MICHIGAN TURFGRASS RESEARCH REPORT

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VOLUME I - NUMBER 1

Michigan Agricultural Experiment Station
Michigan State University
East Lansing

MICHIGAN TURFGRASS FOUNDATION Department of Farm Crops

317 Agriculture Hall • Michigan State University • East Lansing

May 16, 1963

TO: Michigan Turfgrass Foundation Members

RE: Crops-Soils Turfgrass Field Day

The 1963 Crops-Soils Turfgrass Field Day at Michigan State University is scheduled for Tuesday, June 25, from 9:00 a.m. to 3:30 p.m. The tour starts from the Farm Crops Laboratory which is located on the south side of Mt. Hope Road between Farm Lane and Hagadorn Road.

The tour will feature the following:

1. Bentgrass, bluegrass, fescue and ryegrass variety performance.
2. Nematode population studies in turfgrasses.
3. Nitrogen-carbohydrate relationships of grasses.
4. Management studies.
5. Shade-grass adaptation.
6. Selectivity evaluation of turf herbicides.
7. *Helminthosporium* disease problems.
8. Turfgrass breeding.
9. Sod investigations.
10. Soil mixtures for putting greens.
11. Insecticides for turf.
12. Thatch control.

This is a good opportunity for the professional people who serve Michigan turfgrass industry to view the latest developments and research in turf.

Mark June 25 on your calendar and plan to attend the Michigan State University Turfgrass Field Day.

Sincerely yours,

Jim Beard

James B. Beard,
Assistant Professor in
Farm Crops

JBB:js

MICHIGAN STATE UNIVERSITY East Lansing

Department of Farm Crops

May 16, 1963

Gentlemen:

Enclosed is the initial copy of the Michigan State University Turfgrass Research Report. It is currently planned that the report will be issued on a quarterly basis and it is punched for filing in a loose-leaf notebook if you wish. Any suggestions for future issues will be welcome.

Much of the work reported in this publication has been encouraged by your interest and support through the Michigan Turfgrass Foundation. We are looking forward to continued interest from you in our turfgrass program and for support through membership in the Foundation.

Sincerely yours,

Jim Beard

James B. Beard,
Assistant Professor
in Farm Crops

JBB:js
enclosure

1962 TURFGRASS RESEARCH REPORT

Volume 1-Number 1

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ESTABLISHMENT EVALUATION OF COMMERCIALLY AVAILABLE AND NEAR-RELEASE TURFGRASS VARIETIES

James B. Beard
Department of Farm Crops

This report concerns establishment data of turfgrass varieties. The following ratings only reflect the ability or rate at which the turfgrass selections are capable of establishing a dense turf of satisfactory quality. These ratings do not reflect the overall performance of these grasses as this requires four to five years of evaluation involving disease susceptibility, color, mid-summer performance, thatching tendency, and winter survival.

The establishment data will be reported in three main ways: (a) a visual establishment rating (1-best; 9-poorest) that indicates the rate at which a quality turf is formed, (b) seedling vigor measured as height in inches, and (c) density measured in shoots per unit area.

Establishment Procedures

The plot area is located at the Farm Crops Field Laboratory, East Lansing, Michigan. The soil type is a sandy loam having a pH of 6.6. Prior to planting, two pounds of actual N, P, and K per 1,000 square feet was worked into the seed bed. An insecticide was also applied.

All entries were replicated three times in a randomized block design. A firm seed bed was prepared, seed raked lightly into the soil, and a heavy straw mulch applied. Subsequently, the plot area was rolled and watered. The seed bed was kept moist throughout the emergence and seedling stages.

BLUEGRASSES

The establishment performance of bluegrass varieties is shown in Table 1. *Poa trivialis* or roughstalk bluegrass was superior to all Kentucky bluegrasses in seedling vigor and rate of establishment. Park, among the Kentucky bluegrasses, ranked highest in seedling vigor while Merion was lowest.

Delta and Park ranked highest in overall establishment performance with Merion and C-1 the lowest and Common Kentucky intermediate. K-5(47) a Penn State selection out of Merion shows considerably better establishment vigor than does Merion. Of the newer selections, Campus and Prato show good establishment vigor. All selections had good fall vigor. The Prato, C.B., Newport, and CWB seed lots were found to be contaminated with objectionable amounts of *Poa annua* seed.

Table 1. Establishment Evaluation of Bluegrass Varieties Maintained at 1-1/2 Inches. Planted July 26, 1962, at East Lansing.

Entry	Variety	Establishment Rating (1-best; 9-poorest)	Seedling Vigor (Height in Inches) 8/3	8/17
1	*Poa trivialis*	1.50	0.7	2.7
2	Delta	1.75	0.4	1.8
3	Park	1.92	0.6	2.7
4	Campus	2.25	0.4	1.4
5	Prato *	2.25	0.4	1.4
6	K5(47)	2.35	0.2	1.6
7	CB *	2.42	0.4	1.8
8	IBB #15	2.57	0.4	1.3
9	IBB #16	2.75	0.4	1.6
10	Common Kentucky	2.92	0.3	1.8
11	PNW	3.17	0.4	1.3
12	Newport *	3.17	0.3	1.5
13	IBB #17	3.25	0.4	1.4
14	Brabantia	3.25	0.5	1.8
15	ZWB *	3.42	0.4	1.7
16	C-1	3.95	0.3	1.6
17	Merion	4.22	0.0	1.3
	High	1.50	0.7	2.7
	Low	4.22	0.0	1.3
	Average	2.77	0.4	1.7
	$S_{\bar{x}}$	0.58		
	5% Lsd	1.66		

* Seed contained *Poa annua*

RED FESCUES

The red fescue variety establishment data is found in table 2. Highlight, S-59, MSU-36-Fr, and Syn B showed good seedling vigor as did Pennlawn, Rainier, and Ilahee. Chewing, Duraturf, Grand Prairie, Composite and SL3 showed the poorest seedling vigor.

Highlight from the Netherlands and S-59 from England were superior in overall establishment performance as was the MSU selection 18-Fr. SL-3 from New Zealand ranked quite low in overall establishment performance. Of the commercially available creeping red fescue selections Rainier, Ilahee, Pennlawn, and Olds ranked intermediate in establishment ability.

Table 2. Establishment Evaluation of Red Fescue Varieties Maintained at 1-1/2 Inches. Planted July 11, 1962, at East Lansing.

Entry	Variety	Establishment Rating (1-best; 9-poorest)	Late Fall Growth (1-best; 9-poorest)	Seedling Vigor (Height in Inches) 7/23
1	Highlight	1.80	2.0	2.0
2	MSU-18-Fr	1.90	1.7	1.5
3	S-59	2.00	1.3	2.0
4	Oase	2.65	1.3	1.8
5	Duraturf	2.65	1.3	1.1
6	Chewings	2.70	1.3	1.0
7	MSU-36-Fr	2.90	2.3	2.1
8	Syn B	2.90	1.3	2.0
9	Rainier	3.33	1.3	1.9
10	Pennlawn	3.33	2.0	1.9
11	Grand Prairie	3.33	1.3	1.2
12	Ilahee	3.40	1.7	1.9
13	Olds	3.50	1.0	1.7
14	Syn A	3.85	1.3	1.7
15	Golfrood	4.35	1.7	1.5
16	Composite	5.00	2.0	1.2
17	SL-3	7.30	1.0	1.2
	High	1.80	1.0	2.1
	Low	7.30	2.3	1.0
	Average	3.35	1.5	1.6
	$S_{\bar{x}}$	0.65		
	5% Lsd	1.89		

RYEGRASSES

Ryegrass evaluations are found in table 3. Of the perennial ryegrasses, Common and Norlea exhibited excellent seedling vigor, but ranked lowest in density. S-23 from England, MSU-6-Lp, Brabantia from the Netherlands, MSU-21-Lp, and A-2272 from New Zealand ranked high in density. Norlea was distinguished by a dark green color.

Among the annual ryegrasses, Common ranked highest in seedling vigor but lowest in density. MSU-3-Lm showed good density and seedling vigor as well as an excellent upright growth habit.

Table 3. Establishment Evaluation of Perennial and Annual Ryegrass Varieties Maintained at 1-1/2 inches. Planted July 10, 1962, at East Lansing.

Entry	Variety	Density (Shoots per 12.5 sq. in.) 9/11	Seedling Vigor (Height in Inches 7/26
		Perennial Ryegrass	
1	S-23	95	3.2
2	MSU-6-Lp	94	2.7
3	Brabantia	92	3.8
4	MSU-21-Lp	89	3.4
5	A2272	89	3.0
6	Pelo	81	3.0
7	Common	79	4.2
8	Norlea	73	4.0
		Annual Ryegrass	
1	MSU-3-Lm	58	4.0
2	E1506	57	3.2
3	MSU-2-Lm	52	3.2
4	Common	52	4.2
	High	95	4.2
	Low	52	2.7
	Average	76	3.5
	$S\bar{x}$	8.67	
	5% Lsd	25.75	

TALL FESCUE

Table 4 shows the establishment ranking of tall fescue varieties. MSU-1-Fe ranked high in both density and seedling vigor. Kentucky 31 and Alta were intermediate in density. Traveler tall fescue was found to contain a high percentage of off types.

Table 4. Establishment Evalaution of Tall Fescue Varieties Maintained at 1-1/2 Inches. Planted July 10, 1962.

Entry	Variety	Density (Shoots per 12.5 sq. in.) 9/11	Seedling Vigor (Height in Inches) 7/26
1	MSU-1-Fe	90	2.9
2	MSU-7-Fe	70	2.2
3	Kentucky 31	52	2.2
4	Syn A	52	2.5
5	Alta	51	2.5
6	Traveler *	47	2.4
7	S-170	30	1.7
	High	90	2.9
	Low	30	1.7
	Average	56	2.3
	$S_{\bar{x}}$	8.67	
	5% Lsd	25.75	

* High percentage of off types

BENTGRASSES

The establishment evaluation of vegetative and seeded bentgrasses is found in table 5. Of the vegetative bentgrasses, Pennlu, Nimisilla, Toronto, Cohansey, and Congressional in that order ranked high in overall establishment ability. Cohansey and Nimisilla showed a minimum of fall discoloration.

Among the seeded bentgrasses, Penncross was superior in establishment ability. Astoria rated very low in establishment with Seaside intermediate. All three seeded bentgrasses exhibited considerable fall discoloration.

Table 5. Establishment Evaluation of Bentgrass Varieties Maintained at 1/4 inch. Vegetative Materials Planted October 25, 1961, and Seeded Bentgrasses Planted June 4, 1962, in East Lansing.

Entry	Variety	Establishment Rating (1-best;9-poor)	Fall Discoloration (1-best;9-poor)	Spring Growth (1-best; 9-poor)
		Vegetative Bentgrasses		
1	Pennlu	1.95	3.3	5.4
2	Nimisilla	2.22	2.0	3.2
3	Toronto (C-15)	2.55	3.3	5.4
4	Cohansey (C-7)	2.82	1.3	6.4
5	Congressional (C-19)	3.00	2.7	5.0
6	Arlington (C-1)	4.55	3.3	7.2
7	Washington (C-5)	4.70	2.3	6.2
8	C-1 & C-19	5.00	2.7	6.8
		Seeded Bentgrasses		
1	Penncross	3.75	3.7	
2	Seaside	4.15	4.0	
3	Astoria	6.80	3.3	
	High	1.95	1.3	3.2
	Low	6.80	4.0	7.2
	Average	3.77	2.9	5.7
	$S\bar{x}$	0.53		
	5% Lsd	1.54		

CURRENT TRENDS IN TURF PESTS AND THEIR CONTROL

Gordon Guyer
Department of Entomology

The increase in the establishment of good turf has intensified the interest in the associated area of pest control. Individuals with the responsibility for the establishment of new turf, as well as the maintenance of established areas, are faced with the following three problems:

1. Increased importance in dissemination of turf pests.
2. Intensified interest in the utilization of pesticides for protecting turf from insect infestations.
3. The development of concern among many people regarding the use of pesticides.

In Michigan, many of the native pests have made it difficult to maintain established sod. This has been especially true where white grubs and wireworms have been consistent problems. In addition to the native pests we are now involved with the possible spread of the Japanese beetle, European chafer, as well as other very serious introduced species. These important pests have been contained by rather stringent regulatory programs. However, the intensive populations in surrounding states makes future action increasingly difficult.

The introduction of the cereal leaf beetle into southwestern Michigan presents an additional hazard. This pest, although primarily involved as a foliage feeder of cultivated grasses, such as oats and wheat, does represent a potential to other grass species. Fortunately, Michigan has not had serious problems with chinch bug, sod webworm, and other foliage feeders that have devastated established sods in many parts of the United States.

Perhaps the most exciting development in the area of pest control for turf insects has been in the areas of new materials and improved formulations. The availability of granular formulations, fertilizer-insecticide mixture, and combinations of insecticides and herbicides have made the use of these materials very attractive. The availability of a combination multi-purpose treatment is very attractive to the urbanite with a high prestige turf. With the increased ease and expansion of general application, there has been a corresponding increase in the misuse of various materials. In general these misuses have resulted in the application of sublethal dosages or the use, in some instances, of materials that are not designed for turf insect control.

In evaluating the future for pest control on turf, there are several guidelines which seem evident. With the intensified use of pesticides there will undoubtedly follow an increasing problem of resistance in certain of the insect pests to some of the common materials. Wireworms, in certain areas of the southeastern United States, have developed resistance to some of the chlorinated materials, as has some of our fruit and vegetable pests under Michigan conditions. It would be naive to believe that there will not be an increase in the number of species, as well as the intensity of insect pests. With the transportation of sod and the increased intensity in growing sod, pests will find such an ecological situation ideal.

With intensified research there will follow better materials and more effective methods for controlling pests. It will be imperative that the turf grower, like the vegetable grower and fruit farmer, become increasingly aware of the pest problems and most effective control techniques.

LOW TEMPERATURE INJURY TO THE LOWER PORTION OF POA ANNUA CROWNS WHICH OCCURRED IN THE SPRING OF 1962.

James B. Beard
Department of Farm Crops

Extensive winterkill to sport turfs occurred in southern Michigan in the spring of 1962. Turfs which exhibited healthy foliage with the advent of spring thaws were found to subsequently die after several warm, sunny days. Death could not be attributed to pathological causes. Annual bluegrass (Poa annua L.) was most seriously injured under these conditions, whereas Common Kentucky bluegrass and creeping bentgrass were affected to a lesser degree. Injury occurred on both well drained and poorly drained sites. The most seriously affected areas were covered by heavy ice sheets in excess of sixty days.

Microscopic examinations of annual bluegrass leaves after spring thaw and prior to death showed that no injury had occurred from direct low temperature affects, from leaching, from suffocation, or from toxic accumulations under the ice layer.

Careful washing and examination of individual plants revealed most of the root system to be dead. The few live roots were found to be newly initiated from higher on the crown. The upper portion of the crown, stem, and leaves appeared normal and healthy.

A longitudinal section of the crown showed a browning of the lower portion. The root system and base of the crown contained deteriorating and discolored tissue.

Cross sections from the crown of injured annual bluegrass plants revealed that the dark areas of injury and deterioration were concentrated in the vascular bundles. Vascular bundles are important in that they are the channels of carbohydrate, water, and nutrient transport to and from the root system. Detailed microscopic examinations showed severe mechanical disruption and injury to cells in the vicinity of the xylem vessels resulting from ice crystal formation. A similar type of injury has been observed in barley.

These observations indicate that death of annual bluegrass under these conditions was caused by disruption of tissue organization. accompanied by destruction of protoplasts in roots and especially the crown tissue following intracellular ice crystal formation. This type of injury has been associated with non-equilibrium freezing processes in other grasses. Initial injury of this type results from the sudden formation of large ice crystal masses in the spaces between protoplasts.

With the advent of spring thaws, the plant may appear normal on the surface. However, warmer temperatures promote growth and transpiration of the above ground tissue as well as degeneration of injured root and crown tissue. Those plants with severely injured crowns may not be capable of producing a new root system rapidly enough to meet the water uptake requirements of transpiration. Under these conditions, the upper plant tissue often becomes desiccated and dies.

WINTER INJURY OF TURFGRASSES ASSOCIATED WITH ICE SHEETS

James B. Beard
Department of Farm Crops

INTRODUCTION

Winter injury to turfgrasses has been an extensive problem in portions of the northern United States and Canada; particularly grasses maintained under fairway, tee, or putting green conditions. Much has been written regarding possible causes of this injury with practically no experimental evidence to support these theories. Before effective practices can be developed to reduce winter injury, the actual cause or causes must be determined.

Winterkill is a term encompassing a large number of types and causes of injury. It is loosely used to include any type of injury that occurs during the fall, winter, or spring period including desiccation, heaving, flooding, disease (snow mold), and direct low temperature injury. This paper will be limited to winter injury associated with ice coverings. Winterkill associated with ice coverings is common in areas where sleet storms predominate and in poorly drained locations.

SURVEY OF LITERATURE

A review of the literature reveals only one paper which involves the study of winterkill on turfgrasses. In 1939, Carroll and Welton found that common Kentucky Bluegrass was more susceptible to winter injury when heavy, late fall nitrogen applications were made.

Several individuals have published theories as to the causes of winter injury. One of the current theories is suffocation beneath ice sheets. A more recent theory is the accumulation of toxic substances such as carbon dioxide under ice sheets. Another theory which has been suggested is the outward diffusion of water from the plant during ice incasement resulting in desiccation.

TYPES OF INJURY

In 1962, Beard divided winter injury into two major types. Type I was grass which was dead at the time of spring thaws. Type II was grass which appeared alive and healthy at the time of spring thaws but which subsequently died.

Type I injury kill may occur in five ways.

1. Deficient supply of oxygen under the ice sheet. The respiring plant requires oxygen for maintenance of plant tissue even at extremely low temperatures. The ice sheet could impair oxygen diffusion to the extent that, in time, it might become limiting.

2. <u>Accumulation of toxic levels of carbon dioxide under the ice sheet</u>. Carbon dioxide is a by product of plant respiration processes. Even at below freezing temperatures a minimum respiration rate exists. Thus, it is possible, in time, for killing concentrations of carbon dioxide to accumulate or for some similar toxic breakdown product to accumulate. Injury of this type has been reported in alfalfa.

3. <u>Severe hydration of the plant tissue causing leaching of cell contents from the protoplasm.</u> On sun shiny days light rays will pass through the ice and be absorbed by the opaque grass surface. It is possible that these absorbed light rays could heat the grass sufficiently to melt the ice surrounding them. This would result in a condition in which the leaves are incased in water with a heavy ice sheet still existing around them. This condition would be favorable for severe leaching to occur, and has been observed in small grains.

4. <u>Outward diffusion of water from leaves incased in ice</u>. When leaves are incased in ice the relative concentrations of solutes is higher outside the leaf than internally, due to water existing in the solid phase. This could result in outward diffusion in water from the leaf in an attempt to attain equilibrium. If sufficient water is removed from the leaf, desiccation could occur. However, when the vapor pressures of water and ice are compared it appears that at equilibrium sufficient water would not be removed to cause plant desiccation.

5. <u>Total destruction of the protoplasm within the hydrated growing tissue of the plant due to severe ice formation at low temperatures</u>. This is a mechanical injury to the brittle protoplasm caused by the formation of large ice crystals. This type of injury will be less in plants that are permitted to properly harden through dehydration or reduction in water content. If plants are improperly managed through over watering, fertilization or any process which stimulates growth in the late fall, then the chance of direct kill by low temperature is much greater.

Type II injury could occur in two primary ways.

6. <u>Total destruction of cellular protoplasm within the hydrated growing tissue of plants which have prematurely initiated spring growth</u>. The grass may survive the winter in excellent condition. Subsequently, the weather may turn extremely warm for three or four days, resulting in a premature loss of hardiness due to an increase in hydration within the plant. If this is followed immediately by a severe drop to below freezing temperatures, direct low temperature injury may occur. The chance of this type injury occurring can be reduced by avoiding any practices which encourage premature early spring growth.

7. The mechanical injury of the lower crown tissue and root. The original cause of injury is destruction of the cellular protoplasm in the lower crown tissue due to ice crystal formation. This in turn results in death of the root system and lower crown while the above ground leaves and shoots appear normal. Cross sections of the grass crown show a browning of the lower crown and roots. With the advent of spring thaws the grass plant will appear on the surface to be normal. However, warmer temperatures will result in growth and transpiration of the above ground tissue. Plants with severely injured crowns may not be capable of producing a new root system fast enough to meet the water uptake requirements of transpiration. Under these conditions the plant will die of desiccation resulting from the severe crown injury.

PROGRESS REPORT OF RESEARCH FINDINGS

In the fall of 1962 studies were initiated to determine the actual cause or causes of winterkill. Three species were utilized in the experiment: Common Kentucky bluegrass, Toronto creeping bentgrass, and *Poa annua*. All vegetative materials were allowed to harden naturally in the field. On November 26, 1962 (soil temperature 34°F.) four-inch plugs were taken for use in the experiment. The following treatments were applied: (1) flooding then freezing, (2) freezing then applying thin ice layers, (3) freezing then applying a snow layer followed by an ice layer, (4) placing in a sealed container and freezing, (5) balk pressure freezing, (6) no treatment, and (7) submerging in water at 35°F. All treatments were held at 25°F. except for number 7. At fifteen-day intervals, replicated samples from each variety and treatment were removed from the low temperature chamber, thawed, and placed in a 70° growth chamber.

The total length of the experiment was ninety days. Observations made included percent top survival, moisture content, microscopic crown examination, and yield. Results of this study showed that during the 90-day period winter injury by oxygen suffocation, toxic accumulations, cellular leaching, or outward water diffusion in ice were of no significant importance. No injury occurred in bentgrass while a small degree of injury was observed in Kentucky bluegrass. Annual bluegrass was intermediate between the two. These results cast doubt on the importance of suffication, toxic accumulations, or leaching in the winter injury of these three grasses which is associated with ice covers. None of these treatments produced symptoms of lower crown injury of the type which was observed in the spring of 1962 in the Detroit area.

EVALUATING INJURY IN THE FIELD

The conditions under which each of these six types of injury occur are quite different. The turf specialist must be capable of recognizing both the type of winter injury and the causal conditions. This involves observations of types of ice and snow cover; duration of coverage; time of occurrence, degree, and duration of low temperature; occurrence of water encasement in ice; and physiological condition of the grass plant at the time of low temperature occurrence.

Samples of grass should be taken at key times in the winter and placed under higher growing temperatures to observe if injury has occurred. Cross sections of the grass crown can be taken with a knife to check for lower crown injury which will typically appear as a browning of the lower crown and root. By this means, the turfman can ascertain if and when winterkill has occurred.

In time, the turfman will become experienced with the conditions under which injury occurs, as well as, in what locations injury is most likely. With this knowledge proper precautionary measures can be taken. Hasty evaluations regarding winterkill causes based on superficial information can lead to erronous conclusions. On the spot, detailed observations are needed to arrive at the correct causal factors.

HELMINTHOSPORIUM - SCOURGE OF THE GRASS FAMILY

Nicky A. Smith
Department of Plant Pathology

The general yellowing of the leaves of your bentgrass can be caused by a Helminthosporium. If the disease spreads rapdily under warm, humid conditions, there is reason for real concern. If it's there but you do not see it, it still causes its damage. When it seems to respond to a fungicide, then there is reason for rejoicing. The situation is seldom as clear-cut as this. Let's take a closer look.

Helminthosporium is the name of a genus of fungi which causes diseases in cereal plants and turfgrasses. The turf management specialist, homeowner, farmer or plant pathologist is constantly confronted with this group of pathogenic fungi that cause many leaf spot diseases. Helminthosporium is like a family name of Smith, Jones, Brown or McGillicutti. Like a family, it has certain physiological features in common. However, the family is composed of individuals (species) just as the Smith family may have Mary, Martha, Mabel and Mathilda. Each species is a little different from her sister. None of them can make a living and provide for herself, because she is without the food manufacturing green chlorophyl of other plants. She must live on the accumulated food of another. This is a parasite. And this is where she comes into conflict with man.

One species, Helminthosporium turcicum, is partial to field corn; another species is partial to wheat, oats, or rice. Helminthosporium dictyoides restricts itself pretty much to fescues, particularly red fescues, either Chewings or creeping red. Helminthosporium vagans prefers Kentucky bluegrass, including any trade variety of Kentucky bluegrass except Merion Kentucky bluegrass. This was the main selling point for Merion. But, alas, we found that Merion was susceptible to powdery mildew and rust not to mention that it required better than average management.

In contrast to these species of Helminthosporium is Helminthosporium sativum, which can survive handily on over 100 species in the grass family. It attacks the farmer's wheat as a root rot or foliar spot blotch or seed black pointe. It attacks the farmer's oats, barley and rye, too. If it stayed on quackgrass we would not object. But it attacks bentgrass and bluegrass - both common and Merion Kentucky bluegrass.

The farmer in Shiawassee or Clinton counties had H. sativum in his wheat last fall. But the southeastern Michigan golf course superintendent had H. sativum the previous spring in his bent grass putting green.

Turf pathologists have said that H. sativum is a warm weather disease --- Then why did we see it in May and October of 1962? Actually we had some very warm weather last May and September-October. If the temperature and humidity are optimum, the spores can germinate and grow in 30 minutes.

Scientists like J. J. Christensen of the University of Minnesota have spent a lifetime fathoming the depths of Helminthosporium sativum. Last year's outbreak showed us that we still have much more to learn.