4	8 $\frac{3}{4}$	35	16	22 $\frac{1}{2}$	45	25	34 $\frac{1}{2}$
Salix fragilis.....	8 $\frac{1}{2}$	2	4 $\frac{1}{2}$	30	18	24	40	22	23 $\frac{1}{2}$
Scotch Pine.....	7 $\frac{3}{4}$	2 $\frac{3}{4}$	4 $\frac{3}{4}$	9	2	5	16	2	4
Larch.....	7 $\frac{1}{2}$	2 $\frac{3}{8}$	5	14	2	11 $\frac{1}{2}$	16	2	11 $\frac{1}{2}$
Black Hills Spruce.....	5 $\frac{1}{2}$	1	2 $\frac{3}{4}$	4	1	2 $\frac{1}{2}$	2 $\frac{1}{2}$	2	2 $\frac{1}{4}$
White Pine.....	7 $\frac{1}{2}$	1 $\frac{1}{2}$	4 $\frac{1}{2}$	8	1	4 $\frac{1}{2}$	8	1	4 $\frac{1}{2}$
Populus certinensis.....	39	9	25 $\frac{1}{2}$	40	14	37	34	10	24 $\frac{1}{2}$
Box Elder, one year old*	32	3 $\frac{1}{4}$	10 $\frac{3}{4}$	38	10	28 $\frac{1}{2}$	39	12	32
Box Elder, two years old*	34	5 $\frac{1}{2}$	18	45	20	37 $\frac{1}{2}$	54	24	38 $\frac{1}{2}$
Cottonwood, 1 year old*	35	4 $\frac{1}{2}$	15 $\frac{1}{2}$	66	16	40 $\frac{1}{2}$	40	19	29 $\frac{1}{2}$
White Ash.....	14	3	9 $\frac{1}{4}$	34	8	22 $\frac{1}{4}$	31	6	19

\*When transplanted.

NOTES ON PARASITIC FUNGI OBSERVED AT BROOK-  
INGS DURING THE SUMMER OF 1891.

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T. A. WILLIAMS, M. A.

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INTRODUCTION.

The term fungus (plural fungi) is a general one, applied to a class of flowerless plants that get their nourishment from other dead or living plants, or from animals. They contain no green coloring matter (*chlorophyll*). They are unable to manufacture their own food from the elements of the soil or air, as do most of the higher plants, but get nourishment already prepared by higher plants.

A fungus is composed of two parts, a vegetative portion, or plant body, and a reproductive portion or spore. The former usually consists of variously modified threads (*mycelium*), which spread over or penetrate into the substance upon which the fungus grows. These threads are usually more or less branched and are colorless or colored according to the kind of fungus of which they form a part.

The reproductive portion consists primarily of small bodies (*spores*) which are born on branches of the mycelium, or, in specialised bodies or *receptacles*.

From their methods of obtaining nourishment fungi are divided into two classes: Those obtaining nourishment from decaying matter, or SAPROPHYTES; and those obtaining their food from living plants or animals, or PARASITES. A parasitic fungus

then is one that gets all its nourishment by robbing some other living plant or animal.

Saprophytic fungi seldom does much damage. Under proper conditions, however, some of them become parasitic or semi-parasitic in their habits and then are more or less injurious. It is to the parasitic fungi that we must look for our injurious forms. These send their vegetative threads through the tissues of other plants causing disease and often death. The plant upon which a fungus grows is called the "host plant" or the "host."

#### METHODS OF REPRODUCTION IN THE PRINCIPAL KINDS OF PARASITIC FUNGI.

The greater part of our injurious fungi belongs to the kinds commonly known as, THE BLIGHTS, THE MILDEWS, THE WHITE RUSTS, THE SMUTS, THE RED OR BLACK RUSTS, and THE LEAF SPOT FUNGI. In order that all may have some idea of the ways these plants perpetuate themselves, a short account of the various methods of reproduction is appended.

#### THE DOWNY MILDEWS AND WHITE RUSTS.

In both of these there are two kinds of spores or reproductive bodies, one kind born on mycelia within the tissues of the host plant, remains there until the tissues decay and fall away, which is usually the following spring. These spores are known as *resting spores*. They serve to carry the fungus over to the next season. That is performing the same function as do the seeds of the flowering plants. The other kind of spores (*conidia*) are born upon upright branches of the vegetative threads. In the downy mildews these spores are born outside, on the surface of the host plant, upon many-forked branches, and give the surface a light colored down-like appearance. In the white rusts the spores are developed beneath the surface of the host, forming shining white spots and later bursting through the epidermis, giving the surface a white powdery appearance. In nearly all cases this last kind of spore is produced in much greater quantities than the resting spores, and as they germinate readily serve to produce a more rapid multiplication of plants and a wider

distribution than could be gained were there but the one kind of spore.

#### THE BLIGHTS (*Perisporiaceae*).

These fungi have reproductive organs, much like the mildews except that both kinds of spores are born on the surface of the host plant. Leaves affected by the blight appear covered with a grayish or whitish cobweb-like mass of threads or mycelia interspersed here and there with small blackish specks. If one of these specks were examined, with a compound microscope, it would be seen to have a ball-like form, usually with many slender projections coming from its surface. This ball-like body is the *resting spore*. When a mature resting spore is mashed under the microscope it is seen to contain one or more sac-like bodies filled with spores. These resting spores are provided with a thick, heavy covering to protect the spores during the winter, just as many seeds are provided with a hard shell for a like purpose.

The *conidia* of the blights are of the same color as the mycelia and are produced earlier than the *resting spores*. They are born on upright branches of the mycelia.

The mycelia of the blights grow on the surface of the host and send little branches or suckers down into the plant tissues for nourishment and to insure a good hold upon the host.

In the *leaf spot fungi* the spores are born on little upright threads or in minute blackish receptacles clustered in variously colored (usually whitish or brownish) spots on the surface of the leaf. Most of these fungi are imperfect forms and have but one kind of spore.

#### THE SMUTS (*Ustilagineae*).

The mycelia of the smuts grows entirely within the tissues of the host plant so that it is difficult to ascertain whether or not plants are affected until the spores appear. As the mycelia develop a mass of them congregate at some place within the host plant (generally at or near the flowers or fruit) and form the spores. These when ripe show as a black powdery mass, as is seen in the smutted ear of corn or head of wheat or barley. The spores are very small, more or less rounded and black; when



dry they are easily blown about by the wind and so become scattered over a large field. Many of them are covered with minute projections which enable them to adhere to the surface of plants and various other substances, and are thus carried about as sandburs or cockle-burs are.

#### THE RUSTS (*Uredineae*).

The rusts are without doubt the most injurious of all fungi. They are also the most difficult to destroy or prevent. This is doubtless due to their natural facilities for insuring reproduction. Normally a rust, as for example the common wheat rust *Puccinia graminis*), passes through three readily recognized stages of growth on the same host plant or on different hosts as the case may be. Stage I, known as the "Cluster Cap" stage consists of numerous small orange colored cup shaped bodies, arranged in clusters or scattered uniformly upon the surface of the host. These "cups" are filled with yellowish spores which fall upon the surface of the host plant, germinate, and give rise to stage II, or the "Red Rust" stage. This may be readily recognized in the reddish powdery masses covering the various small grains just before harvest on a bad "rust" season. The spores of this stage are born in small redish or blackish, often elongated, openings in the epidermis of the host. These are called *sori* (singular *sorus*). The red rust spores fall upon the host and germinate very readily producing stage III, or the "Black Rust" stage. Sometimes however the same *sori* that produced *red rust spores* produce *black rust spores* later in the season. Black rust is by far the most destructive of all the stages of these fungi. The black rust spores constitute the resting spores. They lie in the straw or upon the ground till spring when they germinate and produce minute colorless bodies which attach themselves to the young host plant, germinates, and the fungus starts on its round of life once more.

#### REMEDIES AND PREVENTIVES OF FUNGOUS DISEASES.

To combat fungous diseases successfully the greater part of the work should be done in endeavoring to prevent the disease rather than to try to cure it after it has gotten a start. While

it is often necessary to treat different diseases in different ways, yet a few general suggestions can be given that may be profitably followed in most cases.

No straw or trash from infested grain should be allowed to accumulate or remain upon the ground, especially if the same crop must be planted the next year. All the refuse should be burned. Straw and stubble, from wheat affected with rust should be burned. Rotation of crops should be practiced as much as possible. Potatoes or beets should never be planted in ground where "scabby" potatoes have been raised the preceding year.

For the diseases caused by "blights," "mildews," or the "leaf spot" fungi such remedies as the Bordeaux mixture may be used with reasonable assurance of success.

This mixture is made of *lime, copper sulphate, and water*, mixed in the following proportions.

Lime,.....	4 lbs.
Copper Sulphate,.....	6 lbs.
Water, .....	22 gallons.

The usual way is to slack the four pounds of lime in six gallons of water; then dissolve the six pounds of copper sulphate in sixteen gallons of water; as soon as they are cool mix all together well. As the lime is only held in suspension it is necessary to keep the mixture well shaken while applying it to the plants. It may be applied by means of a spraying pump. The time for spraying depends a great deal upon the season. As a rule the spraying should begin about the last of May or the first of June; this being about the time that the fungi are beginning their growth. The mixture falls upon the leaves and prevents the germination of the fungus spores and kills the young fungi where they have not yet penetrated into the host.

It has been found that a more dilute solution of the Bordeaux mixture is quite effective with such diseases as "leaf spot," "scab," &c. Mixing together 4 lbs. lime, and 4 lbs. of copper sulphate to 50 gallons of water, this is much less expensive than the first and more easily applied.

As yet no fungicide has been found that will successfully prevent rust.

Serious damage from smuts may be prevented. It has been found that the damage done to grain by smuts comes from fungi developed from spores adhering to the seed of the grain when sown. Dr. Jensen acting upon this fact treated grain with hot water and found that the fungus spores were killed and that the grain grown from seed treated thus was practically free from smut while untreated seed yielded smutted grain. Experiments carried on at the Kansas Experiment Station by Dr. Kellerman showed that grain could be raised comparatively free from smut, by treating the seed with either *Jensen's Hot Water Treatment* or a solution of *Livers of Sulphur* (Potassium sulphide). Dr. Kellerman also found that there was a considerable increase in yield of grain beyond the amount that would have been destroyed by smut. He describes the method of treating the grains as follows : \*

\* (Bulletin No. 15, Kansas State Experiment Station 1890.)

## DIRECTIONS FOR TREATING THE SEED.

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### THE JENSEN HOT-WATER TREATMENT.

“The hot-water treatment consists in immersing the seed which is supposed to be infected with smut, for a few minutes in scalding water. The temperature must be such as to kill the smut spores and the immersion must not be prolonged so that the heat would injure the grain or embryo concealed within the seed coats. If the water is at a temperature of  $132\frac{1}{2}^{\circ}\text{F}$ . the spores will be killed, and yet the immersion, if not continued beyond fifteen minutes, will not in the least injure the seed. The smut spores will possibly be killed by a ten minutes' immersion. A fifteen immersion, however is recommended. The temperature must be allowed to vary but little from  $132\frac{1}{2}^{\circ}$ , in no case rising higher than  $135^{\circ}$ , nor falling below  $130^{\circ}$ . To insure these conditions when treating large quantities of seed the following suggestions are offered:

Provide two large vessels, as two kettles over a fire, or boilers on a cook stove; the first containing warm water (say  $110^{\circ}$ — $130^{\circ}$ ), the second containing scalding water ( $132\frac{1}{2}^{\circ}$ ).

The first is for the purpose of warming the seed preparatory to dipping it into the second. Unless this precaution is taken, it will be difficult to keep the water in the second vessel at a proper temperature.

The seed which is to be treated must be placed a half bushel or more at a time, in a closed vessel that will allow free entrance and exit of water on all sides. For this purpose a bushel basket made of heavy wire could be used, within which spread wire netting, say 12 meshes to the inch; or an iron frame could be made at a trifling cost, over which the wire netting could be

stretched. This would allow the water to pass freely, and yet prevent the passage of the seed. A sack made of loosely woven material (as gunny-sack) could perhaps be used instead of the wire basket. A perforated tin vessel might be preferable to any of the above.

Now dip the basket of seed in the first vessel; after a moment lift it; and when the water has for the most part escaped, plunge it into the water again, repeating the operation several times. The object of the lifting and plunging, to which might be added also a rotary motion, is to bring every grain in contact with the hot water. Less than a minute is required for this preparatory treatment, after which plunge the basket of seed into the second vessel. If the thermometer indicates that the temperature of the water is falling pour in hot water until it is elevated to  $132\frac{1}{2}^{\circ}$ . If it should rise higher than that, add small quantities of cold water. This will doubtless be the most effectual method of keeping the proper temperature, and requires only the addition of two small vessels one for cold and the other for boiling water. The basket of seed should very shortly after its immersion be lifted and then plunged and agitated in the manner described above, and the operation should be repeated eight to ten times during the immersion (which should be continued fifteen minutes). In this way every portion of the seed will be subjected to the action of the scalding water. Immediately after its removal dash cold water over it, or plunge it into a vessel of cold water, and then spread out to dry. Another portion can be treated similarly, and so on till all the seed has been disinfected. Before thoroughly dry, the seed can be sown.

The important precautions to be taken as follows: 1st—*Maintain the proper temperature* of the water ( $132\frac{1}{2}^{\circ}$  Fahr.), in no case allowing it to rise higher than  $135^{\circ}$  or to fall below  $130^{\circ}$ . This will not be difficult to do if a reliable thermometer is used and hot or cold water be dipped into the vessel as the falling or rising temperature demands. Immersion fifteen minutes will not then injure the seed. 2nd.—See that the volume of scalding water is much greater (at least six or eight times) than that of the seed treated at any one time. 3rd.—*Never fill the basket*

or sack containing the seed entirely full, but always leave room for the grain to move about freely. 4th.—Leave the seed in the second vessel of water *fifteen minutes*.

#### THE POTASSIUM SULPHIDE TREATMENT.

Our experiments this year seem to show that a weak solution of potassium sulphide is nearly if not quite as good as hot water for treating oats to prevent smut. Since this method may prove more convenient than the Jensen method for treating small quantities of grain, we give directions for carrying it out. The potassium sulphide is cheapest in the "fused" condition; it costs about 25 cents a pound. One pound of the sulphide should be dissolved in 24 gallons of water. Place the seed in a wooden vessel and pour on the solution until the seed is covered several inches deep. Stir the solution before pouring it on the grain and thoroughly mix the seed several times before taking it out of the solution. The oats should stand in the solution 24 hours after which they may be spread out to dry.

It will probably be best to sow the seed as soon as possible and before it becomes thoroughly dry."

#### NOTICE.

We are desirous of obtaining all the information possible concerning the fungous diseases of economic plants. All such information will be gratefully received. Specimens of diseased plants can be sent by mail at one cent for each ounce. They need only be wrapped in paper and directed to the station.

We are also anxious to get specimens of grasses and forage plants of the state together with information concerning their habits and value as forage, either for hay or grazing.

Address THE BOTANIST OF THE AGRICULTURAL EXPERIMENT STATION, BROOKINGS, SOUTH DAKOTA.

## I

### FUNGI CAUSING MORE OR LESS DAMAGE TO USEFUL PLANTS.

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#### PERONOSPORACEAE.

- PERONOSPORA ARTHURI, Farlow. Mildew of evening primrose. On yellow evening primrose (*Oenothera biennis*), covering the leaves with a mass of white filaments causing them to curl, lose color, and finally fall prematurely. It has been very injurious to plants in the flower gardens this season,
- PERONOSPORA VIOLAE, DeBary. Violet or pansy mildew. Found rarely on pansies in flower gardens. It is very injurious.

#### PERISPORIACEAE. THE BLIGHTS.

- PODOSPHAERA TRIDACTYLA, (Wallr.) DeBary. Cherry blight. On leaves of the common cultivated cherry (*Prunus cerasus*) and sand cherry (*Prunus pumila*). It covers the leaves with a network of fine whitish filaments, spreading over both upper and under sides. The leaves of young shoots are usually more liable to injury. The fungus was especially injurious to the sand cherry, often covering every leaf on a plant and causing early dropping of the leaves; thereby hindering the proper development of buds and ripening of the wood. June—September.
- SPHAEROTHECA PANNOSA, (Wallr.) Lev. Rose blight. This fungus has been observed but a few times on leaves of wild rose (*Rose arkansana*) and once on leaves of cultivated roses. It has caused little or no damage so far. July.

*SPHAEROTHECA MORS-UVAE*, (Schw.) Berk. and Curtis. Gooseberry and currant blight, on leaves of cultivated gooseberry, and wild black currant (*Ribes floridum*). Not common enough to be injurious. June.

*MICROSPHAERA ALNI*, (DC.) Winter. Lilac blight. On leaves of lilac (*Syringa vulgaris*). Rare. Causing but little damage. June—July.

*ERYSIPHE COMMUNIS*, (Wallr.) Fr. Pea blight. Common on leaves and stems of garden peas. This fungus was not so destructive this season as it has been in previous ones. It often becomes a serious pest. June—July.

#### PYRENOMYCETES. THE BLACK FUNGI.

*SPHAERIA ULMAE*, Schw. On leaves of White Elm (*Ulmus americana*). It forms irregular blackish spots on the leaves but appears too late in the season to do much damage.

*PHYLLACHORA GRAMINIS*, (Pers.) Fkl. Leaf spot. Forming elongated black spots on the leaves of Muhlenberg's grass (*Muhlenbergia mexicana*) and rice-cut-grass (*Leersia virginica*). Although the fungus is very plentiful it seldom does much injury as it generally appears late in the season when the leaves are dead or dying from frost.

*PLOWRIGHTIA MORBOSA*, (Schw.) Sacc. Black-knot. On limbs of wild plum (*Prunus americana*) and choke cherry (*Prunus virginiana*), causing great black swellings, deforming and finally killing the limbs. Very common and injurious. In many states this fungus has become so bad on cultivated plums as to completely ruin large orchards. The only remedy is to cut off and burn all diseased parts year after year, taking care that no affected parts are allowed to remain over from one season to another.

#### DISCOMYCETES. THE CUP-FUNGI.

*RHYTISMA ACERINUM*, (Pers.) Fr. Black leaf spot of maple. On living leaves of soft or silver maple (*Acer saccharinum*), forming large, irregular, thickened, black, areas. Thus far this



fungus has not been plentiful enough to be very injurious. It has been known to completely strip large groves of maple in Nebraskâ. June to September.

**RHYTISMA SALICINUM**, Fr. Black leaf spot of willow. On living leaves of diamond willow, (*Salix cordata* var. *vestita*), forming spots as described in the preceding. It was found quite plentifully this season and did considerable damage. July—October.

### UREDINEAE. THE RUSTS.

**UROMYCES TRIFOLII**, (Alb. & Schw.) Wintør. Clover rust. On leaves of mammoth red clover (*Trifolium pratense* var.) grown in the experimental plats on the College farm. It was found but once and was not very plentiful but did considerable damage to the host.

**MELAMPSORA FARINOSA**, (Pers.) Schroet. Willow rust. Very plentiful on the leaves of nearly all our common willows. During the summer the leaves become covered with small powdery spots of orange yellow spores. These spots become brown or black later in the season. The fungus has been very destructive this year, having much to do with the early falling of the leaves.

**MELAMPSORA POPULINA**, (Jacq.) Lev. Cottonwood or poplar rust. Common on leaves of cottonwood (*Populus monilifera*) and the various species of poplar growing on the college grounds. Similar in appearance to the willow rust but not so injurious, this year. A few trees were noticed badly damaged.

**PUCINIA CORONATA**, Corda. Oat rust. II and III on leaves, sheaths and stems of oats. This rust occurred but rarely, and did but little damage compared to the next.

**PUCINIA GRAMINIS**, Pers. Grain rust. II and III. Common on wheat, cats and many grasses. It has not been very destructive to small grains this year, as it appeared rather too late. A few fields of late wheat were found that were more or less damaged. It has been very destructive to the wheat grasses, (*Agropyrum glaucum*, *Ag. caninum*, and *Ag. ten-*

*crum*) especially to the latter species. Squirrel-tail grass (*Hordeum jubatum*) was also very badly affected. Several farms were noticed where wheat grass and squirrel-tail were so badly affected that there is no doubt that their stems and leaves contained enough rusts pores to "seed" thousands of acres of grain. Were these grasses carefully collected and burned most of these spores would be destroyed. It is probable that such grasses as these aid materially in causing many damaged fields of grain.

Puccinia Pruni, Pers. Plum rust. III. On leaves of wild plum (*Prunus americana*). Rare. It is very injurious when abundant.

Puccinia Stipae, Arthur. III. On porcupine grass (*Stipa spartea*). It causes but little damage.

Puccinia Violae, (Schum.) DC. Violet rust. I-III. On leaves of common wild violet (*Viola cucullata*). It often becomes very injurious. May—July.

Accidium Fraxini, Schw. Ash rust. On leaves and petioles of green ash (*Fraxinus viridis*) Quite common and destructive. Often greatly distorting the affected parts. June—July.

Aecidium Grossulariae, Schum. Gooseberry or currant rust. On leaves and berries of common gooseberry (*Ribes rotundifolium*), and black wild currant (*Ribes floridum*). Abundant. Very destructive, especially when the fruit is affected. Many bushes were noticed with scarcely a leaf or fruit unaffected. May—July.

Uredo caeoma-nitens, Schw. Blackberry and Raspberry rust. Covers the whole under surface of the leaves with an orange red powder (the spores). Does much damage to the host wherever found. Happily it is as yet quite rare here.

#### USTILAGINEAE. THE SMUTS.

Ustilago Avenae, (Pers.) Jensen. Loose smut of oats. In heads of oats, causing them to turn to a black powdery mass, totally ruining the grains. Quite common and very destructive. Damaged some fields considerably this year.

- USTILAGO HYPHODYTES, (Schlect) Fr. Grass smut. Destroys the tissues of the stem within the sheaths. Found but once on porcupine grass, (*Stipa spartea*.)
- USTILAGO MAYDIS, (DC.) Corda. Corn smut. On ears, stalks, and tassels of corn. Often totally destroying the ear. It has not been plentiful enough to cause much damage.
- USTILAGO NUDA, (Jensen) Kellerm & Swingle. Naked smut of barley. Often causing the complete destruction of barley heads. Several fields were observed to be quite badly afflicted by this smut.
- USTILAGO TRITICI, (Pers.) Jensen. Loose smut of wheat. Similar in appearance and effects to the preceding species. Common and destructive. Some fields were badly damaged the past season.

#### SPHAEROPSIDAE.

- VERMICULARIA DENUDATA, Schw. (?). On leaves and stems of Kentucky blue grass (*Poa pratensis*) and wire grass (*Poa compressa*). Usually not very destructive as it is most plentiful rather late in the season. In a few instances it did considerable damage to Kentucky blue grass.
- STEGONOSPORA SPINACEAE, E. & E. (*n. sp. in lit.*). Leaf spot of spinach. This species was discovered on leaves of spinach in the college gardens the past season. It forms circular grayish spots on the leaves, causing them to be unfit for use, and finally, to fall off. *Very destructive*. Found usually in company of *Peronospora effsua*.
- SEPTORIA PRUNI, Ellis. Leaf spot of the plum. On leaves of common plum (*Prunus americana*), giving them a spotted appearance, not pleasant to behold, and damaging them considerably.
- SEPTORIA RIBES, Desm. Gooseberry and currant leaf spot. Quite abundant on leaves of gooseberry (*Ribes rotundifolium*), and wild black currant (*Ribes floridum*). Many instances of its destructive character have been observed this season, particularly on the wild black currant.

SEPTORIA RUBI, West. Raspberry leaf spot. Not uncommon on leaves of both wild and cultivated raspberries. It sometimes becomes destructive.

PIGGOTIA FRAXINI, B. & C. On leaves of green ash (*Fraxinus viridis*). It forms irregular black patches on the leaves, and though most plentiful on the fallen leaves, has been very destructive to the fresh ones this year. It has been one of the chief agents in stripping the trees so early in the season.

### HYPHOMYCETES.

OIDIUM ERSIPHOIDES, Fr. Mildew. On leaves of turnip, causing them to appear as if covered with flour. Apparently not injurious.

RAMULARIA ARMORACIAE, FÜCKEL. Leaf spot of horseradish, (*Nasturtium armoracia*). Frequently doing a great deal of damage to the leaves. Many of these may be found with the spots completely covering the surface; the whole leaf having a whitened appearance.

RAMULARIA TULASNEI, Sacc. Strawberry leaf spot, or Strawberry blight. On leaves of both wild and cultivated strawberries, common. Some varieties of cultivated strawberries are almost free from blight, while others are always more or less affected. When a patch becomes infested with this fungus all the affected leaves should be collected and burned. Some growers recommend burning over the entire patch once a year. This, however, should not be done if the ground is very dry, but if the soil is moist and a good wind blowing, it may do, great care is necessary at all times.

SCOLECOTRICHUM MACULICOLA, Ell. & Kell. Causing spots on leaves of reed grass, (*Phragmites vulgaris*).

CERCOSPORA BETICOLA, Sacc. Leaf spot of beet. Common on leaves of garden beet, frequently becoming quite injurious. Causes the leaves to curl and dry up.

CERCOSPORA CIRCUMSCISSA, Sacc. Leaf spot of cherry; gun shot disease. On leaves of wild and cultivated cherries. The

fungus forms brownish spots, which after a time, fall out, leaving the leaves as if perforated by shot holes. Often very destructive.

CERATOPHORUM ULMICOLUM, E. & K. Elm leaf spot. Not very common, and not very destructive. On leaves of elm (*Ulmus Americana*).

## II.

### BENEFICIAL FUNGI.

The fungi classed under the above head include those parasitic species damaging weeds, and injurious plants, hence they are to be classed as beneficial to the farmer.

#### ENTOMOPHTHORACEAE. THE INSECT FUNGI.

*EMPUSA MUSCAE* (Fr.) Cohn. Fly fungus. On the common house fly. It has been very plentiful here this year, appearing earlier than usual. The affected flies may be readily recognized, as they attach themselves to the walls, curtains, &c., and soon become more or less distended, and covered with a whitish powdery substance (the spores). After hanging for some time in this manner they become surrounded by a white circle of spores.

#### PERONOSPORACEAE.

*PERONOSPORA CYPARISSIAE*, DeBary. Mildew of spurge. On leaves and stems of spurge (*Euphorbia spp.*). Showing as a violet tinged mildew on the affected parts. It causes the plants to assume an upright mode of growth, (Conidia deeply tinged with violet;  $13\frac{1}{2}$ — $18\mu$ , Ellipsoid). Very plentiful. The affected plants were usually quite badly damaged.

*PERONOSPORA LEPTOSPERMA*, DeBary. On under side of leaves of wormwood (*Artemisia biennis*). Common. Frequently doing considerable damage to the host by causing the leaves to turn yellow, dry up, and fall off. July—September.

*SCLEROSPORA GRAMINICOLA*, (Sacc.) Schroet. Mildew of grass. Very common this season on fox tail (*Setaria viridis*). It

appears usually, on the upper leaves and causes them to curl and die. The flower-spike instead of ripening the usual quantity of seed forms a bushy, leafy, mass and bears no seed at all. The fungus has kept a great many plants of this weed from "going to seed" this year.

*PLASMOPARA HALSTEDII*, (Farl.) Berl. and DeToni. On leaves of wild artichoke (*Helianthus tuberosus*), and marsh elder (*Iva xanthifolia*). Plentiful. This is the most destructive species of my acquaintance. Many plants were found with every leaf affected. The marsh elder is one of our commonest roadside weeds, and thousands of them were killed this season by the mildew. July—September.

*CYSTOPUS BLITI*, (Biv.) DeBary. White rust of pigweed. Very plentiful on common pigweed (*Amarantus retroflexus*), and the tumble weeds (*Amarantus alba* and *A. blitoides*). It forms white patches on the under side of the leaves; which break open later emitting many white, powdery, spores, hence the name "white rust." Quite injurious especially to the tumble weeds. July—October.

*CYSTOPUS CANDIDUS*, (Pers.) Lev. This white rust occurs upon a great number of hosts belonging to the order *Cruciferae*. It has been collected on pepper grass (*Lepidium virginicum* and *L. intermedium*), hedge mustard (*Sisymbrium officinale*), shepherd's purse (*Capsella bursa-pastoris*), black-mustard (*Brassica nigra*), white mustard (*B. alba*), charlock (*B. arvensis*), and water cress (*Nasturtium hispidum*).

*CYSTOPUS PORTULACAE*, (DC) Lev. White rust of purslane. Affects the under side of the leaves of purslane (*Portulaca oleracea*). Very plentiful but apparently doing little damage.

*CYSTOPUS TRAGOPOGONIS*, (Pers.) Schroet. On rag weeds (*Ambrosia spp.*). Common. By far the most destructive species of this genus, comparing well with *Plasm. halstedii*. In many places along the roadside and streets the weeds were completely stripped of all but the very uppermost leaves, and sometimes even these succumbed. What is probably the same species

was collected on wormwood (*Artemisia biennis*), where it was equally injurious, when found in sufficient quantities.

#### PERISPORIACEAE. THE BLIGHTS.

**ERYSIPHE CICHORACEARUM**, DC. On great rag weed (*Ambrosia trifida*), and golden rod (*Solidago* spp.). Common and often quite destructive.

#### URDEINEAE. THE RUSTS.

**UROMYCES EUPHORBIAE**, Cke. & Pk. Rust of Euphorbia or spurge. II—III on leaves of spurge (*Euphorbia serpyllifolia* and *E. hypericifolia*). One of our commonest rusts. It seldom becomes very destructive.

**UROMYCES POLYGONI**, (Pers.) Fuckel. I—II—III. On leaves and stems of knotweed, or door weed (*Polygonum erectum*, *P. aviculare* and *P. ramosissimum*). A very common species often becoming quite destructive in all its stages. May—September.

**UROMYCES RUDBECKIAE**, Arthur & Holw. Cone flower rust. III. On cone flower (*Rudbeckia laciniata*). Forms definite raised, light brown, or brown, spots on the underside of the leaf. The tissues of the affected spot, after a time, fall away, leaving an irregular hole. When the whole leaf is affected, it rolls up and falls off. A common and destructive species. June—October.

**PUCCINIA CONVULVULI**, (Pers.) Cast. Morning glory rust. II—III. On leaves of wild morning glory, or hedge bind-weed (*Convolvulus sepium*). A common and often very injurious species, often destroying nearly every leaf.

**PUCCINIA EMACULATA**, Schw. III. On old witch grass (*Panicum capillare*). Usually on the upper surface of the leaves, causing them to shrivel and dry up. Not uncommon, and frequently destructive.

**PUCCINIA HELIANTHI**, Schw. Sunflower rust. II & III. On sunflower (*Helianthus annuus*, *H. maximiliani*, & *H. giganteus*)



Very common and destructive. Often covering the entire under surface of the leaf.

**Puccinia polygoni**—**amphibii**, Pers. II & III. On water persicaria (*Polygonum amphibium*), and tan weed (*Polygonum terrestre*). This species is very common, and also very destructive. It appears on the under side of the leaves, sometimes scattered indefinitely over the surface, but usually in more or less circular spots.

**Puccinia prenanthis**, (Pers.) F'uckel. I, II & III. On wild lettuce (*Lactuca pulchella*). Common and destructive, especially in the first stage, which is usually found along the mid-ribs of the leaves. The affected plants assume a much more upright mode of growth than their fellows, and seldom ripen many seeds.

**Puccinia taraxaci**, Plow. Dandelion rust. II & III. On false dandelion (*Troximon glaucum*). Not common and not very injurious. What is probably the same thing has been collected several times on common dandelion (*Taraxacum officinale*), upon which host it is much more destructive.

**Puccinia xanthii**, Schw. Cockle bur rust. III. On common cockle bur (*Xanthium canadense*). Forms large, swollen brownish places on the under surface of the leaves. It is quite common and frequently becomes very destructive.

**Phragmidium speciosum**, Fr. Stem rust of the rose. II & III. On wild rose (*Rosa arkansana*). Very common and destructive. Stage II appears usually in June on the younger stems, petioles, and sometimes, leaves, buds and fruit, forming large, bright orange masses of spores. Stage III appears later as a black, powdery mass upon the stems.

**Phragmidium subcorticium**, (Schrank) Winter. Rose leaf rust. II & III. On leaves of wild rose (*Rosa arkansana*). Not uncommon, and sometimes becoming destructive. Sori scattered over the under surface of the leaf, giving it a powdery appearance. This species has been known to be quite injurious to cultivated roses, but so far, it has been found here only on wild roses.

- AECIDIUM APOCYNII**, Schw. On Indian hemp or dogbane (*Apocynum cannabinum*). Not very common and seldom injurious.
- AECIDIUM COMPOSITARUM**, Mart. var. **HELIANTHI**, Burrill. Sunflower cluster cup, or rust. On leaves of sunflower (*Helianthus rigidus* and *H. grosse-serratus*) common and often destructive.
- AECIDIUM EUPHORBIAE**, Gmel. Euphorbia, or spurge rust, or cluster cup. On leaves of (*Euphorbia* sp—). Often very injurious, completely covering the under surface of the leaves, and causing the affected plants to have a more upright mode of growth.
- AECIDIUM JAMESIANUM**, Pk. Milkweed rust. On wild milkweed (*Asclepias syriaca* and *A. speciosa*). Very common and quite destructive, especially to the latter host.
- AECIDIUM URTICAE**, Schw. Nettle rust. On leaves of common nettle (*Urtica gracilis*). Rather uncommon, but very destructive whenever found.
- AECIDIUM VERBENAE** Speg. Verbena rust. On leaves of hoary vervain (*Verbena stricta*). As yet not common or destructive.

#### USTILAGINEAE. THE SMUTS.

- USTILAGO PANICUM-MILIACEI**, (Pers.) Wint. On flower panicles of old witch grass (*Panicum capillare*). This smut has been exceedingly plentiful this year, and very damaging to its host, often completely destroying the panicles, turning them into black masses of spores. The plants are generally very much distorted.
- ENTYLOMA PHYSALIDIS**, (Klachbr & Cke.) Wint. White smut of ground cherry. On leaves of *Physalis lanceolata*, forming roundish spots in the tissues of the leaves; white on the lower surface and brownish on the upper. Not uncommon and usually causing but little damage.

#### SPHAEROPSIDEAE.

- SEPTORIA ASCLEPIADICOLA**, E. & E. Leaf spot of milkweed. On swamp milkweed (*Asclepias incarnata*). Common and destructive.

- SEPTORIA ATRIPLICES, (West.) Fuckel. On leaves of goosefoot (*Chenopodium hybridum* and *C. albidum*). Very common and destructive.
- SEPTORIA ERIGERONTIS, B. & C. Leaf spot of horse weed (*Erigeron canadense*). Plentiful and destructive.
- SEPTORIA LACTUCICOLA, E. & M. Leaf spot of lettuce. On leaves of wild lettuce (*Lactuca sp---*). Not uncommon and often rather injurious.
- SEPTORIA POLYGONORUM, Desm. Leaf spot of smart weed. On leaves of lady's thumb (*Polygonum persicaria*) and smart weed (*P. pennsylvanica*). Forms conspicuous spots on the leaves. Very common and quite destructive.
- SEPTORIA RUDBECKIÆ, E. & Halsted. Leaf spot of cone flower. On leaves of tall cone flower [*Rudbeckia laciniata*]. Very plentiful and destructive. Forms large irregular purple-brown spots containing one or more whitish ones. The spots often run together and cover the entire surface of the leaf, causing it to wither and die.

#### HYPHOMYCETES.

- OVULARIA OBLIQUA, [Cke.] Oud. Leaf spot of dock. On leaves of curled dock (*Rumex crispus*), and golden dock (*R. maritimus*). Forming brownish spots on the leaves. Common and destructive.
- RAMULARIA ARVENSIS, Sacc. On leaves of five finger or cinque foil (*Potentilla norvegica*). Very common and one of the most destructive members of the genus.
- CERCOSPORA AVICULARIS, Wint. Leaf spot of knot weed. Very common on leaves of common knot weed or door yard grass, (*Polygonum aviculare* & *P. erectum*). It is very destructive, forming whitish spots on the leaves. Many patches of this weed were almost completely destroyed by the fungus this season.
- CERCOSPORA CLAVATA, (Ger.) Peck. On leaves of swamp milkweed [*Asclepias incarnata*] and common milkweed [*A. syriaca*]. Forms brown patches on the under surface of the leaves. Common, sometimes becoming quite injurious.
- CERCOSPORA ZIZIÆ, E. & E. On leaves of *Zizia cordata*. Quite common and injurious. Form conspicuous white spots with purple-brown borders.

### III

## FUNGI FOUND DAMAGING BOTH USEFUL PLANTS AND WEEDS.

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### PERONOSPORACEAE.

PERONOSPORA EFFUSA, [Grev.] Rabenh. Downy mildew of goosefoot and spinach. On leaves of goosefoot [*Chenopodium hybridum* and *C. album*], and spinach [*Spinacea oleracea*]. Plentiful. The fungus has been exceedingly destructive to all hosts this season. The spinach was completely ruined, much of it being killed before going to seed, and nearly all rendered unfit for use. Though this fungus is very useful in injuring the weeds it is one of the worst enemies that the spinach growers have to contend with here.

PERONOSPORA PARASITICA, [Pers.] DeBary. This mildew has been common on all of our cruciferous weeds, as the mustard, and peppergrass. In some cases it has been very damaging to them. It was also troublesome to the radishes in the garden but did little damage to them.

### PYRENOMYCETES. BLACK FUNGI.

CLAVICEPS PURPUREA, [Fr.] Tul. Ergot Common on wheat grass (*Agropyrum glaucum*), quack grass (*Ag. repens*), and wild rye (*Elymus canadensis*). It has been especially destructive to the wheat grass and quack grass. Hardly an unjured head of either species could be found on the college grounds. Here where these grasses are weeds the fungus is beneficial in its effects, but in some parts of the state, especially the West, where the wheat grass is one of the forage grasses, it is very injurious wherever it occurs.

It is thought by many to be very hurtful to stock that eat it in the hay. The fungus has been known to occur on timothy and cultivated rye in many states and is usually more or less injurious in its effects.

#### UREDINEAE. THE RUSTS.

**PUCCINIA MENTHAE**, Pers. Mint rust. II—III. On leaves of Mint (*Mentha sp.*), in wild flower garden, and on common wild mint (*Mentha canadensis*), along streams. Very plentiful. This is one of our most destructive rusts. The plants in the garden were almost ruined by it this year.

**COLEOSPORIUM SOLIDAGINIS**, (Schw.) Thuem. Golden-rod rust. On leaves of tall golden-rod (*Solidago serotina*), in the flower garden and in the fields. Common. Frequently covers nearly every leaf on a plant with scattered masses of orange colored spores. Destructive

**COLEOSPORIUM SONCHI**, (Pers.) Lev. On leaves of wild aster in both wild flower garden and field. Common. Not nearly so injurious as the preceding species.

#### SPHAEROPSIDAE.

**SEPTORIA OENOTHERAE**, West. Leaf spot of evening primrose. Very plentiful on yellow evening primrose (*Oenothera biennis*), in wild flower garden and in the fields. It is very destructive forming large, irregular, pallid spots on the leaves.

#### HYPHOMYCETES.

**PERICULARIA GRISEA**, [Cke.] Sacc. On leaves of foxtail (*Setaria viridis* and *S. glauca*), millet (*Setaria italica*), and rice-cut grass [*Leersia virginica*]. Common. It often proves very injurious to millet, causing the leaves to shrivel and dry up long before it is fit to cut for hay.

**CERCOSPORA ROSICOLA**, Pass. Rose leaf spot. On leaves of both wild and cultivated roses, forming roundish pallid spots bordered by purple. Not yet found to be very plentiful on cultivated roses here, but becomes very destructive to the wild rose.