STUDIES ON A LEAF BLIGHT OF CIMARRON OATS

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INTRODUCTION

The oat variety Cimarron C. I. 5106[1] was produced by the Oklahoma Agricultural Experiment Station and distributed to growers through the Oklahoma Crop Improvement Association in the fall of 1954. The variety was recommended primarily for western and northern Oklahoma based on its winter hardiness and early grain production. It was not recommended for eastern Oklahoma because of its susceptibility to rust and to an unidentified leaf blight disease.

The unidentified disease, commonly called "Cimarron blight", is known to occur only on Cimarron oats or its genetic derivatives. Seriousness of this disease is indicated by the fact that the total leaf surface often may be reduced by more than 65 percent. This happens with such regularity in some areas that the use of the variety is undesirable.

Very little work has been done to determine the cause of Cimarron blight. H. R. Rosen[2] reported from Arkansas the production of blight symptoms on "vigorous seedlings" of Cimarron oats after spraying them with a fungus spore suspension of a species of the genus Cladosporium. In Oklahoma numerous isolations made by other members of the Department of Botany and Plant Pathology, Oklahoma A & M College, failed to yield any fungi or bacteria with sufficient consistency to be regarded as a causal agent.

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[1]C. I. refers to the accession number assigned by the Cereals Section, Field Crops Research Branch, United States Department of Agriculture.

[2]Personal Correspondence, H. R. Rosen to H. C. Young, Jr., 1953.

It was the writer's purpose in these studies to determine, if possible, the cause and nature of this disease of Cimarron oats.

Origin and Description of Cimarron Oats. Cimarron originated as a mass selection of early maturing panicles from Woodward Winter Oat Composite C. I. 3527 made by A. M. Schlehuber in 1946. C. I. 3527 was a "bulk" of all surviving plants of 30 oat varieties grown in the U. S. D. A. Uniform Winter Hardiness Nursery at Woodward, Oklahoma, during the severe winter of 1934-35. The total survival in that nursery was estimated at 2 to 3 percent. This "bulk", which became C. I. 3527, was grown as a composite from 1936 through 1946 and contained a wide diversity of types. The variety Cimarron resembles none of the varieties or selections grown in the Uniform Winter Hardiness Nursery in 1934-35 or any year since that time. Therefore its parentage and exact origin are unknown.

Cimarron is a winter oat that performs well from either fall or spring planting, a characteristic which has caused it to be termed a "two-way" or "dual purpose" variety (1). Other notable characteristics of the variety include: outstanding fall and/or spring forage, early maturity from either fall or spring planting, good yield, and excellent winter hardiness. Cimarron can be distinguished by its wide, semi-erect, light-green leaves which are somewhat blunt at the apex. Gray striping may commonly occur on the lemmas. It is considered completely susceptible to crown and stem rust (10).

PRELIMINARY OBSERVATIONS

Symptomatology. The disease symptoms are first recognizable when small chlorotic spots begin to appear on the leaf blade; more often on the lower half (Fig. 1, B, C, I). The spots are typically located near the mid-rib of the leaf but rarely begin at the margins. These spots soon develop into large oval to long irregular necrotic areas, which become buff to light-brown in color. The lesions may have a sharply defined margin, the leaf being green to the edge of the necrotic area, or the edge of the lesion may be diffuse and ill-defined. As the spots increase in size, necrosis often advances more rapidly along the mid-rib (Fig. 1, K, M). Some of the larger, more symetric, blighted areas also may show a faint concentric pattern (Fig. 1, A, G, H, L). This is more evident on the broad, coarse leaves of plants growing in the field.

During the later stages of disease development spots usually coalesce and extend the entire length and width of the leaf (Fig. 1, D, E, M). The blight advances rapidly at this stage and lower portions of the leaf blade may appear completely dead while the upper portion remains green for some time (Fig. 1, C, J). However, death of the tissue gradually proceeds upward until the entire leaf becomes shrivelled and brown.

The blight symptoms invariably occur first on the lower, more mature leaves with successive leaves being attacked as they approach maturity. However, it was observed of plants growing in the greenhouse during the winter months, that the upper leaves, including the flag leaf, were sometimes more severely affected even though they were the last to show symp-

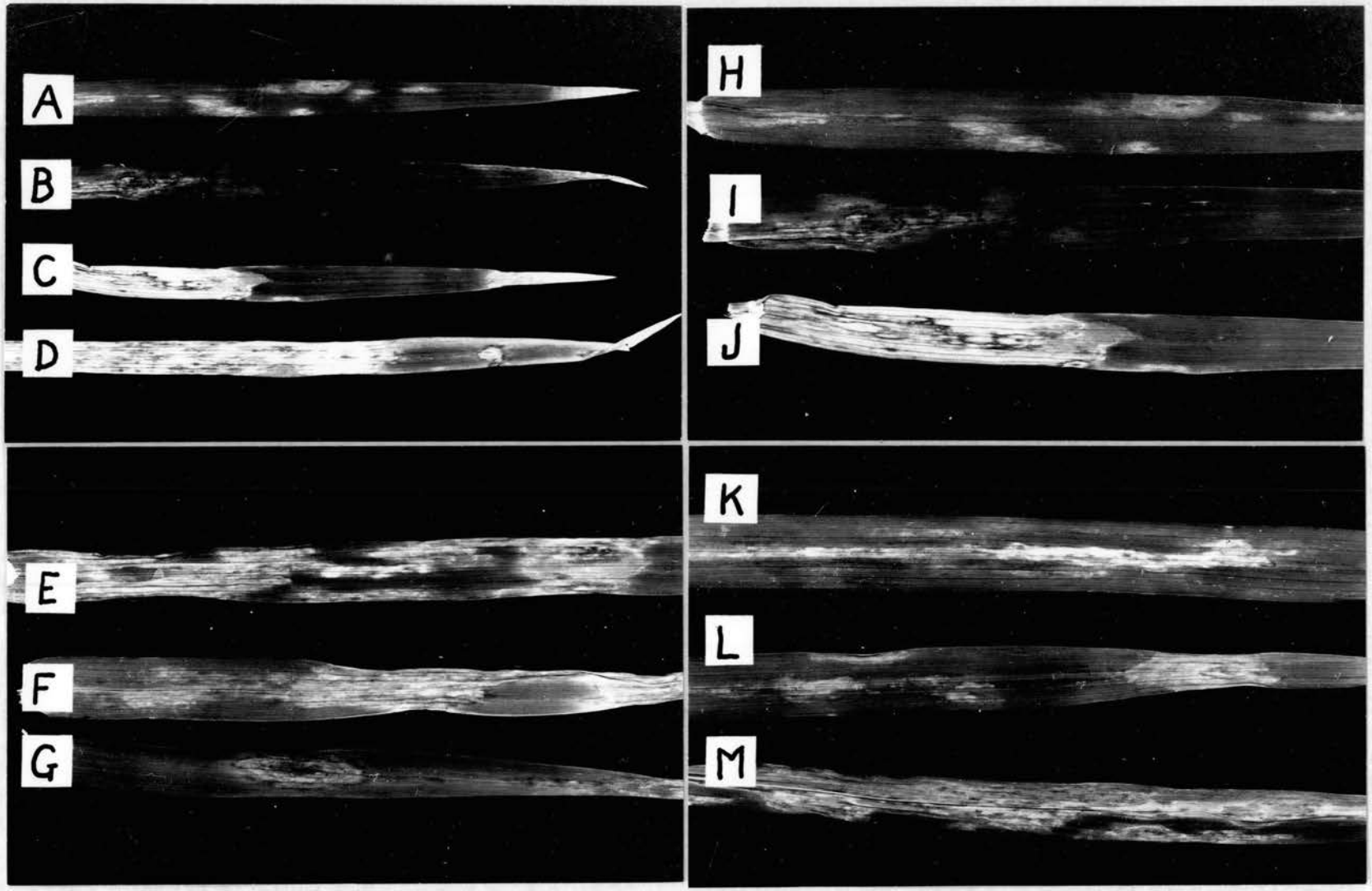

Fig. 1. Leaves of Cimarron oats showing typical symptoms of Cimarron blight. Lesions in the early stages of development are found on A, H, and K. Lesions in more advanced stages of development are found particularly on D, F, J, and M.

toms.

Symptoms have never been observed to occur, during the course of these studies, on Cimarron seedlings before they reach the age of at least 9 weeks. This was true both of plants grown in the greenhouse and in the field. Cimarron oats were planted at 5- to 10-day intervals in the greenhouse from October to March and they could be regularly predicted to exhibit symptoms between the ninth and twelfth week after planting. It was found that Cimarron grown in a non-heated greenhouse, where it developed a typical prostrate winter habit, also exhibited blight symptoms at about 12 weeks after planting.

The disease has been observed to develop most rapidly during the last 2 to 3 weeks before maturity, but this may vary somewhat. In test plots containing several oat varieties, Cimarron is often conspicuous due to the large number of dead and blighted leaves at the base of the plants. This is particularly noticeable when plants are in the winter habit, or just starting spring growth.

Although the environment seems to influence the expression of spotting, it is not difficult to recognize the symptoms as being those of Cimarron blight, whether in the field or in the greenhouse (Fig. 2). Secondary invaders also apparently play some part in symptom expression, especially as the plant approaches maturity in the field.

Occurrence. Cimarron blight has been associated with this variety since its initial selection. The blight has been of little consequence in western and northwestern Oklahoma, but at times has been rather severe in the eastern portion of the state. This is probably due, in part at least, to some climatic factor or factors since the disease also is more severe in some years than others at the same location. Soil types appear less likely to be a critical factor at this time.

Fig. 2. Cimarron oats showing typical symptoms of Cimarron blight which develop in the greenhouse.

MATERIALS AND METHODS

All of the seed used in these studies was obtained from the Department of Agronomy, Oklahoma A. & M. College. The Cimarron seed was of 1953 origin. The F_2 seed used in the genetic studies were from crosses of Cimarron with Traveler C. I. 4206, and Stanton Strain 1 C. I. 3855. The crosses were made in 1947 and the F_1 plants had been grown in 1948. Seed from these F_1 plants was harvested and stored in the laboratory without temperature or humidity controls.

Potting soil used in all greenhouse experiments consisted of sandy loam soil, cow manure, peat moss, and sand mixed in the approximate ratio of 4:1:1:1. Standard 4- and 6-inch clay pots were used except in special cases.

All of the plant material used in the isolation experiments was of the variety Cimarron. Diseased tissue showing typical symptoms was collected from plants grown either in the greenhouse or in the field. Some isolations were made from leaf tissue which had been dried in a dessicator containing $CaCl_2$; but fresh tissue was used in most attempts. Leaf pieces from 5 to 10 mm in dimension were cut so as to include: (1) only necrotic tissues, (2) necrotic areas and lesion margins together, or (3) only marginal tissue. An attempt was made to include lesions in all stages of development in each experiment. Leaf sections were washed and/or sterilized in one or a combination of the following solutions: (1) sterile distilled water, (2) ethanol (95% and 70%), (3) 0.5% NaOCl (10% Clorox), and (4) $HgCl_2$ (1:1000). Following surface sterilization, the tissue was placed

in 10 cm Petri dishes, each containing approximately 20 ml of medium. For isolations potato-dextrose agar was the most frequently used medium, but water agar, glucose-peptone agar, and oxgall agar also were used (7). For increase of inoculum glucose-peptone broth or oatmeal broth were used.

Diseased and normal material for histological examination was secured from Cimarron oats grown in the greenhouse during the period from November, 1955 to February, 1956. All of the material was killed and fixed in Craf III solution, using a dioxan dehydrating series (9). Serial sections which had been cut from embedded leaf, sheath, and stem tissue were stained with Safranin "O" and Fast Green and then mounted permanently for interpretation.

EXPERIMENTAL RESULTS

Isolation Experiments. Two organisms were found to appear most frequently from 492 leaf tissue isolations. An unidentified species of Alternaria appeared most frequently on material from the field but occurred less frequently in later isolations from greenhouse-grown plants. Another fungus, tentatively identified as Helminthosporium triseptum (2), also occurred with some consistancy although less often than the former organism.

An attempt was made to identify each fungal isolate to its genus, except when the organism had not produced spores after several weeks of culture. No isolates were found which could be placed in the genus Cladosporium or which resembled the fungus obtained from Rosen.

Several separate isolates of Alternaria and Helminthosporium were retained for use in inoculation experiments. The most commonly occurring bacteria were selected from each group of isolations and transferred to agar slants for comparison. Although bacterial colonies appeared rather regularly throughout the experiments, they were considered as contaminants or secondary organisms because of the variation in cultural characteristics. No one type seemed to predominate consistantly throughout all the experiments, and therefore no bacterial isolates were tested for pathogenicity.

Inoculation Experiments. Three experiments were planned to determine whether one of the organisms isolated from diseased Cimarron oat plants was the causal agent in Cimarron blight.

The first inoculation experiment was made during June and July, 1955. In this experiment, the species of Alternaria isolated most consistently was cultured for 16 days on potato-dextrose-agar in Petri dishes. An inoculum was prepared by removing mycelial mats from the cultures. These mats were macerated with a knife, filtered through cheese cloth, and diluted with water to form a concentrated spore and mycelial suspension. The inoculum was applied as a spray from a hand insect sprayer. The inoculated material consisted of one hundred 10-day old Cimarron oat plants grown in the greenhouse with 5 plants to each 4-inch pot. Following inoculation the plants were kept in a moist chamber for 24 hours and then moved to the greenhouse for observation as they continued to develop.

Plants were protected from direct sunlight, but day temperatures in the greenhouse still ranged to 100°F. Leaves became unusually long and "tip-die-back" was severe. After 4 weeks most plants were heading. No disease symptoms occurred during the course of this test.

The second series of inoculations was made in a cold room at 60-65°F. where the plants received 18 to 20 hours of fluorescent light per day. An isolate of Alternaria similar to that used in the first experiment was used in this test. The plants were kept in the moist chamber for a period of 48 hours following inoculation. Control plants were grown under identical conditions except that inoculum was not applied.

The inoculated plants as well as the controls suffered from excessive "tip-die-back". No recognizable disease symptoms occurred after an observation period of 1 month following inoculation.

At the time that the first two pathogenicity tests were made it was not known that symptoms of this disease normally did not appear until the plants were at least 9 weeks old. The third test, which also involved the use of the Alternaria culture, was made at a different time of year,

(November, 1955 through January, 1956), and the plants were observed over a longer period.

In this experiment three organisms were tested for their pathogenicity: Alternaria sp. and Helminthosporium triseptum which had been isolated previously from Cimarron blight lesions, and the culture of Cladosporium obtained from H. R. Rosen. The organisms were cultured in 250 ml Erlenmeyer flasks containing 50 ml of either glucose-peptone broth or oatmeal broth. After 10 days growth an inoculum was prepared by macerating 4 cultures of each organism together with 150 ml of distilled water in a Waring Blender. There were slight but inconsistant differences in the amount of growth on these two media. The cultures which made up the inoculum came from either one or both, depending upon which had the most growth at the time. Six to eight week old Cimarron oat plants, grown in the greenhouse, were sprayed with the inoculum and placed in sheet plastic moist chambers for 24 hours. For 10 days following this inoculation, plants were placed in the moist chambers each evening at 6 p.m., sprayed with distilled water, and removed the next morning at 9 a.m. Controls were treated in the same manner except inoculum was not applied. The plants were then kept under continuous observation in the greenhouse at 65-75°F. for a period of more than 4 weeks.

All oat plants in this experiment developed chlorotic leaf tips similar to those of the preceeding experiments. There was no difference in the reaction of plants inoculated with the different fungi. Typical Cimarron blight symptoms began to occur on all plants, including controls, as they approached the age of 12 weeks.

There seemed to be no correlation between the development of disease symptoms and the inoculation with any of these organisms. Cimarron oats planted in 5- to 10-day intervals were grown in the greenhouse throughout

the course of these studies. All plants which matured during the period from November through April developed severe Cimarron blight symptoms between 9 and 12 weeks after planting. It was impossible to grow the variety in the greenhouse, at that time of year, without the blight occurring in all plants. Blight symptoms became progressively less severe on those plants maturing after this period, but all Cimarron plants continued to develop at least some symptoms. Seedlings were never observed to exhibit symptoms before the ninth week after planting.

Histological Studies. Diseased tissue prepared for histological examination was selected to include lesions in all stages of development. Comparisons were made between non-diseased (Fig. 3, 4) and diseased (Fig. 5, 6) leaf, sheath, and stem tissues. All plant material used in these studies was obtained from the greenhouse with the intention of eliminating most saprophytic organisms which occur naturally on material from the field.

There was no indication of bacteria or of fungal mycelium in any of the 63 permanent slides examined. Nor was there evidence of mechanical injury due to chewing insects or other causes. Hyperplasia or hypertrophy was not apparent.

Blight lesions were first distinguishable in leaf transections as areas where the mesophyll had begun to collapse. These areas most frequently occurred adjacent to the mid-vascular bundle or one of the other major bundles of the leaf. The epidermal, vascular, and bundle sheath tissues retained their normal appearance during the initial stages of lesion development (Fig. 5). Subsequently, bundle sheath cells collapsed and tissues in the diseased area disintegrated, leaving only the sclerenchyma and xylem elements intact (Fig. 6).

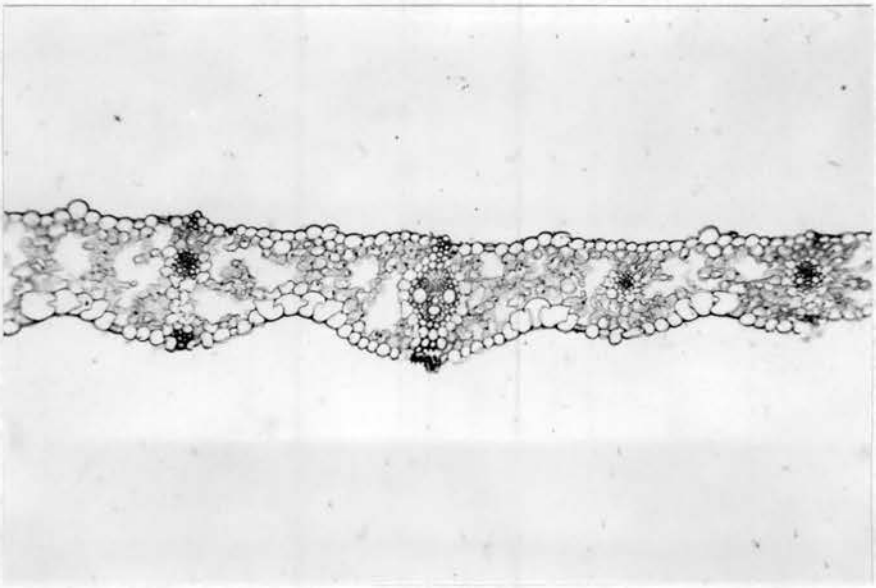

Fig. 3. Transection of normal leaf of Cimarron oats.

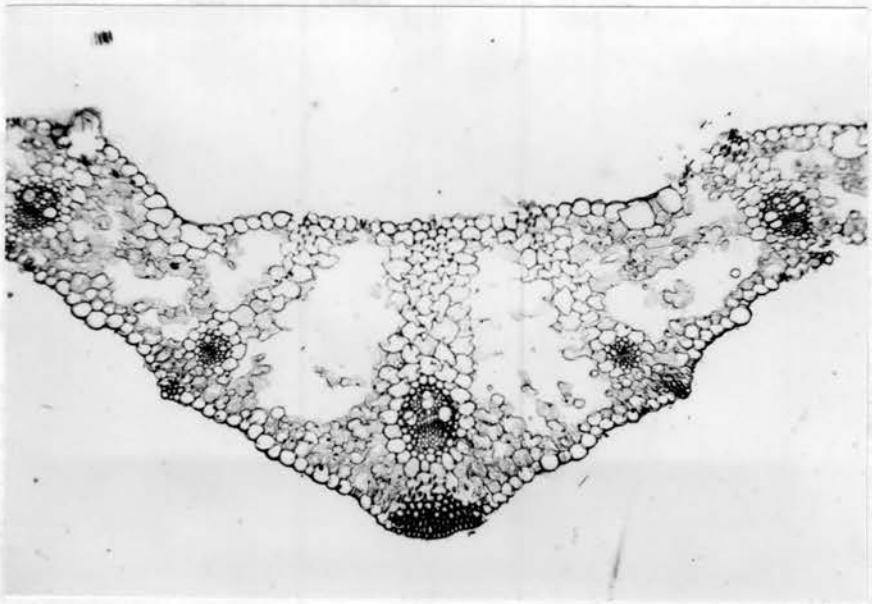

Fig. 4. Transection of the mid-rib portion of a normal Cimarron oat leaf.

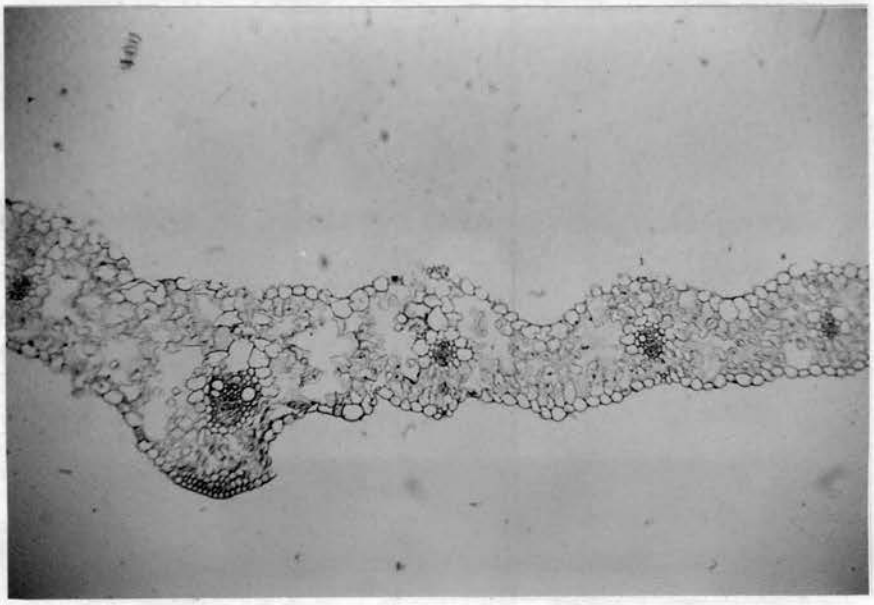

Fig. 5. Transection of a Cimarron oat leaf showing the early stage of Cimarron blight development.

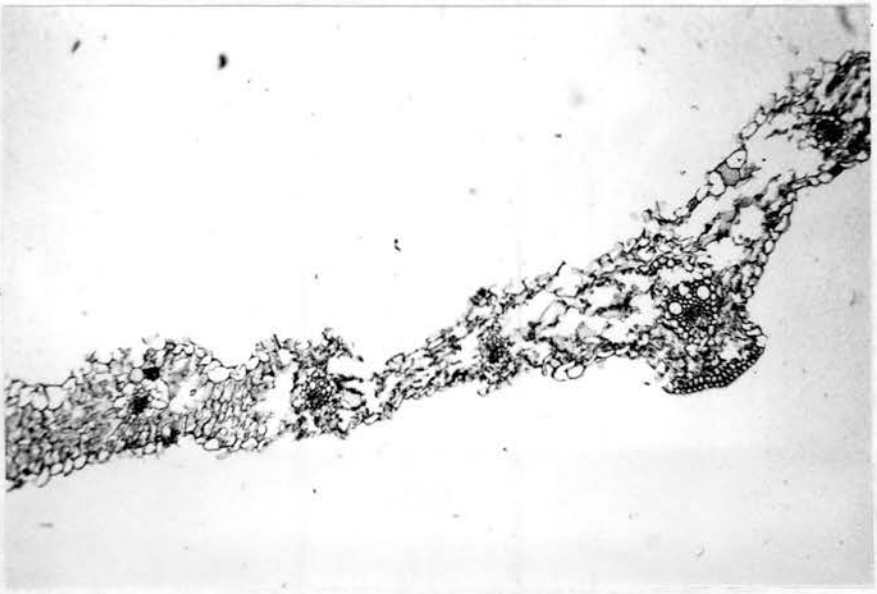

Fig. 6. Transection of a Cimarron oat leaf showing an advanced stage of Cimarron blight development.

The sections shown in Figures 5 and 6 were selected for illustrative purposes and were typical of the many sections examined. Disease expression was similar in both the leaf blade and sheath. Disease symptoms were never observed on stem tissue.

Seed Treatment Experiment. Cimarron oat seeds were treated by 4 methods to determine the possible effects of seed treatment on disease development. In the first method, seed was treated with a 1% NaOCl solution (10% Clorox) for 7 minutes while under vacuum produced by a laboratory aspirator. The second treatment was by the hot water method. Seed was presoaked in water at room temperature for 14 hours, placed in water at 53°C. for 13 minutes, and then immediately immersed in cool water and dried. The final methods consisted of dry treatment with two widely used fungicides, Arasan and Ceresan M., at a rate recommended by the manufacturer. These were applied by shaking the chemicals and seed together in a small envelope. Seed of the controls were planted without treatment.

The seed was germinated in a germinator at 65°F. for 48 hours before planting in the greenhouse and field. Germination was only 56 percent for the hot water treated seed, compared to 95 percent for all other treatments and the controls. The germinated seed was then planted in 6-inch pots in the greenhouse and in 5-foot rows in the field. The date of post-germination planting was February 12, 1956.

Symptoms of blight were not severe on plants grown in the greenhouse for 4 months, and there was no difference in any of the treatments. In the field symptoms also were found in all treatments, and again there was no difference in any of the treatments.

Sterile Plant Experiment. Containers were devised to facilitate the growing of oat plants over an extended period of time under sterile conditions (Fig. 7, 8). A modification of apparatus used by German and

Bowen (4) and Katherein (6) was developed. For this purpose, a 2 liter wide-mouth Erlenmeyer flask, partially filled with Vermiculite, formed the basic component. The flask was then fitted with a 2-foot length of 50 mm glass tubing which extended down into the Vermiculite. The neck of the flask was packed with cotton to form a tight, sterile fit. The top of the large glass tube was sealed with a cotton plug containing a smaller tube for watering. An aluminum foil "cap" protected the top from settling dust. One hundred ml of sterile distilled water was added to moisten the vermiculite. Finally, the whole container was autoclaved twice at 17 to 20 pounds pressure for one hour. Eight such containers were constructed.

Cimarron and Traveler oat varieties which had been de-hulled were surface sterilized in 1% NaOCl for 7 minutes under vacuum. The sterile seeds were then placed on a potato-dextrose agar medium in Petri dishes for germination. Germination occurred within 3 days and any contaminated seeds were easily detected. At this point, the sterile germinated seeds were added, aseptically, one to each of 8 containers. They were then covered with a small amount of finely ground sterile Vermiculite. Five flasks contained Cimarron oat plants while 3 contained the variety Traveler. A complete nutrient solution (5) was autoclaved and added, aseptically, to the containers as it was needed for growth. These plants were grown from February to the latter part of May, 1956.

Growth of the sterile plants was very rapid during the initial weeks, with leaves becoming abnormally long. Leaves were a healthy green color with no noticeable etiolation. As the plants grew the first and second leaves died and turned almost white by the time the third and fourth leaves approached maturity.

At the age of 9 1/2 weeks all five of the Cimarron plants began to show foliar spotting which resembled the early stages of Cimarron blight

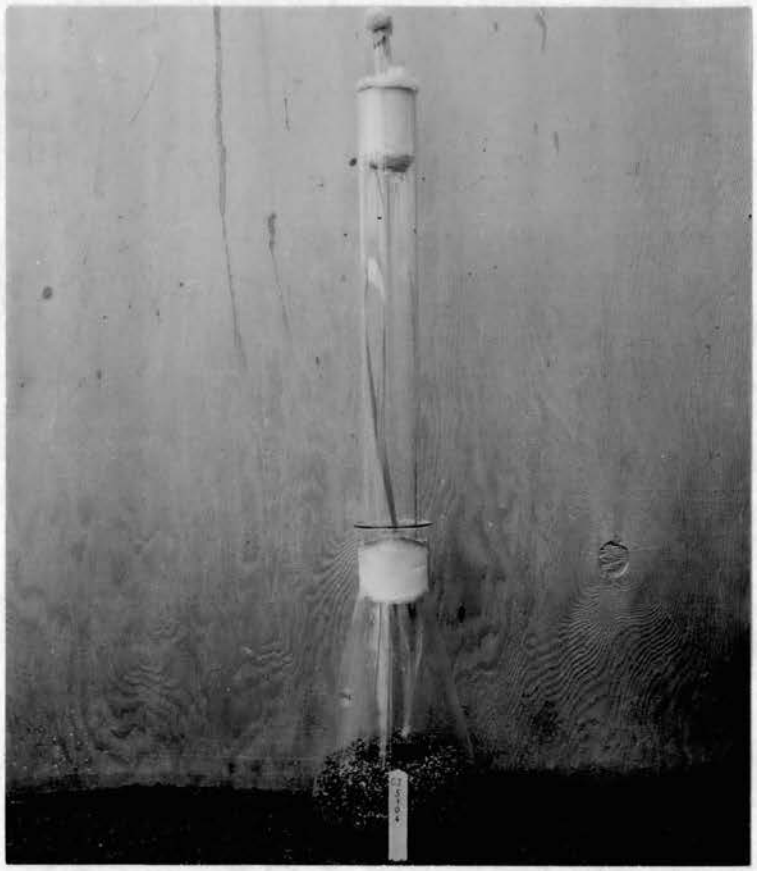

Fig. 7. The container used for growing oat plants under sterile conditions.

Fig. 8. Cimarron and Traveler oats growing under sterile conditions.

(Fig. 9). Blighted areas developed along the mid-rib of the leaf blades about two-thirds of the distance from the base, and progressed longitudinally at a rapid rate. Although the symptoms which occurred on these sterile plants (Fig. 10) were never positively identified as those of Cimarron blight, they were certainly typical of the early stages of the disease as it appears in the field or the greenhouse. Nothing of a similar nature developed on the variety Traveler.

Fungal contaminants appeared in one flask containing Traveler a few days after the experiment had begun. No other contaminants were evident until after the tenth week, but by the end of the thirteenth week all of the cultures had become contaminated. These contaminating fungi were observed only on the older dead leaves of the otherwise vigorously growing plants, and appeared after the symptoms on Cimarron became evident. It seems probable that these contaminants gained entry through the tubes at the time the nutrient solutions were added.

Inheritance Studies. Seed produced by F_1 plants from two crosses, Cimarron X Traveler and Cimarron X Stanton Strain 1, were grown to determine the heritibility of Cimarron blight. Since the seed was almost 8 years old it was treated with Arasan and germinated under optimum conditions in a germinator. Thirty percent of the seed from the Cimarron X Traveler crosses germinated but no germination occurred in the Stanton Strain 1 crosses. Germination of the Cimarron and Traveler parents was 0 and 4 percent respectively. Following germination the young seedlings were placed individually in soil-filled plant-bands in flats. Two weeks later each individual was transferred to a 6-inch pot. At first, all of these F_2 hybrids were grown in the greenhouse. Later, some were moved outside to a cold frame and some were kept in the greenhouse. All individuals originating from a single F_1 plant, however, were given similar treat-

Fig. 9. A Cimarron oat plant growing under sterile conditions showing a chlorotic spot in the early stage of development.

Fig. 10. A Cimarron oat plant growing under sterile conditions showing a chlorotic spot in the later stage of development.

ment. This study covered the period from January 26, to July 6, 1956.

On April 28, chlorotic spotting began to appear on several of the F_2 plants. It was soon found that these plants could be classified into three catagories: resistant, intermediate, and susceptible. There was no question of the classification of those in the resistant and susceptible classes. Those in the intermediate group developed chlorotic spots and streaks indicative of the early stages of Cimarron blight, but they failed to develop symptoms typical of the disease in its advanced stages.

On the basis of the reactions of 196 F_2 individuals, it appeared that susceptibility was recessive. The data obtained do not fit any known genetic ratio (Table I). It is probable that these results were influenced by at least two factors. First, the environment may have influenced symptom expression in plants grown in the greenhouse during the period from April through June. This has been discussed previously. Second, the poor seed germination may have been a factor in altering the ratios obtained. None of the Cimarron parent seed germinated while a small portion (4 percent) of the Traveler seed germinated. It seems likely then, that a degree of selectivity existed toward a higher germination rate of the Traveler-type hybrids. If this assumption is true, a greater number of susceptible individuals could be expected from seed of more recent origin.

Observations were made on the Cimarron blight reaction of several selected lines which had originated from crosses between Cimarron and Traveler (Table II). These notes were made using plants grown in the greenhouse or in various nurseries on the Agronomy Farm, Oklahoma A. & M. College, Stillwater, Okla., in 1954 and again in 1956. All lines were in the F_9 or F_{10} generation and all were susceptible to Cimarron blight. These lines had been selected primarily for their Cimarron-type agronomic characteristics, and therefore, susceptibility to Cimarron blight would

TABLE I

THE CIMARRON BLIGHT REACTION OF F_2 PLANTS FROM THE CROSS CIMARRON X TRAVELER OATS

F_1 Plant Number	Number of F_2 Plants	Number Resistant	Number Intermediate	Number Susceptible
48 Stw. 9708-1[a]	36	25	8[b]	3
48 Stw. 9708-2[c]	84	43	33	8
48 Stw. 9709-2	12	8	3	1
48 Stw. 9709-3	64	33	18	13
Total	196	109	62	25

[a]Number assigned to plants by the Agronomy Dept., Okla. A. & M. College.

[b]Intermediate refers to those individuals which had chlorotic spotting and lesions similar to those of Cimarron blight in the early stages but failed to develop further.

[c]Those plants removed to the cold frame.

TABLE II

THE REACTION OF CIMARRON AND SOME CIMARRON X TRAVELER SELECTIONS TO CIMARRON BLIGHT

Variety or Line	Blight Reaction[a]				
	1954, Agronomy Farm, Obsn. Nursery[b]		May, 1956, Agronomy Farm, Stillwater Rust Nursery	May, 1956, Agron. Farm, Pure Seed Increase	June, 1956 Greenhouse
	Rep. I	Rep. II			
Cimarron C. I. 5106	3	2+	2-	2	2
Stw. 513705	3	3+	—	—	1+
Stw. 513795	1	1	1	—	0-1
Stw. 513861 (C. I. 6989)	2	2	0-1	1	0-1+
Stw. 513714 (C. I. 7128)	3+	3	2	2+	2+
Stw. 513694 (C. I. 6988)	3	1	1+	1+	1

[a]The severity of reaction to Cimarron blight is based on a graduated scale of 0 to 4. The reaction 0 indicates complete absence of symptoms, while the reaction 4 indicates complete susceptibility with 75 percent or more of the leaf surface destroyed.

[b]Young, H. C., Jr. and D. F. Wadsworth. 1954. Unpublished data. Dept. of Botany and Plant Pathology, Okla. A. & M. College.

be expected. One selection, C. I. 7128, consistently showed a more severe disease reaction than the other lines, including the variety Cimarron. These observations are summarized in Table II. On the basis of a disease rating from 0 (no symptoms) to 4 (severe, 75 percent of the leaf area destroyed), Cimarron averaged 2+ and C. I. 7128 averaged 3. The best line, Stw. 513795, averaged only slightly over 1.

DISCUSSION

At the beginning of these studies it seemed most reasonable to accept the hypothesis that a fungus was the causal agent of Cimarron blight. This was substantiated by two factors: Rosen had apparently identified a fungus pathogen as the causal agent, and, in preliminary observations during previous years, the disorder reacted as though it were a fungus disease. The experimental proceedure was therefore planned with this in mind.

A series of isolation experiments produced two fungi with some regularity, Helminthosporium triseptum and an unidentified species of Alternaria. These were tested for their pathogenicity on Cimarron oats together with an isolate of Cladosporium isolated by Rosen. In no case was there any indication that these organisms were the causal agent of the Cimarron blight disease.

Histological sections were prepared of Cimarron leaf blade and sheath tissue in various stages of disease development. These were examined microscopically and compared with normal tissue. There was no evidence indicating the presence of a fungal or bacterial pathogen. Lesion development appeared to be preceeded by a spontaneous collapse of the mesophyll tissue which was later followed by destruction of the epidermal and supporting tissue.

Since the disease potential seemed to be present almost everywhere Cimarron oats have been grown, the possibility of a seed-borne agent was examined. An experiment was planned to test the possible effects of both chemical and hot water seed treatment. There was no significant differ-

ence in the disease reaction of plants grown from treated seed and the reaction of plants grown from non-treated seed.

Subsequently, then, an experiment was devised in which Cimarron and Traveler were grown under sterile conditions for approximately 4 months. The development of blight symptoms under such an environment would preclude the possibility of an air-borne pathogen as the causal agent. The Cimarron oats grown under these conditions developed symptoms resembling those of Cimarron blight after a period of 3 months. Similar symptoms were not observed on Traveler.

A final study was planned to determine the heritibility of Cimarron blight reaction. Expression of symptoms is apparently an inherited character since both resistant and susceptible types occurred in the progeny of a cross between Cimarron and Traveler oat varieties. Examination of 196 F_2 individuals indicated that susceptibility to the disease is recessive, but the data failed to fit any known genetic ratio. Observations of several selections from Cimarron X Traveler crosses in later generations showed that different stable lines may posses a constant, but different degree of susceptibility. One line consistently demonstrated a greater susceptibility to the disease than Cimarron.

It has been observed of Cimarron oats grown in the field that fall plantings are more severely affected than spring plantings. Similar observations have been made of plants grown in the greenhouse. From this it would appear that disease development is influenced by the environment both in the greenhouse and in the field. These observations also would indicate that temperature and light intensity and/or photoperiodicity are possibly the most important factors.

In conclusion, these studies indicate that the cause of Cimarron blight is not a parasitic agent, but probably a heritable physiologic

tissue breakdown. Although expression of the disorder may be altered somewhat by the environment, symptoms invariably occur at a particular stage of physiologic maturity of the foliar tissue. In the greenhouse, symptoms have been observed to occur in all cases on plants between the ages of 9 and 12 weeks. All plants grown during the period from November through April exhibited symptoms, regardless of the various treatments that were applied. An heritable blotch of a similar nature not quite so restricted by genotype has been described on oats by Ferdinandsen and Winge (3). A manganese deficiency disease, expressed as a leaf blight, has been described by Samuel and Piper (8). In this case, however, the possibility of a mineral deficiency was not examined because the disease was associated only with the variety Cimarron and its derivatives.

SUMMARY

1. A leaf blight disease, commonly called Cimarron blight, peculiar to the oat variety Cimarron and its derivatives is described.

2. Two organisms were frequently isolated from diseased Cimarron oat leaf tissue, but neither was found to be pathogenic on the variety.

3. Comparative histological studies of diseased and non-diseased Cimarron oat leaf tissue showed that the appearance of disease lesions is associated with a spontaneous collapse of the mesophyll tissue. No indications of a causal agent were found.

4. There was no difference in disease expression between Cimarron plants grown from chemically or hot water treated seed and those grown from non-treated seed.

5. Cimarron and Traveler oat plants were grown for almost 4 months under sterile conditions. The Cimarron plants developed lesions resembling Cimarron blight after 3 months, and the Traveler oats showed no signs of this disease.

6. All plants grown in the greenhouse during the period from November through April developed the disease at the age of 9 to 12 weeks. During the period from May through June the disease appeared on plants of the same age, but not all plants had symptoms.

7. The reaction of 196 F_2 hybrids from crosses between Cimarron and Traveler indicate that susceptibility to the disease is recessive. However, the data did not fit any known genetic ratio.

8. Observations of several relatively stable selections from Cimar-

ron X Traveler crosses indicate different lines may consistently vary in the degree of susceptibility to Cimarron blight.

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