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UNIVERSITY OF ILLINOIS
DIVISION OF UNIVERSITY EXTENSION

ILLINOIS

TURFGRASS CONFERENCE

PROCEEDINGS

College of Law
Auditorium

DECEMBER 5–6, 1963

arranged and conducted by the

COLLEGE OF AGRICULTURE

with the cooperation of the

ILLINOIS TURFGRASS FOUNDATION

This conference is presented specifically for persons interested in turf management by the University of Illinois College of Agriculture. Abstracts in this manual bring to you up-to-date information required by those who wish to maintain high quality turf-grass area but do not constitute positive recommendations unless so stated. Statements made herein are the responsibility of either the speaker or the institution he represents. Reproduction and publication are permitted only with the approval of each author.

University of Illinois
Division of University Extension

Announces the

FOURTH ILLINOIS TURFGRASS CONFERENCE

December 5 and 6, 1963
Auditorium, Law Building
Urbana, Illinois

arranged and conducted by the College of Agriculture with the cooperation of the Illinois Turfgrass Foundation

PROGRAM

Thursday, December 5 -- First Session

9:00 - 12:00 Noon	Registration
10:30 - 11:30 a.m.	Illinois Turfgrass Foundation Business Meeting J. W. Brandt, President
11:30 - 1:10 p.m.	Lunch

Thursday, December 5 -- Second Session

Moderator - R. M. Carleton, Chicago, Illinois

1:10 - 1:15 p.m.	Welcome - Dean L. B. Howard
1:15 - 1:35 p.m.	Turf Diseases M. P. Britton University of Illinois
1:35 - 2:20 p.m.	Prairie and Prairie Plants R. A. Evers University of Illinois
2:20 - 2:40 p.m.	Soil Amendments T. D. Hinesly University of Illinois
2:40 - 3:00 p.m.	Poa Annua R. L. Snodsmith University of Illinois
3:00 - 3:15 p.m.	Break

Moderator - C. R. Habenicht, Tinley Park, Illinois

3:15 - 3:35 p.m.	Introducing a Turfgrass T. Gaskin Palos Park, Illinois
3:35 - 4:00 p.m.	Turfgrass Nutrition R. A. Miller University of Illinois

Thursday, December 5 -- Second Session (continued)

4:00 - 4:20 p.m.	Variations in Bentgrasses J. D. Butler University of Illinois
4:20 - 4:40 p.m.	Disease Research M. J. Healy University of Illinois
6:30 p.m.	Banquet 314 Illini Union

Friday, December 6 -- Third Session

Moderator - T. Woehrle, Chicago, Illinois

8:30 - 8:40 a.m.	Briefs J. W. Brandt Danville, Illinois
8:40 - 9:00 a.m.	Weed Control Dr. F. W. Slife University of Illinois
9:00 - 9:45 a.m.	Landscaping the Golf Course W. R. Nelson University of Illinois
9:45 - 10:05 a.m.	Kentucky Bluegrass--A Composite of Many Types C. W. Lobenstein Southern Illinois University
10:05 - 10:20 a.m.	Break

Friday, December 6 -- Fourth Session

Moderator - L. Short, Keokuk, Iowa

10:20 - 10:40 a.m.	Nematode Research C. F. Hodges University of Illinois
10:40 - 11:25 a.m.	New Developments in Turfgrass Science R. E. Engel Rutgers University
11:25 - 11:45 a.m.	Lawn Disease Control M. C. Shurtleff University of Illinois
11:45 a.m.	Adjourn

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Stripe Smut Damage to Kentucky Bluegrass Lawns

M. P. Britton

Stripe Smut: Caused by the fungus Ustilago striiformis has been found to cause extensive killing of Merion Kentucky bluegrass plants. The damage generally appears in May as patches of dead grass 2-8 inches in diameter. The presence of the smut fungus as black, dusty masses of spores in linear streaks on the leaves of the dead plants is the conclusive identification characteristic. In addition, many of the living plants will be infected. Symptoms on live plants consist of the black linear spore masses, stunting, yellowing of some plants, and death of the leaves from the tip downward (the dead portion is curled and twisted). In May and June the dead leaf tips may be so numerous that a light brown color is imparted to areas of the lawn even though the plants have not been killed.

Merion bluegrass appears to be the most susceptible variety in common use for home lawns. The heavily infected lawns observed were all over four years old. In the most heavily infected lawn more than 60% of the tillers (shoots) were smutted. In this lawn a few small dead areas of grass appeared in May. During the summer the number and size of the dead areas increased and on October 22, 40% of the lawn was dead. This lawn was irrigated only once during the growing season and it is thought that plants weakened by the smut fungus were unable to survive periods of low soil moisture content. That this might be the case is indicated by the fact that in heavily infected lawns which were irrigated dead areas occurred in May but did not become progressively worse during the summer, even though a high percentage of plants was smutted.

Stripe smut can usually be found in about all Kentucky bluegrass lawns, whether they be Merion, Common or some other variety. Generally, the number of smutted plants is low. Only in Merion have high numbers of smutted plants been observed and obvious damage as described previously has not been common. I have observed three lawns where extensive death of plants occurred and this is a small percentage of the Merion lawns in Illinois! However, the disease is capable of causing extensive damage to lawns and this potential menace should not be disregarded.

The fungus spores may be carried on the seed harvested from fields in which smutted plants occur. Since the spores are carried on the outside of the seed, fungicide seed treatments would eliminate this source of infection. In addition to this source of infection the fungus spore can persist in the soil and in plant debris.

Infection of the bluegrass plants occurs through the coleoptile of the seedling plant or through the tillers from crown buds or rhizomes produced by mature plants. Once the plant has been penetrated the fungus grows into the crown of the plant where it persists without doing apparent damage to that part of the plant. As new leaves, rhizomes or shoots arise from the infected crown the fungus grows out into them and typical symptoms are produced resulting in the death of these structures. After the fungus has entered the plant it remains there until the death of the plant. Infected bluegrass plants under pasture management rarely live beyond the second year after infection. We do not know how long infected plants will live under lawn management.

We also do not know how to control this disease once it has become extablished in a lawn. Two years of fungicide testing at Hillside, Illinois, with captan, zineb, maneb, dyrene, actidione, nabam, and Ortho Lawn and Turf fungicide applied as drenches as given no reduction in the number of smutted shoots.

The application of seed treatment fungicides will undoubtedly kill the spores of the fungus that are carried on the seed. However, we do not know whether this is an important source of infection.

Chemical sterilization of heavily infested soil and reseeding to less-susceptible varieties may be the most practical method of combatting stripe smut once it has become established.

PRAIRIE AND PRAIRIE PLANTS

Robert A. Evers

A talk with a title as this may seem a bit odd at the Illinois Turfgrass Conference. You are interested in grasses. As a botanist, and, moreover, a botanist concerned with the Illinois flora and vegetations, I am interested in grasses, especially prairie grasses. Illinois is often called "the prairie state" and we should know something about prairie. I shall attempt to describe the extent of the prairies and prairie types in Illinois, and to some extent those found elsewhere, mention a few of the common prairie plants, and conclude with remarks on the origin and the present status of Illinois prairies. Perhaps the first task of this talk is to define prairie.

The word prairie comes from the French and means a meadow. The word was applied to the vast grasslands of North America by the French. Over a period of years, especially in Illinois, the meaning of the term was gradually changed to designate a flatland, especially the flat farm land of east-central Illinois. Any reference to prairie on steep slopes would have been seriously questioned in the light of the modified meaning of the word. Botanically, prairie was and is a grassland. It is a type of vegetational cover in which grasses dominate. The cover may be on flatland or on steep slopes, just as a forest, another vegetational cover, is dominated by trees and can cover flatland or slope.

The prairie has other characteristics that we should mention. It is a closed community. J. E. Weaver (1954) wrote: "From a half-inch below the surface to a depth of 3 to 6 inches, the soil is occupied by roots and rhizomes, and less frequently by bulbs, corms, tubers, and their out growths. A dense network of roots extends several feet in depth. Everywhere the soil is so thoroughly threaded with plant parts as to form a dense sod." Because of this the plants that are not native to the prairie are kept out. Grasses, as indicated earlier, form the bulk of the vegetation but non-grass plants are also important. Many of the prairie species have a long life, 10 to 20 years, and many reproduce vegetatively. In winter they are alive below the ground and renew their growth above the ground in spring and form a dense cover, so dense that the light intensity at the soil surface is very low. This in a typical land of sunshine.

Grassland extended from the Rocky Mountains eastward to form a triangular pattern with the eastern point extending through Illinois and in to Indiana and Ohio. Transeau, a botanist who studied rainfall-evaporation rates in the eastern parts of this grassland, called that section "The Prairie Peninsula" and his map shows the prairie peninsula in Illinois and Indiana with a few off-shore islands in Ohio.

Not all of this vast grassland was the same. Climate, including the temperature and rainfall, and also light and other controls varied in such a sizable area and this variation was reflected in the type of prairie. To the east we found the tall-grass type. Westward this gave way to the mid-grass type. The first of these types to be seen by a European was probably the mid-grass type when Coronado ventured from Mexico northward into what is now New Mexico and into Kansas during the 16th century. The first extensive writings were from French explorers and missionary priests who came into the tall-grass prairies and named the vast grasslands the prairie. What were some of these early descriptions? Let us quote one, written only 118 years ago, by Dr. C. W. Short (1845). Short journeyed as far west as Peoria and then southward in Illinois. Here is what he said:

"The first sight of the prairie with which we were greeted was in the neighborhood of Terre Haute, on the eastern side of the Wabash, and consequently in the State of Indiana. In approaching this new and apparently thriving town, from the east, over the national road, the eye is filled with the prospect of an extensive plain entirely destitute of all timber-trees, and stretching to a great distance both above and below the town. Such a view, agreeable at all times, was particularly so as it opened suddenly upon us just after emerging from the heavily wooded forest through which we traveled all day. The Terre Haute prairie, however, has been all reclaimed, or rather, botanically speaking, desecrated by the hand of man, and no portion of it now remains in a state of nature. ----

"Twenty miles west of the Wabash at this point, we met the first prairie in a state of nature; and from this, extending northward to the Lakes, and westward to the Mississippi, they continue, increasing in magnitude, and interrupted only by the occasional groves of timber, so as to occupy by far the largest portion of the central, eastern, western, and northern portions of the State of Illinois.

"On fairly entering the prairie region, and reaching the centre of one of these immense natural meadows, the view presented to the eye of a novice in such scenery, is one of the most pleasing sort. But beautiful, imposing, and even grand as is this spectacle, I must own, that in a botanical point of view, I was disappointed! The Flora of the prairies--the theme of so much admiration to those who view them with the ordinary eye--does not, when closely examined by the Botanist, present that deep interest and attraction which he has been led to expect. Its leading feature is rather the unbounded profusion with which a few species occur in certain localities, than the mixed variety of many different species occurring anywhere. Thus from some elevated position in a large prairie the eye takes in at one glance thousands of acres, literally empurpled with the flowering spikes of several species of Liatris,...."

Short continued by telling how Coreopsis and other autumnal composites formed vast patches of yellow. In other words, according to his description, the prairie was a quilt-work of vast numbers of only a few species. It is deplorable that plant ecology and its methods were not well developed and widely used during Short's time or we would have better and more accurate descriptions of the prairie and, I am sure, Short would have enjoyed the prairie far more.

Another early description of prairies in Illinois was left by Eugene Woldemar Hilgard who resided in St. Clair County between 1836 and 1848. In one of Hilgard's unpublished manuscripts he gives his recollections of a trip from St. Clair to Wayne County. This was a different section of Illinois prairies than Short visited. Hilgard also noted the patchiness of the prairies.

"It may be said that most of the species growing on the prairies had a tendency to grow in more or less compact patches, so as frequently to remind one of a varicolored quilt."

The prairies of Illinois can be sub-divided into groups. The sub-division here made are purely one of convience and man-made. They are based primarily on the dividion made by B. Shimek (1911), an outstanding student of the prairie, especially of Iowa prairies. The Illinois prairies can be sub-divided into six types or groups. It is necessary to keep in mind that one group may blend into another. It is impossible to have a nice pigeon-hole arrangement into which every prairie can be placed; things of nature have too much variation for such a rigid system of classification.

1. Flatland--Flatland prairie is the type that covered much of Illinois especially east central Illinois. It was the grassland on the glacial drift. The drift sheet was not perfectly flat but had a sag and swell topography. As the sags were not all connected, there were extensive wet places on the landscape. The flatland prairie was characterized by being quite wet except during the dry season--late summer and early autumn--when the water dried away and huge mud cracks formed. In the wetter portions of the prairie, prairie cordgrass or slough grass abounded; in the less wet places big bluestem, switchgrass, and Indian grass were dominate ones.

2. Rolling--Rolling prairie is the type that covered the rolling hills in parts of Illinois as in the Rock River hill country and in the western part of the state. Perhaps the big bluestem was the dominate grass together with Indian grass and switchgrass. Not much of this type of prairie remains in Illinois.

3. Hill--Hill prairie is a prairie on a pronounced slope. In Illinois such prairies are usually found on the upper slopes of the bluff of the major streams. Little bluestem is the dominate grass.

4. Bottomland--The bottomland or floodplains type of prairie covered the floodplains of the Illinois and Mississippi rivers. Contrary to popular opinion, the floodplains were not covered by extensive forest, but as Turner (1934) has shown, prairie was extensive. The Great American Bottom, the floodplain stretching from Alton southward to the mouth of the Kaskaskia River was mostly prairie, with forest usually restricted to the banks of borders of streams and sloughs, Prairie du Rocher, a village in Randolph County, founded by the French in 1722, was named because of the prairie in the bottomland which at this site was underlain near the surface with rock. Prairie cordgrass was the dominate grass of this type of prairie.

5. Prairie Openings in Forests--Prairie openings, usually quite small in size, occupied the ridge tops. In Illinois, they are found mostly in western and southern parts of the state.

6. Sand--Sand prairie is the type which grows in sand. It occupies parts of the inland sand deposits in Illinois. Elsewhere, as in Nebraska, sand prairie may occupy large sand hills.

Now let us examine some of the prairie plants. In the definition of prairie, it was stated that certain grasses are dominate. Prairie cordgrass, Spartina pectinata, was dominant in the wetter parts of the prairie. This grass has a wide range in the United States. In less wet sites, the big bluestem, Andropogon gerardi, was generally dominant. Like the other two species, it was also widespread in the midwest. Other common prairie grasses include Indian grass and certain panic grasses such as switchgrass.

In mixed prairie to the west of Illinois the needlegrass, Stipa comata, is dominant. Other dominants of this grassland are western wheatgrass, Agropyron smithii, and junegrass, Koeleria cristata. In the short grass prairie, the dominants are buffalo grass and blue grama.

Some of the common and colorful non-grass plants are leadplant, Amorpha canescens, purple prairie-clover, Petalostemum purpureum, white prairie-clover, Petalostemum candidum, purple cone-flower, Echinacea Pallida, rosinweed, Silphium integrifolium, compass plant, Silphium laciniatum, prairie dock, Silphium terebinthianceum, blazing star, Liatris aspera, and coreopsis, Coreopsis palmata. The restriction of some of these species to the prairie peninsula is quite notable.

It is interesting that some of the species that are restricted in Illinois to such dry prairies as the hill prairies are common westward. Thus the species of bluets called Houstonia nigricans is common in only a few hill prairies of southwestern Illinois. In the grasslands around Manhattan, Sylvan Grove, and Morton, Kansas, this species is very common.

The reverse trend may also be true. Prairie dock is common on flatland prairie in Illinois but does not go far westward.

Of course, these are not all the species in prairie; it is impossible to list all of them in a paper of this length. Prairie plants are different from plants of the forest. B. Shimek wrote that prairie has "...a flora which is wholly distinct from the smaller (chiefly herbaceous) flora of the forest."

From where did these species, and consequently the vegetational cover come? What is the origin of the prairies?

Origin of the Prairie--Much as been written, and perhaps will be written, concerning the origin of the prairie. This vast grassland intrigued geologists and botanists of the past century as well as of the present. Geologists were among the first to write articles on this interesting subject. An enormous literature built up and it would be impossible to quote from all, or even a small part, in this short paper. That the volume of literature on this subject was great is well described in a paragraph of an article written by P. O. Hay in 1878.

"For many years past there has been no lack of literature of the subject of the prairies of the western states and territories, nor any dearth of theori to account for their origin. We have had their existence ascribed to fire and water; to heat and to cold; to all sorts of phenomena and to the lack of them."

Authors of some of the earlier writtings attributed the existence of prairies to :

1. the presence of a vast dried up lake bed after the Flood.
2. the presence of a vast dried up lake bed after deglaciation.
3. the type of drainage
4. the amount of rainfall
5. the temperature
6. the climate
7. prairie fires.

and a host of other causes.

Many people, including botanists and geologists believed fire was the cause of prairie. A vast amount of literature supported this contention. Others did not accept this theory. In general, the origin of the prairie by fire is not altogether tenable. We might add here the remark of one writer that a prairie is necessary before it is possible to have a prairie fire.

Prairie must have originated in the geologic past. Prairie may have existed since the advent of a grass flora and especially the appearance of certain grass genera. Here the fossil record is of no value as the environmental conditions which exist in prairie are not suitable for fossilization. Prairie may be very old; as to its age we can only theorize.

One such theory maintains that in Mesozoic time, over 60 million years ago, the present area of Continental United States was covered with a forest, the Arcto-tertiary forest. This equable forest stretched from the Pacific to the Atlantic over a land surface that lacked high mountains. However, the mountain making upheavals of the Laramide Revoluation, between the Mesozoic and Cenozoic time, pushed up a mountain barrier, the Rocky Mountains, which trend in a north-south direction. The mountain range was a barrier for the moist westerly winds from the Pacific Ocean. The land on the west side of the mountains, the side toward the Pacific, had a large amount of rainfall, the land to the east had less rainfall. According to the theory, the Arcto-tertiary forests of the region just east of the mountains died out and grassland occupied its place. Some botanists believe that certain herbaceous forest species evolved at that time into prairie plants. Others, who accept aridity as a force in evolution of plants, might say that prairie species had been present in drier areas and spread out over the region which became more xeric because of the shadow effect of the mountain range upon the rainfall.

Since forest was replaced by prairie, according to the theory, it would be well to know the basic condition of a forest cover. Such knowledge would help in understanding the basic condition for prairie cover. According to Todd (1878) "the fundamental condition for forest growth is a constant medium humidity of air and soil." It is interesting to note that Todd says nothing about the amount of rainfall or the temperature, only a "constant medium humidity." Transeau's work on rainfall to evaporation ratios lends some support to Todd's statement, Rainfall, relative humidity, wind velocity and temperature are involved in rainfall-evaporation ratios. Thus, Transeau was not advocating a single cause of prairie. However, he did not take into consideration other conditions which also influence the presence of prairie. Such conditions would include surface drainage, type of topography, permeability of the subsoil, local exposure, and others.

In the prairie areas of North America, the annual rainfall varies considerably. So does it in deciduous forest areas. But prairie regions there is usually a period during the year, commonly in late summer and early autumn, when rainfall is scant or lacking. Such a dry period, even in an area of moderate annual rainfall, does not permit a "constant medium humidity of soil and air." In these locations, according to Todd's reasoning, prairie, not forest, thrives.

Illinois, however, lies within the region of prairie-forest overlap. Both vegetational covers are found to thrive in the same general location. Rainfall, although varying from south to north in the state, apparently is not <u>the</u> control. Soils have little effect alone. Soils derived from loess, from glacial drift, and sand support both prairie and forest. Perhaps other conditions are influential in determining the type of vegetational cover in Illinois.

Prairie was a relatively stable community up to some years after the arrival of European man. Prairie was a closed community. Invasion by forest or by non-prairie species was almost impossible under the natural conditions in the prairie. These natural conditions included not only climate and soil but the plants themselves. In the prairie, especially in the lush flatland, rolling, and bottomland types, space was not available for any other plants. It is true, at soil surface there appeared to be available space butthe foliage cover above shades the soil surface. Beneath the soil surface, space was absolutely unavailable. The roots and rhizomes formed such a dense subteranean growth that no other plants could become established in this unbroken root-rhizome mass. Prairie possibly established itself on the glacial drift as the Pleistocene ice melted down and back. By priority of occupation the prairie species were able to clothe and maintain a cover over a landscape that possibly could have supported a deciduous forest equally as well as in most, but not in all, of the locations. This was possible because of the adaptations of prairie species for dispersal, their ability to thrive on a newly deglaciated surface and to form a closed community quickly once having occupied that surface. So the prairie, composed of such species, maintained itself until European man decided he needed the land for his use and found the means to open the community.

Development of a plow with a steel share and moldboard and the development of dredges and drainage tile spelled doom to the flatland and bottomland prairie. The steel plowshare was able to cut through the mass of underground plant parts and the moldboard was able to turn this mass. The root-rhizome mass was now broken and the roots died. The prairie community was now opened and planted into European, Asiatic and New World crop plants. But the prairie community was opened also th European and Asiatic weeds and, in the prairie-forest border, to forest species. The dredge and drain tile made possible the quick removal of standing water which was common in spring and early summer to flatland and bottomland prairie and produced conditions which hindered the growth of a deciduous forest. Thus the grassland, which was dominated for ages by big bluestem, prairie cordgrass, or other grasses, was converted in a very short time by European man into other grasslands, the cornfield, the wheatfield, the fields of rye, oats, barley, or to legume patches, the soybean field, and the alfalfa or clover field.

So rapid was the destruction that today the prairie ecologist in Illinois has to search diligently for suitable, small remnants here and there in railroad trackways, fencerows or waste places. While man has set aside numerous square miles of forest for the people of this and succeeding generations to see, examine and enjoy, he has not set aside one section (a square mile) of the flatland or bottomland prairie for such scientific and aesthetic purposes. Only small remnants are available.

Now the remnants are being destroyed rather than conserved. Railroad trackways, one of the last refuges of our flatland prairie in Illinois, are now bulldozed clear of prairie vegetation. During the next growing season the European weeds take over. Prairie species may be able to invade again these areas from little patches which escape the blade of the bulldozer but, about the time they have reestablished themselves, the bulldozer arrives once more on the scene. Fortunately, in most cases, the smaller prairie openings and hill prairies present conditions which render these sites unsuitable for use except for pasturage. Such land use, if kept within limits, has little, if any, harmful effect on the native plants. In some conservation areas where fields have been abandoned, prairie has again invaded. In one such conservation area, however, the prairie was destroyed again with a plow to make way for a pine plantation. In that part of Illinois a pine forest is about as harmonious as a palm grove at the North Pole. Thus we are rapidly losing our prairies.

From this brief discourse on prairie it can be concluded that prairie is not the result of a single control or influence but the results of a complex set of influences that act and react together. The immediate value of each influence may vary in its effect in different sections of the North American grassland so that in one section soil seems the most important, in another rainfall, in another drainage, and so on. Nevertheless all controls work together. How the prairie originated is still theory but how it was destroyed is clearly evident. The type of plant cover from which Illinois received its slogan "The Prairie State" has been almost all destroyed and will be completely destroyed in a decade or so unless interested persons do something to save the last remnants.

Literature Cited

Hay, Oliver Perry
1878. An examination of Prof. Les. Lesquereux's theory of the origin and formation of the prairies. Am. Nat. 12:299-305.

Shimek, B.
1911. The prairies. Iowa Univ. Lab. Nat. Hist. Bull. 6(2):169-240 .

Short, C. W.
1845. Observations on the botany of Illinois, more especially in reference to the autumnal flora of the prairie. West. Jour. Med. and Surg., n.s., 3:185-198.

Todd, James E.
1878. Notes on the distribution of timber in southwestern Iowa, with inferences concerning the origin of prairies. Am. Nat. 12:91-96.

Turner, Lewis M.
1934. Grassland in the floodplain of Illinois rivers. Am. Midland Nat. 15:770-780.

Weaver, J. E.
1954. North American Prairies. Johnson Publ. Co., Lincoln, Neb. 348 pp.

Soil Amendments

T. D. Hinesly

Any organic or inorganic material added to the soil to improve the physical condition of the soil is called a soil amendment even though some may also supply plant nutrients to some extent.

Soil amendments applied to improve the physical conditions rather than the reaction of the soil are important to the extent that they improve (1) soil aeration, (2) the rate at which water moves into and through the soil, (3) the amount of water retained in an available form for plant use, and (4) conditions for plant roots to readily permeate the soil in depth.

In general, as soil particle or aggregate size decreses total porosity increases but individual pores between particles or aggregates decrease. Those pores between particles or aggregates that are drained at 40 to 60 cm of water tension are called non-capillary pore space. When particle size is predominantly less than coarse sand and aggregation is poor rapidly drained non-capillary pore space is often reduced below the minimum 10 to 12 percent by volume considered minimum for good soil aeration. If the proportion of large pores are below this level, the supply of oxygen to roots will be inadequate for normal root growth and development and the adsorption of water and nutrients is impaired. Through this non-capillary or aeration pore space most of the water moves into and through the soil, the rate being determined largely by the amount of these pores and their continuity.

The difference between the amount of water at field capacity and the amount held at 15 atmospheres tension is considered to be the available soil water. Most simply defined field capacity is the amount of water held in a soil after drainage has practically ceased. Water held by the soil with tension greater than 15 atmospheres is unavailable to most plants in sufficient amounts to pervent permanent wilting.

Sandy textured soils often store less than 1/2 to 1 inch of available water per foot of soil depth. Poorly aggregated clay textured soil may not store very much more available water than sands, since most of its water is in the unavailable range of tensions above 15 atmospheres. Some clay loam and loam textured soils may retain 2 inches or more of available water per foot. Water within the available tension range may not be available for plant use because of the lack of aeration when a water table is present in the rooting zone or when a compacted zone may prevent the roots from growing into moist soil.

Ideally, we would like to have a deep rooting medium for grass that has the infiltration, percolation, and aeration capacity of coarse sand and yet have the available water retention and cation exchange capacity of a well structured clay loam soil. Also, we would like the soil to be highly resistant against compaction.

Some examples of organic amendments are manure, compost of various materials, peats, and sewage sludge, all of which furnish some plant nutrients but are primarily mixed with the soil to increase soil humus to stabilize soil aggregates. A large number of manufactured commercial organic soil conditioners, of which Kriluim is most well known, stabilize soil aggregates but have no value as a source of plant nutrients. The category of organic amendments includes the numerous commercial surfactant materials which most directly affects the hydraulic properties of soils. A recent suggested addition to the long list of organic amendments is plastic foams, which will not modify the soil itself but will actually become part of the soil fabric to supposedly increase its porosity, available water retention and elasticity in proportion to the amount added.

The addition of organic matter to sandy soils may increase its water and nutrient holding capacity to a small extent but in the presence of good aeration and high fertility the microbial decomposition rate of the material will be rapid and thus the benefit short lived.

When organic matter is added to heavy textured soils, it helps to stabilize what may otherwise be temperal soil aggregation. However, its stabilizing influence is limited when soils are subjected to highly compactive stresses during times of high moisture content and may actually deteriorate into a more impervious mass than would have been the case without the additional organic matter.

When synthetic soil conditioners are applied to the soil, caution should be exercised in obtaining the desired state of aggregation for stabilization. If these materials are applied to clods or crust they will stabilize the soil in that condition.

Surfactant materials have been used in an attempt to reduce soil moisture loss by evaporation and others have been used as wetting agents to improve infiltration rates. They are expensive and have been only moderately successful. They have no direct effect on soil structure improvement or stabilization.

Many of the inorganic soil amendments are either a source of soluble calcium or make calcium more soluble from natural soil sources. Increasing the calcium in solution increases the flocculation of clays, that is, the particles will come together in large aggregates. If the exchangeable sodium content of the clay is high, calcium will replace the highly dispersing cation from the exchange position. Once the sodium ion is replaced, it can then be leached from the soil.

Calcium chloride, sulfur, sulfuric acid, iron and aluminum sulfates, gypsum, and lime are a few of the inorganic amendments added to the soil for the purpose of adjusting the pH to an optimum level for plant growth or to increase the amount of exchangeable calcium and thereby induce flocculation of the colloidal fraction of the soil--the first step toward soil aggregation.

Amendments used to adjust the soil reaction improve soil physical conditions indirectly by improving the nutrient availability for more abundant plant growth. With increased plant production more readily decomposable organic matter is returned to the soil. Some of the biological decomposition products from the rapidly decomposing material are very effective aggregating agents.

Adding sand, plastic foams, micas, perlite, vermiculite and calcined clays to a soil is mainly for the purpose of constructing a course grained framework. The large particles bridge across spaces forming a continuous framework while the smaller particles of clay and silt are found in the voids. The idea being that under compactive stresses, the larger particles bend and exhibit elastic deformation rather than being displaced into a more dense state of packing.

Perlite in a soil mixture performs about the same structural function as sand -- perhaps providing some additional cation exchange capacity, but having less mechanical strength than sand. Compared to sand, vermiculite and calcined clays may contribute a great deal of nutrient and available water holding capacity but does not possess the lasting mechanical strength of the calcined clays. There is a wide variance in the properties of the calcined clays being marketed. Most of the variation between one calcined clay and another can be explained by differences between the original clay minerals.

Very few results from well planned and conducted research on soil amendments exist in the literature. Much of what is reported consist of little more than individual observations from trial and error applications of some of these materials. Much needs to be done in developing low cost soil conditioning material which will remain effective indefinitely or for long periods of time under excessive traffic or compactive conditions.

POA ANNUA

Ralph L. Snodsmith

In today's turfgrass industry, there is an increasing interest in new grasses. It is possible that many grasses have been overlooked. One of these grasses may be Poa annua. As to date, Poa annua is considered to be a weed in golf greens, fairways and lawns.

Grasses such as Kentucky bluegrass (Poa pratensis), Creeping red fescue (Fectuca rubra) and Creeping bentgrass (Agrostis palustris) have had considerable research done on nutrient requirements, pH optimums, and light requirements for growth. Research of this type has not been done for Poa annua.

Geographical ranges:

For Poa annua, the geographical locations are from Newfoundland and Labrador to Alaska, south to Florida and California and in tropical America at high altitudes. In warmer parts of the United States Poa annua thrives in the winter. In the intermediate latitudes it has been described as a troublesome weed. Poa annua is also found in the humid regions of Egypt.

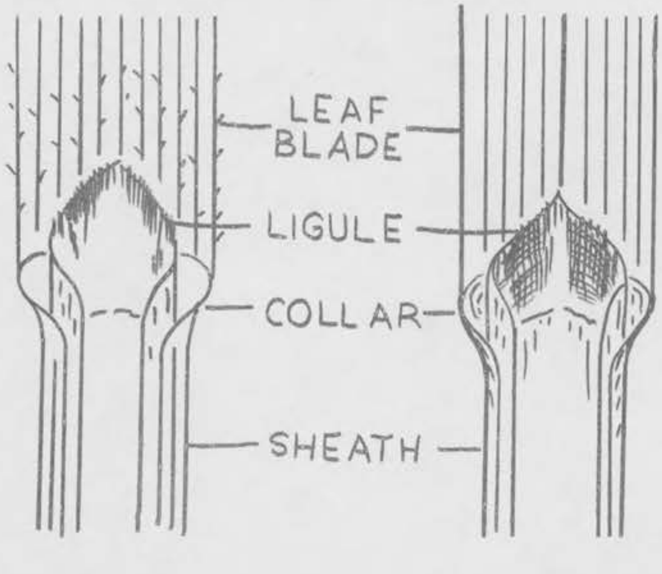
Classification:

Family - Gramineae
  Tribe - Festuceae
    Genus - Poa
      Species - annua
Common name - Annual bluegrass

Identification:

Poa annua L., is considered an annual. This characteristic could change depending upon the regional location. It has an erect culm or stem and is decumbent at the base. The sheath is loose, smooth, and usually longer than the internodes. The leaf blade varies from 1 to 3 mm. wide. The blades are flat with a keeled tip. Generally, the color is somewhat lighter green than Kentucky bluegrass. The ligule is acute as shown in the figure below.

FIGURE I



Creeping Bentgrass
Agrostis palustris

Annual Bluegrass
Poa annua

[illegible]

Poa annua		Agrostis palustris
	Leaf blade tip	
1. Boat shaped		1. Not boat shaped (straight)
	Ligule	
1. Acute at the apex		1. Rounded at the apex
2. Smooth		2. Rough
	Veins in the leaf blade	
1. Concealed		1. Pronounced
	Leaf	
1. Folded in the sheath		1. Rolled in the sheath

The major diseases which attack *Poa annua* are the same that attack other grasses. They are *Helminthosporium* leaf, crown and root diseases; *Fusarium* snow mold; *Rhizoctonia* brown patch and *Sclerotinia* dollar spot.

Helminthosporium leaf, crown and root diseases are considered to be one of the major limiting factors in turfgrass production. Its common names range from melting-out on Kentucky bluegrass to red leaf spot on bentgrass. For a cultural control, the application of readily-available nitrogen fertilizers will help alleviate a serious *Helminthosporium* problem. The use of resistant varieties of grass is also encouraged.

Fusarium snow mold is considered to be a serious problem in areas which have cool, humid seasons. With the possibility of snow over the entire State of Illinois, this disease can become quite serious. A cultural control would be the use of straw on the green, snow fencing where drift is serious and the removal of thatch in the fall of the year.

Rhizoctonia brown patch is one of the major fungus foliar diseases of turfgrass in this area. It can be expected where extended periods of high temperature and high humidity occur. The removal of water accumulation on the leaf surface from heavy dew, fog or guttation will reduce the severe problem and act as a cultural control. This may be done by poling, brushing or dragging a hose over the surface of the grass.

Sclerotinia dollar spot is generally recognized as a major disease of putting greens. It may also be a serious problem in lawns. For a cultural control, the use of high nitrogen fertilizers and good irrigation will alleviate a serious problem but only in the presence of a good fungicide program.

DISEASE

	Helminthosporium spp. leaf, crown and root	Dollar spot *Sclerotinia*	Brown Patch *Rhozoctionia*	Snow mold *Fusarium*
	Chemical control	Chemical control	Chemical control	Chemical control
Poa annua L. Annual bluegrass	Acti-dione Captan PMAS Zineb	Acti-dione Cadminate Calo Cure Kromad PMAS Mercury containing fungicides	Mercury containing fungicides Tersan Acti-dione Thiram	Mercury containing fungicides

What possible uses does Poa annua have in our turfgrass industry? In Illinois, Poa annua is considered a problem in golf greens. In southern Illinois, one course in particular has as high as 95% Poa annua in each green. Many other courses have as high as 50% Poa annua. Under the high maintenance program for greens, Poa annua is capable of being mowed at 1/4" and withstanding considerable traffic. At this height it is able to produce seed for rejuvenation.

One of the major problems that a golf course superintendent has is keeping the greens moist enough to hold a shot. With this requirement for moisture comes Poa annua. Poa annua is quite well adapted to moist areas.

In northern Illinois, several golf courses are developing bentgrass fairways. Again, with the requirement for considerable moisture comes Poa annua. On many courses Poa annua has become a dominant grass and with proper care has proven very satisfactory.

Could it be that we are overlooking an important grass?

TO INTRODUCE A TURFGRASS

T. Gaskin

Today there is a wider interest in fine turf and increasing demands for better performance from turfgrass varieties. This has led to the selection and development of improved turfgrass varieties to fill the need for better turf. Such varieties as Merion Kentucky bluegrass, Meyer zoysia, Pennlawn fescue, the various "Tif" Bermudagrasses as well as others are examples of the new improved turfgrasses.

Demands for better turf indicate that in the future there will be increasing numbers of new varieties put on the market. In order to introduce any new variety of turfgrass in the most effective way, four major points must be considered.

1. INSURE ADEQUATE EVALUATION

Every potential new variety should be tested in various locations in one area and in various regions with proper check or standard varieties for comparison. This will indicate the strong and weak points of the new variety. A variety should not be released "unless it is distinctly superior to existing commercial varieties in some one or more characteristics important for the crop, and is at least satisfactory in other major requirements." (A Statement of Responsibilities and Policies Relating to Seeds, USDA and Experiment Station Committee on Organization and Policy. 1954). If the new variety is resistant to a disease or insect which is very destructive to turf, it may be worthy of introduction even if it should have some poorer characteristics than the standard variety. A variety which is good in only one place should not be introduced unless it is very superior or has qualities and uses that cannot be obtained elsewhere. Adequate testing is vital before a variety should be introduced.

2. HAVE ADEQUATE SUPPLIES AVAILABLE TO MEET INITIAL DEMAND

An adequate supply of seed or vegetative planting material must be available when the variety is released. If supplies are limited, the public will lose interest in the variety by the time enough is available. This will lead to fewer plantings of the new variety which in turn will result in fewer people seeing the variety and thus slower acceptance of the variety.

To develop adequate supplies of seed or other propagative materials, contracts are usually made between the breeder or developer and a seed company or other organization such as the Indiana Crop Improvement Association for the initial increase of the variety. Varieties developed by private breeders are increased within their own organization.

3. PROVIDE PUBLICITY AND KNOWLEDGE OF THE VARIETY.

No matter how good a variety is unless the public knows about it, it will be valueless. It is important that information on the uses and the good and poor points of the new variety is given wide publicity so that the variety will be used where it is adapted and not put in a place or under conditions where it was not intended. The quickest way for a variety to lose public interest is for it to perform poorly. If a new variety is put in a place where it is not intended or is not maintained properly it will not perform as expected. Thus information is important in the introduction of a new variety.

Naming a variety is part of the publicity. Variety names should be easily pronounced and preferably one word. The name should never be changed and a variety should never be released under two names.

4. PROCEDURE FOR MAINTAINING THE IDENTITY OF THE NEW VARIETY

If a new variety is worthy of introduction, steps must be taken so that the desirable characteristics of the variety are not lost through mixing with other varieties, mutations in the variety itself, or in other ways. One of the ways this is accomplished is through the process of certification. Varieties developed by either a public institution or by private breeders can be certified if they meet the certification standards. The procedure of certification attempts to keep a variety as free from offtypes and as genetically pure as possible. This is made possible by the production of seeds or vegetative material under certain standards. In the certification system there are four classes of seed or vegetative propagations:

A. Breeder Seed

This is the original stock of the variety or seed from original vegetative planting. This seed is controlled by the breeder or by a sponsoring institution. For example, Pennsylvania State University maintains breeder seed of Pennlawn fescue, Penncross creeping bent (the vegetative strains that are the seed parents), and Merion Kentucky bluegrass.

B. Foundation Seed

Seed or vegetative stock produced under strict conditions to maintain genetic purity and are the source of the next two classes of seed directly or through an intermediate class.

C. Registered Seed

Progeny of foundation or registered seed grown under approved procedures of the certifying agency.

D. Certified Seed

This is the seed commonly met with on the market and is produced from foundation, registered, or other certified seed.

The standards for the production and purity are higher in foundation seed than registered seed and higher in registered than certified seed. Restrictions are placed on the number of generations that can be grown from certified seed before going back to registered seed. At times some of the classes are omitted if enough seed can be produced in one or two generations from breeders seed.

PRECEDURE FOR INTRODUCING A VARIETY

(USDA)

The outline presented below is the procedure used by the United States Department of Agriculture (by themselves or jointly with one or more states) in introducing a variety.

Step 1

Breeder develops or selects the new variety

Step 2

Breeder or 1-2 seedsmen grow initial increase of variety; all the seed is returned to breeder or organization which will release the variety.

Step 3

Seed is supplied to cooperators who agree to test the variety only and not increase or sell the seed. Variety is tested in various areas.

Step 4

If variety performs well in the tests, breeder seed is then released to all primary seed producers and State foundation seed producers under standard agreements.

Step 5

Seed released to seed producers for increase only. There is no advertising or selling of the variety yet.

Step 6

At the end of each growing season the seed growers report the amount of seed grown.

Step 7

As soon as the supply of seed is sufficient to meet initial demand the variety is named, publicized, and information published about it. Also seedsmen can advertise and sell it.

BLUEGRASS GROWTH RESPONSE TO VARIOUS FORMULATIONS, PLACEMENT AND RATES OF PLANT FOOD

R. Alden Miller

Introduction

Today many choices are available for selecting turf plant food. There is an organic organic or synthetically made inorganic type which has a slow release and provides plants with a longer supply of nutrients. Other approaches to a controlled release of plant food is the use of plastics to coat granular fertilizer and the use of bactericides to reduce decomposition or breakdown of the unavailable form of nitrogen to the available. Obtainable today is the completely available plant food labelled water soluble applied as a liquid. Granular formulations of inorganic chemical fertilizers also are readily available to the plant. Combinations of the above two types can be utilized to cover the use advantages and disadvantages of each.

Perhaps the use rates of plant food advocated today have as wide a range as the types of plant food that can be purchased. Amounts of actual plant food required to satisfy turf requirements will depend upon native soil fertility which can be determined by a soil test, soil structure, percent organic matter, base exchange and water holding capacity of the soil just to mention a few pertinent items. We have a general suggestion for total pounds of nitrogen to feed certain species of turfgrass which usually ranges from three to six pounds per 1000 sq. ft. per year. Quite often the figure of two pounds of actual nitrogen, phosphorus and potassium per 1000 sq. ft. is suggested for establishing new turf. Are these rates adequate? How can the turfman determine the adequateness of the rates?

The visual reaction of the turf specie in question perhaps is the most reliable method of evaluating the turf diet. The quantity of ration can also be determined by the turf response.

Specie Studied

The following test was conducted on the Merion and Newport selections of Kentucky Bluegrass (Poa pratensis). Kentucky Merion Bluegrass was selected because of its prevalent use and high feeding requirement in relation to other bluegrasses. Kentucky Newport was included in this test because few fertilizer experiments have been conducted upon this particular selection.

Formulations

Three formulations of fertilizer were utilized in this experiment. The plastic coated material, supplied by Archer Daniels Midland Company, was selected as the slow release material since this was a new concept in fertilizer formulation. The general theory of plant food release from the plastic coated "container" is that water moves in through the pores dissolving the plant food which then moves to a region of lower concentration which would be outside the plastic capsule. Varying the pores or thickness of the coating would regulate the swiftness of plant food release. The granular and liquid fertilizer used in this test are classed as rapid release inorganic types. The granular product might be called the standard formulation for this work. Liquid feeding is not a new concept, but certainly not one in wide use for turf. The liquid formulation normally would be available to the plant more readily than would the dry granular form. The application method is different by the fact of having a dry and liquid product. The liquid form should be distributed very evenly on the soil because of many small particles being sprayed on the surface. The granular material would fall as small aggregates.

In addition to the varying formulations, another variable, namely placement, was considered where only the dry granular formulation was plowed down as well as being made as a surface application.

Rates

All the formulations had a 1-1-1 ration but did differ in percent of available plant food. The plastic coated material analyzed a 9-9-9, the granular a 12-12-12 and the liquid an 8-8-8. Adjustments were made to supply 2, 4 and 8 pounds of nitrogen, phosphorus and potassium per 1000 sq. ft. as this test required. The two pound rate of plant food per 1000 sq. ft. represented a standard treatment for a new seeding but was a marginally low treatment for the following year that data were to be taken without additional fertilizer being applied. The four pound rate was double the standard seeding rate, but only a marginal adequate yearly rate. The eight pound rate was four times the standard rate for seed establishment and also considered a luxurient yearly feeding rate.

Test Area

The area available for this test was a rough lawn to which no plant food had been applied for several years. The only exception to this was the area where the granular fertilizer was plowed down. This had been a cultivated plot for about ten years. This accounts for the low percent weed cover data shown in Chart VI. The entire area had been limed in 1960 and the pH was 6.2.

Plot Design

The total area was divided into four 36 by 98 sq. ft. plots with a six foot alley to divide the treatments and serve as checks. Each of the four areas received a different formulation or in the case of the granular form a different placement. The four plots were divided in half, 36 by 48 sq. ft. for seeding of the two bluegrass selections. The eight plots were subdivided into three equal parts, 12 by 48 sq. ft., to accommodate the different rates of each formulation.

Procedure

The plot was plowed in August and worked thoroughly several times to promote death of all existing plant material. The sod chunks were removed with a side-delivery rake. The plow down treatment received fertilizer ahead of plowing. The three formulations of fertilizer were applied to the surface and a meeker was used to incorporate the fertilizer in approximately the upper two inches.

The seed was sown September 7th, 1962, with a Lawn Beauty spreader at a rate of 1/2 pound per 1000 sq. ft. This rate represents about eight Merion and six Newport seeds per sq. in. This relatively low seeding rate was selected to better facilitate stand counting. The seedbed was rolled to affect a covering of the seed. Frequent sprinkling was employed to keep the soil surface moist. This required sprinkling twice on windy days. Three to four tenths of an inch of water was applied per day.

Methods of Evaluation and Results

Stand Counts

Seedling stand counts were taken October 19, 1962. Samples were taken by dropping a wire rectangle at random and counting the plants within the frame. Six 1/4 sq. ft. areas were sampled and the total reported in Chart I represents 1 and 1/2 sq. ft. of area. It appears after 42 days of growing conditions that no correlation exists between rates of fertilizers and stand counts. Differences can be seen between formulations and placement, but these differences are not constant between the two selections of bluegrass.

Plant Number and Weight

The number and weight of Kentucky Merion Bluegrass plants were taken on November 2, 1962. Three 12.57 sq. in. areas were selected at random. There is a correlation between number and weight of the samples obtained. With the exception of the plowed down granular treatment, counts and weights consistently began to fall at the 8 pound formulation rates. This reveals that less than 8 pounds of plant food should be applied as a pre-seeding treatment to gain the maximum number of seedlings. The breaking point for maximum number is somewhere between 4 and 8 pounds, probably nearer 8, per 1000 sq. ft. However, Chart II A indicates that plant size was not substantially reduced at the higher rates. The plastic coated and granular surface treatment had slightly larger plants at the highest feeding rate. The plow down treatment could not have affected seed germination or early plant weights. Very little difference can be seen in the liquid treatment. Data for the Newport selection could not be located at this writing.

Percent Ground Cover

On April 19, 1963, the percent of ground cover was taken. Twenty samples were selected for each treatment using a modified point-transect method.[1] The Newport selection gave slightly more ground cover. The differences between formulation or placement was slight also. At this time, the formulation application rates show a difference in percent of ground cover. Larger differences are seen between the 2 and 4 pound rates than the 4 and 8 pound rates. With the exception of the Merion granular surface and plowed down treatments, some increase can be seen between the 4 and 8 pound rates. The adverse affect on seeding number and weight that was seen in Chart II at the 8 pound rate is no longer in evidence. Reduction at that point was temporary.

Clipping Weights

Clipping weights were taken in May and July for comparison of late spring and summer leaf production. The entire plot was mowed and the clippings were weighed green in the field. Charts IV and V indicate more production of leaf tissue on the part of Newport for the May record but less than the Merion Bluegrass for the July mowings. The liquid formulation fertilizer consistently yielded more clippings each month than did the other formulations.

Weed Cover

Percent weed cover was obtained on July 5, 1963, in an effort to determine affects of formulation, placement and rate upon the two selections of bluegrass studied. The data are described in Chart VI. Twenty samples using the modified point-transect method was tabulated. The Merion turf had fewer weeds than did the Newport. The plowed down granular fertilizer plot had fewer weeds than did the other formulations; however, as previously mentioned this portion of the test area had been cultivated previously and this explains the particularly low weed counts obtained here. The other treatments, excluding rates, vary in their order of percent weed control. The lower application rates on Merion enabled more weeds to grow except on the plowed down treatment. The

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1. Clarke, S. E., J. A. Campbell and J. B. Campbell. 1942. An ecological and grazing capacity study of the native grass pastures in southern Alberta, Saskatchewan and Manitoba. Dom. Can. Dept. Agr. Tech. Bul. 54. 31pp.

Newport selection shows interesting results of having more weeds at the higher treatment rates. Perhaps the Newport does not make a tight mat of turf and the higher fertility rates enabled the weeds to compete more successfully.

Desirable Turf One Year After Seeding

The final evaluation of growth response was made by surveying the plot for percent content of desirable bluegrass plant cover. Again the modified point-transect method was employed. Twenty samples were selected at random from each treatment. Chart VII reveals that Kentucky Merion produced about 10% better turf than did the Kentucky Newport selection. The granular plow down treatment in both selections of bluegrass gave slightly better cover. Again, lack of weed competition because of location may have given this treatment an advantage. The other formulation treatments had a random rank between the two bluegrasses. Essentially the same pattern concerning rates of treatments exists where the 8 pound rate produced a better turf at the end of the one year growing period.

Summary

Different formulations, placement and rates of plant food were studies as they affect the seedling and establishing turf of Kentucky Merion and Newport Bluegrass. Stand Counts of young seedlings does not indicate any set pattern affected by the variables applied in this test. With the exception of the plow down treatment, stand counts and weights of Merion turf seedlings dropped as the rate of plant food was increased to the 8 pounds per 1000 sq. ft. level. However, average weight per plant was not decreased. Percent turf cover eight months following a fall seeding indicates much better turf development between the 2 and 4 pound per 1000 sq. ft. level than the 4 to 8 pound rate. The reduction of young stand count and weight of the 8 pound rate over the 4 pound rate had disappeared by the following spring. Clipping weights in May indicated Newport to be more vigorous in leaf production, but the Merion selection produced more clippings during the July harvest. The liquid formulation produced more clippings in May and July. A July weed control rating was in favor of the Merion turf. Higher rates of fertilizer on Merion increased the weed control but decreased the Newport weed control. After one year of growth, the Merion selection of Kentucky Bluegrass had about 10 percent better turf than did the Newport selection. The granular plow down treatment gave slightly better turf under both seedings. The eight pound rates yielded better turf at the end of one year.

CHART I

YOUNG STAND COUNTS

Total of ~~6~~ 5 1/4 sq. ft. Samples

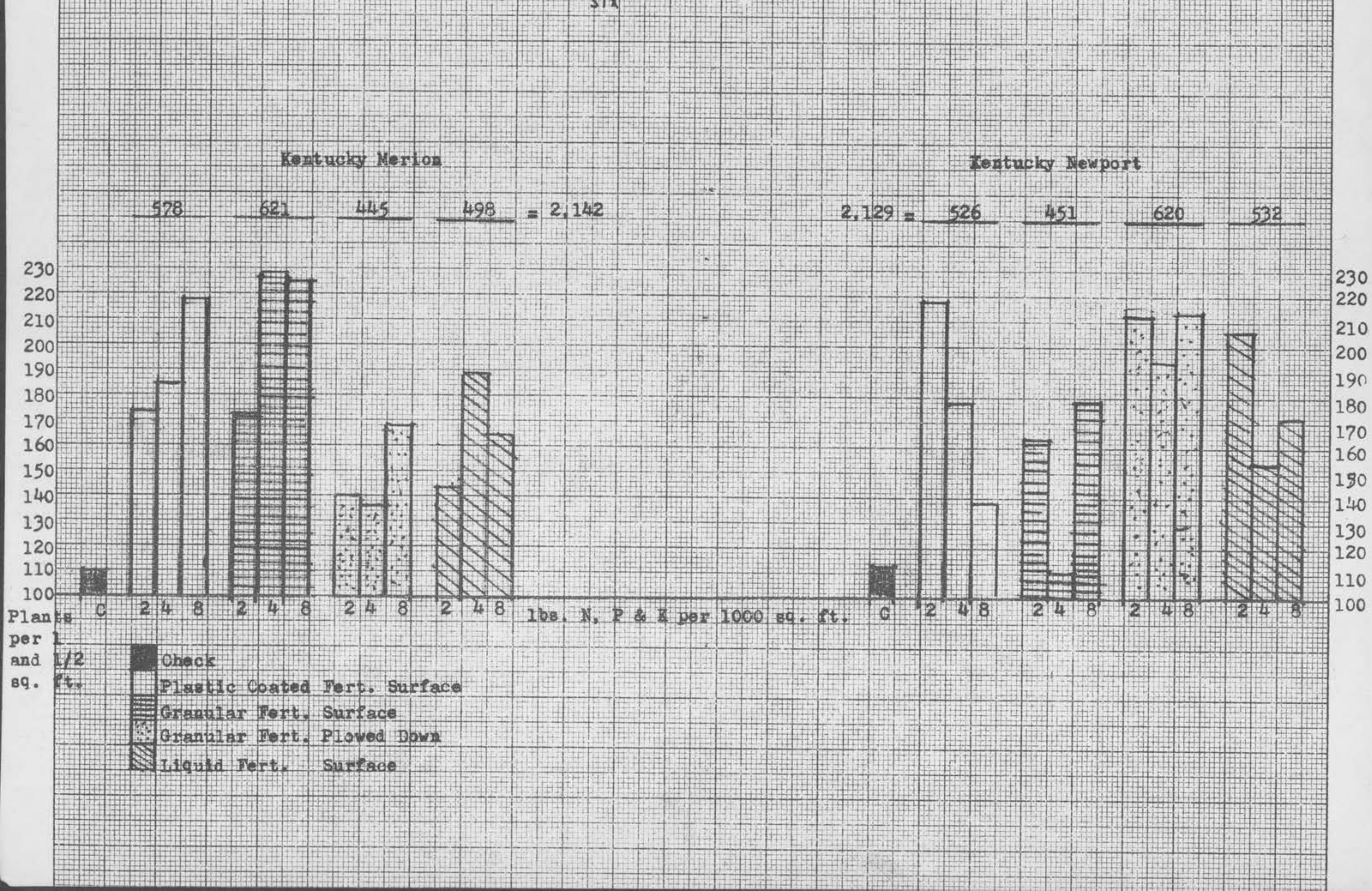


CHART II

NUMBER AND WEIGHT OF KENTUCKY MERION BLUEGRASS PLANTS

Average of Three 12.57 sq. in. areas

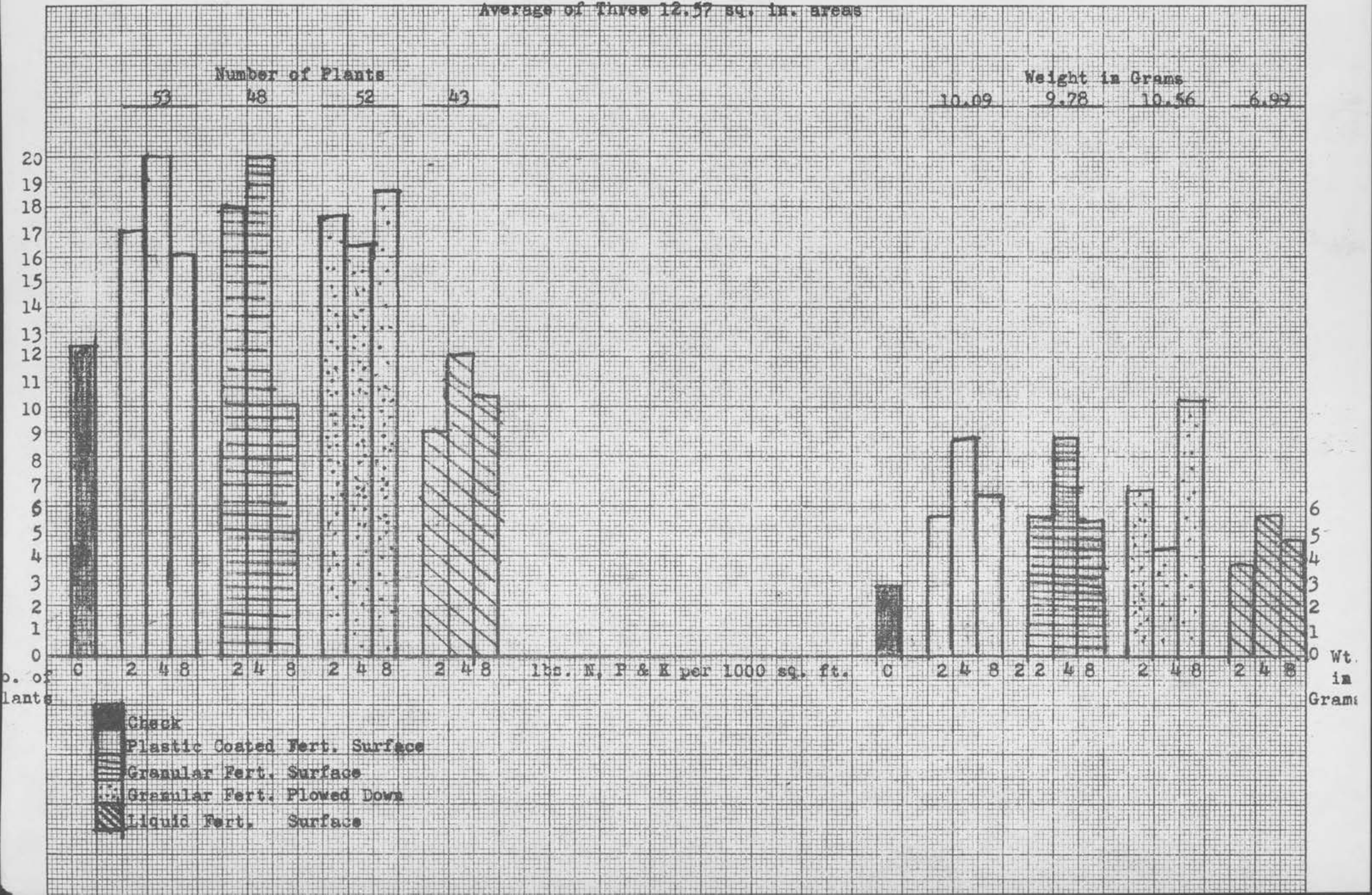


CHART II A

AVERAGE WEIGHT PER PLANT

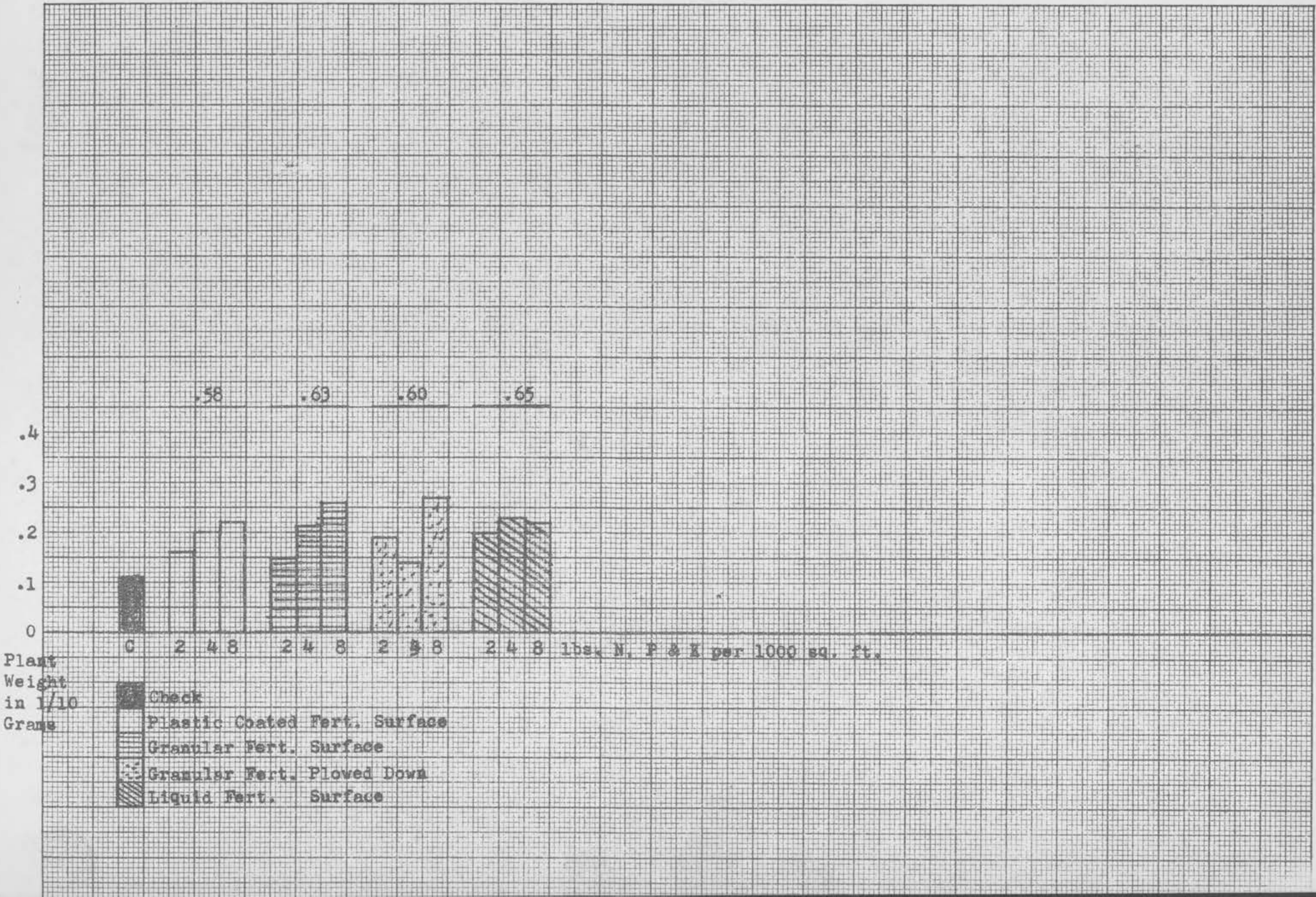


CHART III

PERCENT GROUND COVER APRIL 19, 1963

Average of Twenty Samples

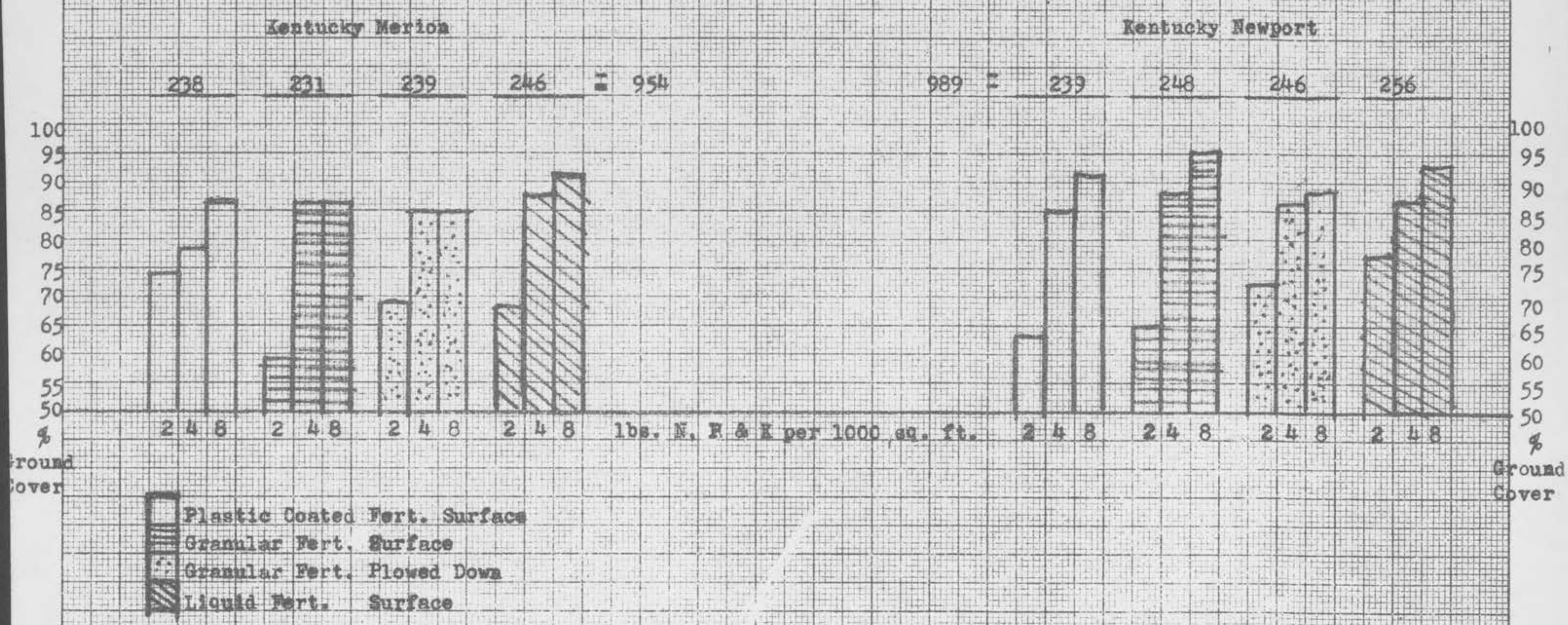
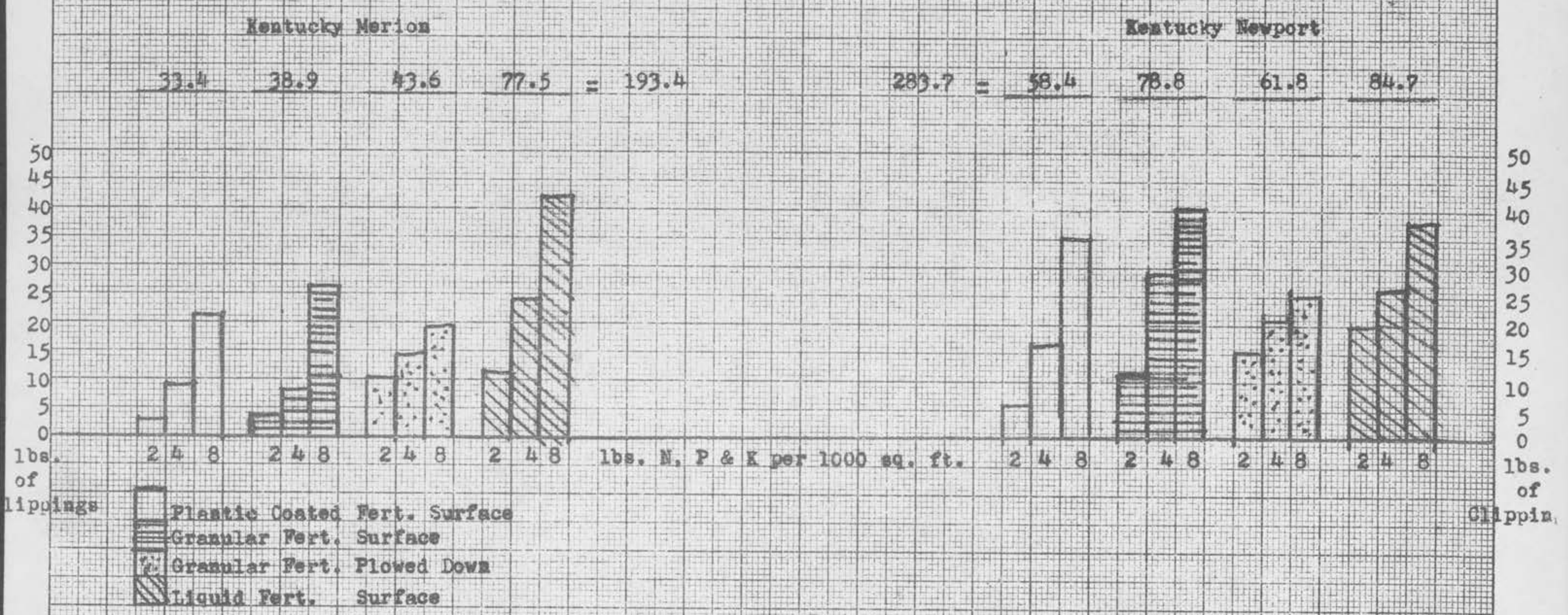


CHART IV

CLIPPING WEIGHTS

Average of Three May Mowings
lbs. of Clippings for 576 sq. ft.



10 Millimeters to the Centimeter
MADE IN U.S.A.

12-188
5788

CHART V
CLIPPING WEIGHTS
Average of Three July Mowings
lbs. of Clippings for 576 sq. ft.

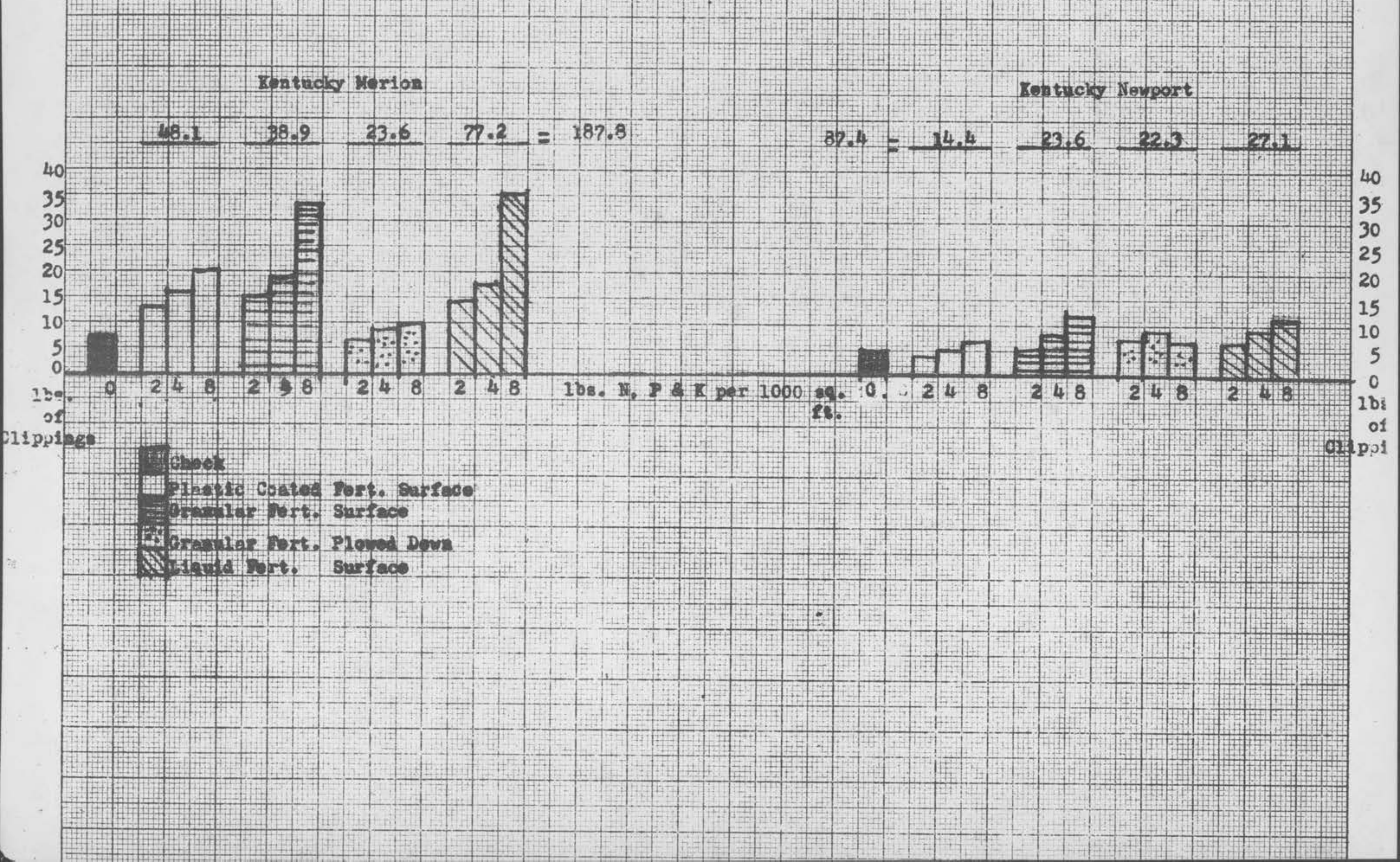


CHART VI

PERCENT WEED COVER JULY 5, 1963

Average of Twenty Readings

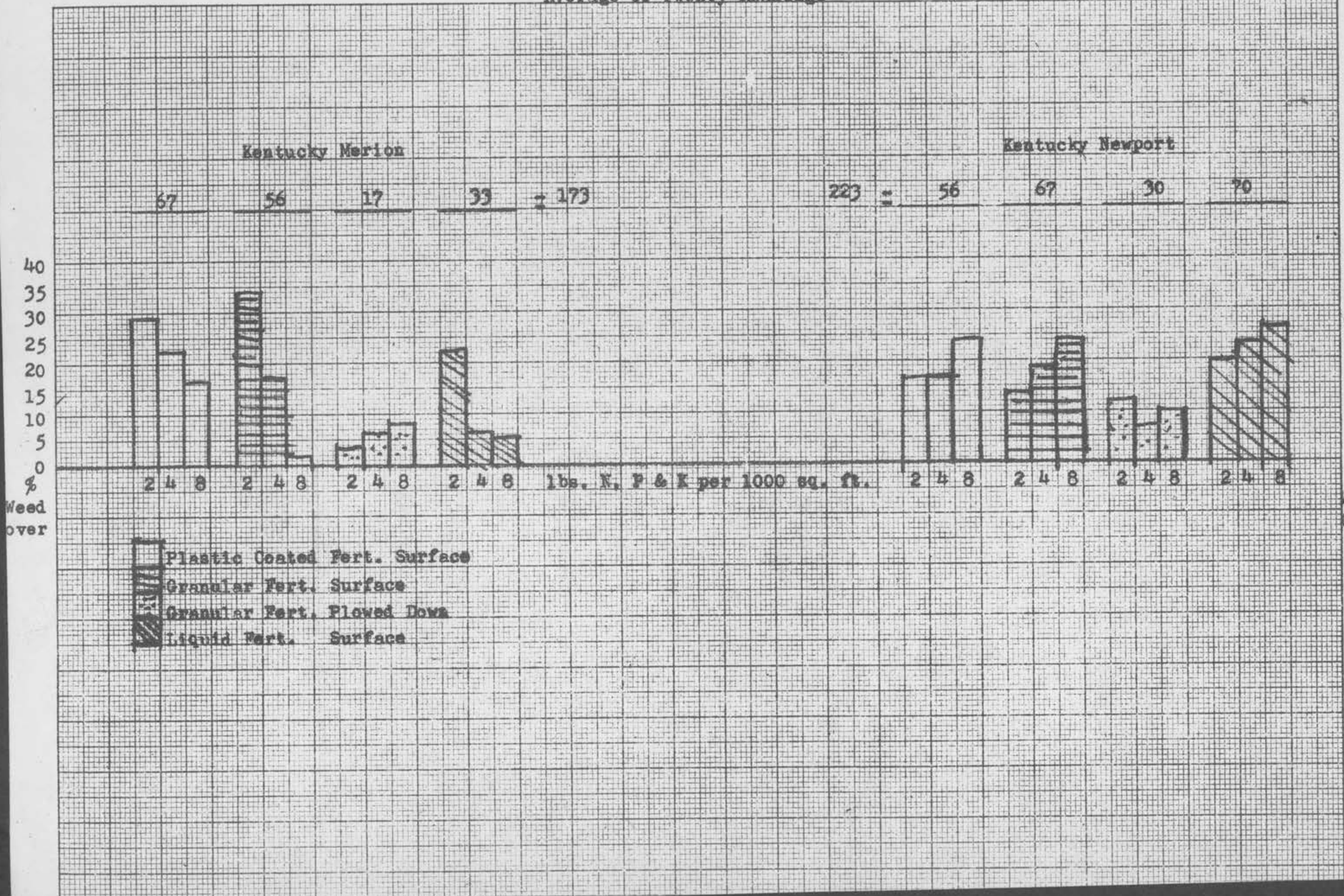
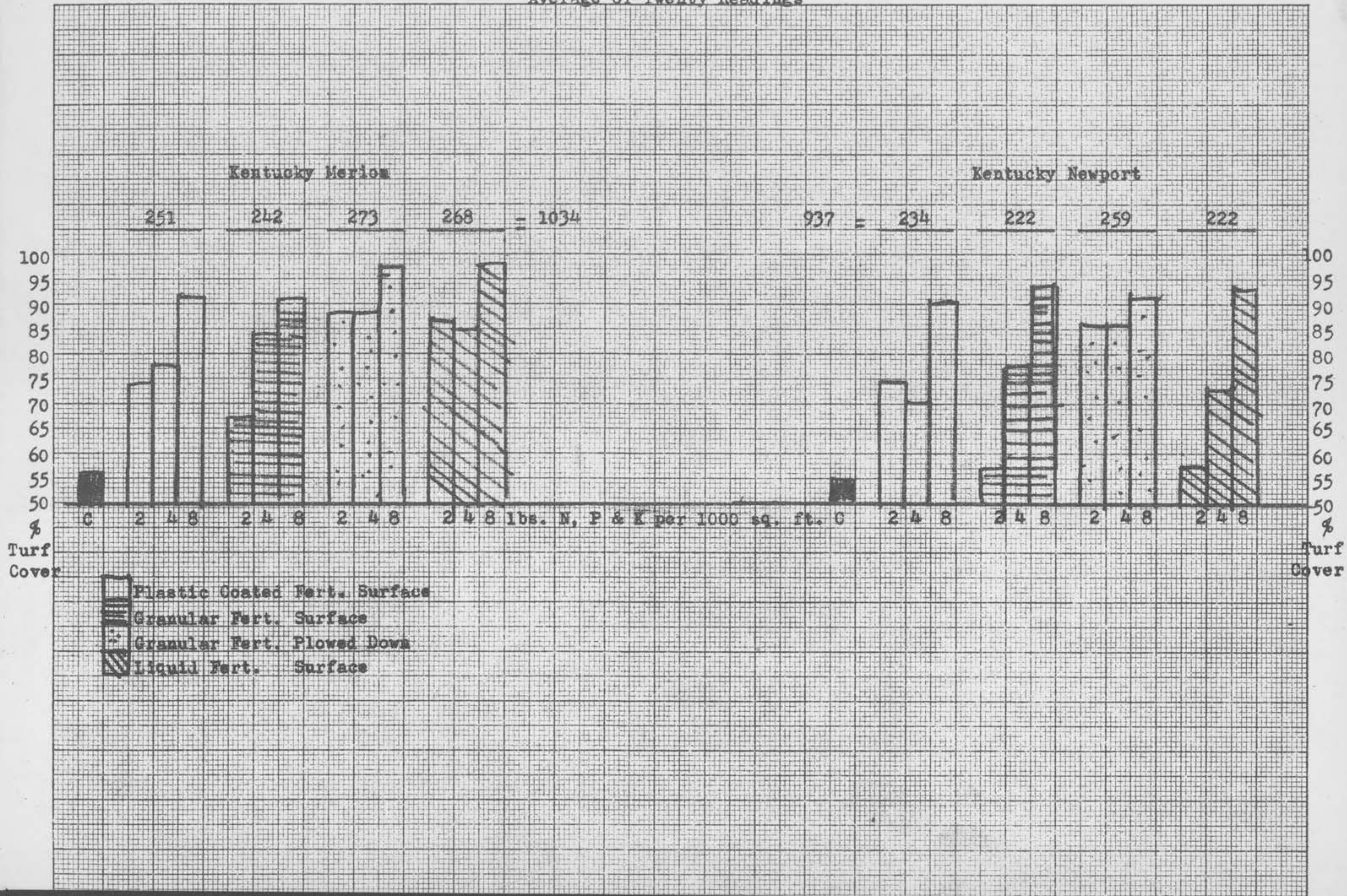


CHART VII

PERCENT DESIRABLE TURF COVER ONE YEAR AFTER SEEDING

Average of Twenty Readings



SOME CHARACTERISTICS OF THE MORE COMMONLY GROWN CREEPING BENTGRASSES

Jack Butler

Creeping bents, colonial bents, velvet bents, and Bermudagrass are commonly used as permanent greens grasses. In Illinois the creeping bents are the predominant grasses used for greens. Only rarely, if at all, are the other permanent greens grasses used.

The creeping bents considered in the following study are the more widely used vegetatively propagated varieties, Toronto (C-15), Washington (C-50), Cohansey (C-7), Congressional (C-19), Arlington (C-1), Old Orchard (C-52), Pennlu (10(37)4), Nimisila, and two rather recent selections, Evansville and Iagreen 4-45. Also included are Seaside and Penncross, which are propagated from seed.

There have been great numbers of creeping bents selected and tested by golf course superintendents and others in the turf industry. Each selection or variety has certain characteristics and attributes which make it either poorly or well adapted to a given habitat, or influence the playability, etc. The varieties having wide distribution are rather limited. These have had a rather thorough testing, and, in general, have done well. In most instances one or two varieties are favored in an area over all others.

A very difficult problem exists in getting new varieties sufficiently tested on golf courses and at experiment stations. Another existing problem is that of keeping a bent variety pure. Constant care must be taken to insure that a variety does not get mixed or contaminated.

In order to characterize a variety, disease tolerance, color, growth rate, texture, weed resistance, etc. must be determined. Complete knowledge of any variety would be practically impossible to obtain. It is important that as much information be gathered as possible. A few features of the 12 varieties studied are listed in Table 1. They offer criteria for comparing the grasses and a basis for discussion of such practical things as what grasses to use in a mixture. These features may differ under different conditions.

The samples for Table 1 were taken from the well established grass on the experimental greens of the University of Illinois Turfgrass Research Area. The grass is maintained at 3/16 inches. Just prior to the sampling on October 25 and 26, the grass was clipped. The grass was irrigated as needed, and a disease control program and a heavy fertilization program were followed. The grass was verti-cut in April and topdressed then and again in June.

The 12 grasses sampled for Table 1 are included in a completely randomized area which has three individual plots for each grass. From each plot a sample 1 & 7/8 inches in diameter was taken. The number of live leaves and stems were determined for the sample. From the total, the amounts were reduced accordingly to give the count per square inch. It was not possible to determine leaf length since most of the leaf tips are destroyed early by mowing. The number of leaves per stem was obtained by dividing the number of leaves by the number of stems. In order to determine the leaf width, 10 leaves from each sample were measured with a micrometer ocular on a microscope. The width of the leaf was determined 2 to 3 mm. from the collar. The colors in Table 1 were determined on the plots by using the Nickerson Color Fan, and the color numbers are Munsell notations.

Table 1 gives the averages from the three samples of each grass. There is a substantial difference in the number of leaves and stems among the grasses. Pennlu had fewer than any of the others; Evansville greatly exceeded all others in both leaves and stems. There was some difference among the grasses in the number of leaves per stem. Congressional had the fewest and Penncross the greatest number. Leaf width was quite variable. Seaside, Penncross, and Evansville were the narrowest. Washington had a rather wide leaf, as did several of the other more commonly-grown stolonized bents. Color was variable. Cohansey, Evansville, and Iagreen 4-45 have rather distinctive colors.

TABLE 1. A SUMMARY OF FIVE DIFFERENT CHARACTERISTICS EXHIBITED BY TWELVE VARIETIES OF CREEPING BENTGRASS

Variety	*No. of Leaves Per Sq. In.	*No. of Stems Per Sq. In.	*No. of Leaves Per Stem	*Leaf Width In mm.	Color
1. Arlington C-1	348.4	100.5	3.47	1.28	(7.5 GY 4/4) Moderate olive green
2. Cohansey C-7	436.0	136.0	3.20	1.17	(5 GY 6/8) Strong yellow green
3. Congressional C-19	307.2	104.7	2.93	1.23	(2.5 G 4/6) Dark yellowish green
4. Evansville	748.3	210.0	3.56	.96	(7.5 G 3/6) Dark Green
5. Iagreen 4-45	451.8	131.2	3.45	1.15	(7.5 BG 4/7) Moderate bluish green
6. Nimisila	399.0	117.9	3.38	1.11	(7.5 GY 4/4) Moderate olive green
7. Old Orchard C-52	400.0	113.9	3.51	1.24	(2.5 G 4/6) Dark yellowish green
8. Penncross	414.1	112.3	3.69	.96	(7.5 G 5/8) Strong green
9. Pennlu 10(37)4	235.6	65.9	3.57	1.29	(5 BG 5/8) Strong bluish green
10. Seaside	267.4	82.7	3.23	.97	(5 G 4/7) Strong green
11. Toronto C-15	330.1	98.7	3.34	1.31	(2.5 G 4/6) Dark yellowish green
12. Washington C-50	298.3	83.7	3.56	1.38	(7.5 G 3/6) Dark green

* Average of samples from three plots for each grass

RESEARCH ON FUNGICIDES FOR TURF DISEASE CONTROL

Michael J. Healy

Fungicide control of Melting-out disease on Seaside creeping bentgrass conducted at the turf plots located at Savoy, Illinois.

Fourteen chemicals were tested for their ability to prevent Melting-out disease (caused by Helminthosporium spp.) on Seaside creeping bentgrass cut 1/4 inch. Each chemical was applied at the manufacturer's prescribed rate to 3' X 8' plots replicated three times. A constant pressure portable spray system was employed in applying the chemicals to insure constant and accurate application rate. The chemicals were applied at 7 day intervals starting July 11 and ending September 12 - a total of ten applications being made.

In the ten week test period there were two dates at which ratings were taken. The first rating date was July 25. At this time there was a moderately severe infection of Melting-out which showed in the check plots. Also at this time chemical damage was apparent in some of the plots. The second rating was made August 24, after a slight infection of Melting-out occurred in the check plots. Again some chemical injury was noted at this time. This second rating was taken after 7 applications of fungicide had been made.

The only other disease occurring on these plots during this period was Brown Patch (Rhizoctonia solani). The total percentage area of Brown Patch showing up under each different treatment for this ten week period is shown along with the Melting-out data on Table one.

Table 1. Chemical control results of Melting-out disease, July 25 and August 24, at Savoy, Illinois.

Chemical	Rate	Est. % injury of reps--July 25	Aug. 12	Total amt. of Brown Patch [1]
Stauffer M37	2 oz/1000 sq'/5gal H_2O	60-70% Phytotoxic; discontinued	———	———
Chemagro 2635	2 oz/1000 sq'/5gal H_2O	60-70% Phytotoxic; discontinued	———	———
Shell SD 345	1cc/sq. yard /1 gal H_2O	50-60% Phytotoxic; discontinued	———	———
Dexon 70%	3 oz/1000 sq'/5gal H_2O	40-50% Phytotoxic; discontinued	———	———
Chipco Mercury Turf Fungicide	2 oz/1000 sq'/5gal H_2O	30-40%	20-30%	0.0%
Dithane M22	4 oz/1000 sq'/5gal H_2O	30-40%	20-30%	0.0%
Memmi	2 oz/1000 sq'/5gal H_2O	30-40%	40-50%	0.5%
Ortho Lawn & Turf	4 oz/1000 sq'/5gal H_2O	30-40%	20-30%	0.0%
Du Pont 4575-81	1/2 oz/1000 sq'/5gal H_2O	30-40%	20-30%	2.4%
Check	———	20-30%	10-20%	2.0%
DAC 1200	6 oz/1000 sq'/5gal H_2O	20-30%	10-20%	1.1%
TCNA	1cc/sq. yard/1gal H_2O	20-30%	20-30%	1.7%
Dithane M45	4 oz/1000 sq'/5gal H_2O	10-20%	20-30%	0.0%
Difolatan 80W	4 oz/1000 sq'/5gal H_2O	10-20%	0-10%	0.0%
Dyrene	8 oz/1000 sq'/5gal H_2O	0-10%	0-10%	0.0%

[1] Expressed as % of the total area of the 3 reps diseased during the ten week period.

Observations from Table 1.

1. Dryene again has shown its excellent ability to control Melting-out disease on Creeping bentgrass.

2. Along with Dyrene, Dithane M45 and Difolatan 80W proved to be quite effective against Melting-out.

3. Dyrene, Dithane M45, Difolatan 80W, and Ortho Lawn and Turf fungicide completely controlled Brown Patch during the ten week period.

While not shown in Table 1, Ortho Lawn and Turf fungicide caused a peculiar thinning out injury to the plots it was applied to early in August. This same injury was noted in other test areas at Savoy where Ortho Lawn and Turf was being used at the same rate.

It was found, earlier in the year, that Manzate, although a good preventative Melting-out fungicide, could cause severe burning if the proper dilution was not made. Application of Manzate at 4 oz/1000 sq.ft./2 1/2 gal water instead of the recommended 4 oz/1000 sq.ft./5gal water caused severe burning on Seaside bent and to a lesser extent on Washington bent.

WEED CONTROL IN TURF

F. W. Slife and J. D. Butler

Three relatively new chemicals will be available in 1964 for Weed Control in turf areas. They are especially promising on golf courses. These chemicals are Banvel D, Betasan, and MCPP.

Banvel D is a benzoic acid which shows reasonably good tolerance to bluegrass turf and yet controls several weed species tolerant to 2,4-D. In some respects Banvel D is similar to silvex since it effects the same weeds that silvex does. Banvel D is outstanding for the control of knotweed and exceptionally good for white clover control in bluegrass turf. Banvel D, appears to be superior to silvex on both of these problems. For chickweed control the two compounds appear to be similar.

The best rate to use Banvel D is yet to be determined. It will reduce the stand of both clover and knotweed at 1/4 lb. per acre but performs best at 1 lb. per acre. Further work may indicate that 1/2 to 3/4 lb. is the best range with retreatment to clean up stragglers. Until the fate of Banvel D, in the soil is more clearly understood, we do not believe retreatment with the 1 lb. rate should be made during the same year.

Banvel D applications should not be applied in the root zones of trees and shrubs.

Applications of 1/4 lb. of Banvel D to bentgrass greens has been made for clover control. Some slight discoloration has resulted with reasonably good clover control.

Betasan is a new pre-emergence crabgrass killer. Although it has not been widely evaluated in the midwest, it appears to be comparable to Zytron and Dacthal for controlling crabgrass. For bluegrass turf, 15 lbs. per acre of active ingredient seems to be the best rate. Very encouraging results have been obtained with Betasan on crabgrass and silver crabgrass in bentgrass. Bentgrass appears to have very good tolerance to Betasan. On at least one golf course in Illinois in 1963, Betasan was effective in controlling silver crab. Our greenhouse tests and field tests would indicate that 5 lbs. of Betasan can be applied to bentgrass without injury.

Research is needed to determine if repeated lower treatments on greens would be more effective than a single 15 lbs. applications and whether bent varieties vary significantly in their tolerance to Betasan.

Very little information is available about MCPP. It apparently was sold in Canada during 1963. Reports are that it is similar to silvex and Banvel D in the weeds it will control. Preliminary reports are that it is exceptionally good on white clover, knotweed and chickweed. There seems to be a good possibility that it can be used on greens and other bent areas.

All three of the above chemicals are new and are quite specific for the conditions under which they can be used. They require accurate application to avoid injury to turf. It is suggested that they be used on small areas until the results can be observed under your local conditions.

Landscape Design Considerations for the Golf Course

William R. Nelson, Jr.

It is not news that golfing is increasing in popularity resulting in a demand for the construction of new courses to meet the needs of the golfing public. It is, however, significant that less desirable land than what was available for golf course construction in years past is having to be used for present-day construction. This perhaps means a lack of interesting topography, a lack of natural hazards and a lack of native vegetation. Where this situation does exist, special emphasis is placed on the designing of a course that will have the interest and challenge that is so important. But, so often in the desire to create interesting topography and hazards to meet this requirement, those responsible for the planning and design completely ignore an equally important quality in golf courses--that of esthetics. This is well pointed out in the statement of a golfing enthusiast who said that he preferred "to play where the scenery is equal to the game."

To come along after the course is constructed and try to add plantings is like trying to put all the sugar called for in a cake recipe into the icing when it should have been in the cake. You cannot successfully separate golf course landscape plantings from your planning any more than you would design a course and, after it was constructed, put in the green. The landscape architect is an important member of the team along with the golf course architect, the professional golfer, the engineer and the turf specialist.

Such a team is the ideal situation; but unfortunately, many of you do not have the good fortune of being on a course that is the result of this ideal situation. Instead, the good planners have charged you with the responsibility of creating a landscape planting and selecting the materials to be used. So my purpose today is to set forth some design considerations to keep in mind when developing a golf course landscape and to make some specific recommendations as to the materials you might consider.

Golf course landscape plantings are an important aspect of such a development. Plant materials should be considered for both functional and esthetic value. Of course, in the preliminary phase of golf course design, all existing plant materials on the site should be analyzed as to the potential value within the design layout and, if possible, incorporated into the over-all scheme. If we are to accept as our basic premise that the plant materials should be both functional and esthetic, it might be well if we consider some of the functional qualities. For example, we might have a protective planting, a planting to control the direction of play, a planting that serves as an aid in judging distance or a planting to serve as an aid to the player in marking ball locations.

Protective plantings may be of importance between fairways or around clubhouses and near greens and tees. For a moment consider fairways that are adjacent to one another. In a situation of this type it is to be expected that a certain number of shots from the tees and fairways of another hole will find their destination on bordering fairways. For this reason, it is advisable to plant these rough areas between fairways with trees and, in rare situations, possibly shrubs. The clubhouse should be the nucleus or center of our course design. The layout is in such a way that number 9 and 18 greens are in close proximity to the building. Therefore, we do not want to overlook the need for protective planting arrangements to protect pedestrian and vehicular traffic in the area. An example would be certain areas of the walk system or parking areas in the clubhouse area. Often we have run into a situation where the tee of one hole is close to the green of another hole; this is particularly true on courses that have been constructed on a minimum amount of acreage. If you should have such situations, a protective planting designed to allow for a maximum of protection against overshots to the previous green might be advisable. Roadways adjacent to fairways require protective plantings of trees and shrubs. In this case trees with dense crowns would be desirable. These are just a few of the actual site situations requiring landscape plantings that I have observed on various courses. Many others might exist depending upon the design, layout and conditions peculiar to each specific course. The point to be kept in mind is that one of the major functions of plantings would be for the protection of players from wild balls.

I mentioned that control of the direction of play was another function of landscape plantings. Perhaps the best example of this might be in the case of a dog-leg fairway. If it were desirable to prevent the player from cutting across, a heavy planting of trees would prevent such strategy.

Plantings might serve as an aid in judging distance. This could be a planting located close to a green which not only provides a background for the green but also aids the player in judging distance of his shot. A single tree at the edge of extremely long fairways also aid in judging distance if this is desirable.

Plantings serving to aid a player in marking ball locations would again be the specimen type tree planted just on the edge of roughs furnishing a landmark for locating balls either in the fairway or out in the rough. This same type of planting is helpful where the fairway slopes. In this situation the golfers field of vision is interrupted or shortened by the ground form. Here a tall tree planted to the edge of the fairway or even in the fairway would be helpful. If it is in the fairway, the tree should have a crown that is open enough not to interfere with the ball.

Something else to keep in mind is the orientation of the fairways. No matter how hard the designer tries to lay out our fairways north and south to avoid playing into the sun, there are times when we often get a fairway playing to the northwest which is very annoying as far as sunlight is concerned. Here we might select a tree to provide shade such as a tulip tree or a sycamore. These same trees would work very well as a deterrent from cutting across dog-legs. Where a large tree such as the tulip tree or sycamore is used, it is often desirable to plant under them using smaller trees which will tolerate shade such as the redbud or shadblow, hazel, alders or dogwood. These not only produce a core of color and a mass of heavy foliage, but they also help to establish a sense of human scale. This discussion of human scale is a detailed one and an important one which involves many aspects of psychology. Because of time limitations you will have to accept my word for the fact that this is an important consideration when arranging planting masses of both large and small units.

A planting can be functional and at the same time contribute esthetic values to the scene. Besides the functional aspects of plantings, we should now mention the esthetic values to be gained. In considering esthetics, we are trying to create interesting views, pleasing lines and challenging experiences. Any planting that is made should provide visual pleasure in terms of texture, color and form. A planting in one fairway is not just related to this fairway, but contributes to the over-all scene since it may be viewed from any number of points located beyond the fairway. In other words, we must consider not only how it is going to look as a protective planting for a certain fairway but how it is going to look as a part of the total mass of landscape plantings. In any planting, we want to have a balance and a color unity regardless of the playing season. In dealing with plants, the landscape architect considers three basic design characteristics. These are: texture, color and form. Too great a variation of any one of these design characteristics can result in a dissatisfying, disjointed and unpleasing mass of plant materials. Because we are entering into the area of principles of art and design in terms of the esthetic values, you can see, it is important that a landscape architect be consulted to complete these values of plantings that might be included. When we begin to talk about the various principles of art and what we are trying to achieve in the area of esthetics, the discussion cannot help but become somewhat vague. It would take me another hour from this point to try to elaborate on these various principles in order for you to have some grasp of their meaning. Therefore, an example might serve better to illustrate what we are saying. You would have a pleasing color and texture composition if the Russian Olive, which is a deciduous plant with very black bark and gray green foliage, were combined with Scotch Pine, which has a very definite form, completely different texture and a yellow color. By allowing the Russian Olives to serve as a backdrop for closely planted Scotch Pines, the planting could serve to accentuate a nearby sand trap by making its location more obvious and at the same time provide additional protection from adjacent fairways. Such a combination is visually pleasing from whatever point it might be viewed. I am pointing out again the importance of having the planting attractive, not only from the immediate fairway but yet harmonious with the total golf course planting.

Now the question arises as to what tree would best serve the functions and esthetic values that we presumably will have established. Therefore, it might be worth our time to spend a few minutes on the criteria for the selection of a tree. First of all, it is important that we consider its hardiness. Will it live through the winter in our particular area? For example, there are a number of trees which would be hardy south of a line drawn from Champaign to Quincy but north of the line they would be killed out due to winter temperatures. Hardiness is a primary concern to you and a check of a reliable reference or through a local nurseryman should give you a good indication as to the dependability of a particular tree. We also have to consider this matter of maintenance. Certainly the responsbilities of maintaining a golf course are many and varied and we should not add to the expense or time requirements of the greens keepers by planting such materials that would require a lot of special attention and care. For this reason, we would avoid using trees that would seed themselves easily, trees that would sucker, trees that would have roots exposed or very shallow, trees that tend to be brittle or break up under high winds, and trees that are short lived. In some rare situations we would consider short lived trees but for permanent type planting we would rely on our longer lived trees. We would want to select a tree that is as insect and disease free as humanly possible although we need to recognize the fact that nearly all of our ornamentals have a problem or two with a few rare exceptions. At least we want to avoid those that are serious and widespread. We would want to consider the color qualities of a tree in terms of the landscape planting. It would be desirable to select a tree which has some interest the year around--perhaps flowers in the spring, good foliage and fruit color in summer and fall and perhaps fall foliage color. We can also consider contrasts of foliage colors. The blue casts of some of our evergreens contrasted with the deep greens of other plants or red foliage plants serving as an accent or as a directional planting. Red foliage plants should be contrasted with a rather neutral background of green. The fruit of plants is another consideration. Since fruit will attract birds and most birds being insect feeding types, it would be desirable to have birds present on a course to keep the insect and worm population at a minimum in our intensive maintenance areas. We can't overlook our soil and the tolerance of a tree to the particular soil situation present on the course. In many cases, we have courses built on bogs with an excessive amount of moisture. Here we would have to select trees such as the red maple to tolerate the high moisture situation that exists. In other cases we might have very poor, dry soil and here we may want to select the Russian Olive, the sassafras, the catalpa or the hackberry or such trees that would tolerate the condition. Since we get the opportunity for a lot of late fall playing on a course, those trees which we select for use on or near the fairway should be such that would have a minimum amount of leaf fall or at least whose leaves are small and would tend to blow into the roughs. However, even in rough areas, leaf fall can become an annoying problem causing much time being spent looking for lost balls hidden by fallen leaves.

There are several factors to be kept in mind when locating trees on your golf course. Trees located in areas that are mowed should be spaced far enough apart to allow for use of gang mowers. Also, these trees should not have any litter that would interfere with the operation of the mowers. Avoid planting large trees under overhead power lines and telephone lines and over under ground water systems, drainage tiles, and sewers.

Some comment should be made on shrubs and shrub plantings. In general, I would not recommend the use of shrub plantings in rough areas or close to fairways, greens or tees because of the tendency to sucker, spread out, cover the ground area and make it difficult to recover lost balls. They collect fallen leaves and litter creating unsightly areas and they add to policing problems.

Following is a list of trees that can be recommended for planting in Illinois. The numbers listed before the name of each tree relate to the key below. This key lists certain esthetic and environmental qualities of the tree and possible uses of this tree on a golf course. The suggested uses do not mean that the tree cannot be used in other ways or situations. Just how each tree is used is determined to a great degree by conditions peculiar to the site. This is the reason why a landscape architect is so important in designing a golf course planting.

KEY:

1. Showy flowers
2. Attractive fruit (attracts birds)
3. Fall color
4. Tolerates wet soil
5. Tolerates dry soil
6. Minimum leaf fall
7. Protective plantings
8. Individual planting to judge distance
9. Under planting
10. Control direction of play

Key	Trees 35 feet or under	Height	Spread	Rate of growth
3-7-8	Amur Maple Acer ginnala	20	20	Medium
1-2-3-8-9	Service berry (Shadblow) Amelanchier laevis	35	15	Slow
1-8-9	Redbud Cercis canadensis	20	12	Medium
1-3-4-8	White Fringetree Chionanthus virginicus	15	6	Medium
1-2-3-8-9	*Yellow-wood Cladrastris lutea	40	40	Medium
1-3-8-9	*Flowering Dogwood Cornus florida	25	15	Slow
	Cornealian Cherry Dogwood	18	20	Medium
1-8	*Carolina Silverbell Halesia carolina	30	20	Medium
3-7-8	American Hornbeam Carpinus caroliniana	30	15	Slow
1-2-5-7-8	*Goldraintree Koelreutaria paniculata	30	20	Fast
1-2-3-8-9	Common Sassafras Sassafras albidum	30-60	25-40	Fast
	Trees 60 feet or under			
1-3-6-7-8	Canoe Birch Betula papyrifera	60	30	Medium
1-3-6-7-8	Cutleaf (Weeping) Birch Betula pendula	40	25	Fast
6-8-10	Littleleaf Linden Tilia cordata	50	40	Medium
1-2-3-6-8	Flowering Crabapple Malus spp.	8-45	30-30	Medium
1-7-10	Common Horsechestnut Aesculus hippocastanum	40	30	Medium
1-2-3-4-7 8-10	Red Maple Acer rubrum	60	30-40	Fast
4-7-10	Green Ash Fraxinus pennsylvanica lanceolata	60	40-50	Fast

Key	Trees 60 feet or under	Height	Spread	Rate of Growth
3-5-8-10	Amur Corktree Phellodendron amurense	40-60	30	Fast
1-7-10	Ruby Horsechestnut Aesculus carnea brioti	50-60	30-40	Medium
2-3-8	White Mulberry Morus alba	30	25	Fast
	Trees over 60 feet			
4-7-10	London Planetree Platanus acerifilia	80	50	Fast
3-7-8-10	Sugar Maple Acer saccharum	80	50-60	Slow
3-7-8-10	Schwedler Maple Acer platanoides Schwedleri	60	30	Medium
1-3-7-8-10	Tuliptree Liriodendron tulipifera	80	30-40	Medium
3-7-8	American Beech Fagus grandiflora	70-80	50	Slow
3-7-8	European Beech Fagus sylvatica	70-80	50	Slow
3-6-8	Ginkgo (Maidenhair Tree) Ginkgo biloba	70	40	Slow
6-7-8	Thornless Honeylocust Gleditsia triacanthos inermis	75	40-50	Fast
7-10	*Kentucky Coffeetree Gymnocladus dioicus	60-80	40-50	Medium
3-4-7-8-10	Tupelo (Black Gum) Nyssa sylvatica	70-90	30-50	Medium
3-7-10	White Oak Quercus alba	80-100	50-90	Slow
3-7-10	English Oak Quercus robur	40-60	30-50	Medium
3-7-10	Red Oak Quercus borealis maxima	70	50-60	Medium
7-10	Norway Maple Acer plantanoides	75	30	Slow
3-7-8-10	Pin Oak Quercus palustris	70	40-50	Fast

Key	Trees over 60 feet	Height	Spread	Rate of growth
7-10	American Linden (Basswood) Tilia americana	70-80	50-60	Medium
6-7-8-10	Hackberry Celtis occidentalis	90	50	Fast
3-7-8-10	*Sweet Gum Liquidambar styraciflua	60	40	Medium

*Should be planted in southern half of the state only.

COMMON KENTUCKY BLUEGRASS -- A COMPOSITE OF MANY TYPES

C. W. Lobenstein

Five dimes or ten nickels are equal to a half-dollar -- a simple obvious fact-- yet we cannot correctly say they are the same units of currency even though composed of the same basic metals and shaped in the same manner. Value-wise there may be no differencebut functionally there is a big difference.

In a similar manner the common practice of considering Common Kentucky bluegrass as a variety in the same sense as Merion, Delta, Newport, and others is somewhat in error. The definition of a "variety" generally implies uniform genetic composition and thus all plants developing from seeds of that variety are expected to be alike. In the case of Merion bluegrass, pure foundation seed stock can be maintained by constant inspection and elimination of off-types because of the high degree of apomixis existing in that variety. Seed produced from such foundation sources can thus be relied upon as true Merion. This is more difficult in the case of Common Kentucky bluegrass because it is a mixture of many types and degrees of apomixis. One needs only to look at the variations in research plots to appreciate the degree of mixing. Hundreds of types have been selected by various workers but only a few have found a valuable place in the turf industry. The essential fact remains that Common Kentucky bluegrass exists as a mixture of a tremendous number of potential individual varieties.

Generally speaking, most of us have a fairly uniform picture of the bluegrass called Common Kentucky. Certain types with fairly consistent features do predominate in the mixture. However, if a moderate number of seedlings or even individual plants from an established turf are planted in spaced plantings, a wide diversity of leaf character, color, growth habit, tiller of rhizome development, and even disease susceptibility can be observed. Many of these inherent differences are masked or suppressed under conditions of sod competition.

In almost any established turf of Common Kentucky bluegrass individual plants or patches can be found whose distinctive characters are not masked even in competition. Furthermore, in many cases, these isolated patches have completely dominated other types indicating either, (a) a specific adaptation for that particular environment, or (b) a desirable capacity to withstand or tolerate the stresses placed on the turf in that particular situation. These are the types that attract the most interest and provide the major hope at present for improvement of Kentucky bluegrasses. The history of Merion is a prime example of the potential which still exists in the creeping bentgrasses; the potential is most likely just as great in that species.

It is doubtful that anyone can truthfully say that seeds produced by Common in different areas are likely to contain the same proportions of types -- or even the same types. A paper entitled "Microenvironment and Grass Adaptation" presented by Dr. L. C. Bliss in the 1962 Proceedings of this conference points out the basic reasons for this statement. The studies of Hiesey, Clausen, Nielsen, and workers in Sweden have consistently shown that different ecological races of Poa pratensis L. respond quite differently to various temperature regimes, soil, or microenvironment conditions.

Natural selection may occur in Common simply because it contains a varied mixture of genetic types. On the other hand, varieties such as Merion or possibly Newport which are previously selected for genetic uniformity would likely not be altered by the process. Some people maintain and probably correctly so, that the ability of Common to thrive over a wider range of conditions than some of its varietal progeny is due largely to the presence of so many types. Thus, in any given locales those types particularly adapted are able to establish a turf, while in another locale still other types would succeed.

This philosophy is at least indirectly involved in the present trend to use of "blend-mixtures" of selected varieties. The argument may be presented that it is foolish to select specific varieties out of the common group and immediately mix them together again. Another simple analogy can be drawn in this case! Occasionally a very tasty dish of hash can be concocted from leftovers in the refrigerator. If, after initial success, the cook desires to repeat the menu, the original recipe and the original ingredients must be available. Genetically speaking, we know very little about what is contained in any particular hashlot of Common bluegrass, nor are we assured that the next lot will contain the same genetic ingredients.

Reference was made earlier to the large number of selections that have been observed by various workers and the very limited number of useful developments from them. This raises the question of whether too much emphasis has been placed upon ability of a selection to produce a maximum amount of foliage and too little attention to other factors such as root and rhizome development. It has been demonstrated repeatedly that continued maximum leaf growth of bluegrass under closely mowed conditions usually occurs at the expense of the underground organs. The net result is a weakening or ultimate death of the plant; thus bluegrass has trouble in fairways. Excessive foliage production and subsequent thatch development also creates problems. It is agreed that foliage is necessary in an acceptable turf -- but to what extent must the tail wag the dog?

There is no question of the necessity for disease resistance in our newer varieties but again there is some doubt that freedom from disease should constitute a completely dominant requirement for selection of new varieties. A common experience in many crops is that almost as soon as new resistant varieties are developed, the pathogens also develop more virulent races and the vicious circle continues. Perhaps efforts in turfgrass improvement could lean more to the idea as now followed by plant breeders in other crops -- namely, seek development of varieties that produce well in spite of, rather than in the absence of diseases.

Efficiency and economy in seed production naturally force the seed producer to desire those selections that produce the heaviest seed yields. Unfortunately there is little evidence that rate of seed production is related in any way to desirable turf characteristics.

During the past three years observations of several selections have disclosed that variations below ground are just as great as in the above-ground parts of the plants. Many of the selections had been taken from fairways of an old established golf course in the Chicago area where many individual patches of distinctly different types of bluegrasses can be found. They provide turf of superior density and quality even though most of them seem to show as much or more susceptibility to the usual bluegrass diseases. Observations were made to determine if these selections might be able to survive and make more rapid recovery from disease or other adversity by immediate production of many new crowns from more extensive rhizome systems.

Individual unbranched crowns of the various selections were planted in nursery rows to permit recovery of total rhizome and tiller growth originating from the single tillers during various time periods. Examples of the variations observed are shown in Tables 1 and 2. These differences were not due merely to the fact that the tillers were released from sod competition. Rhizome measurements taken from 8-inch cores in established sods showed the same trends in selection differences as shown in Table 3. Merion was chosen as the standard of comparison in these observations and results are experssed in part as a comparison with Merion.

The greater total rhizome length produced by many clones was, in most cases, due to the much larger number of rhizomes rather than longer individual rhizomes. Few selections exceed Merion in density as expressed in shoots per unit area; however, they produced a much larger number of new crowns and tillers than Merion, due to greater rhizome development. The larger number of shoots were distributed over a greater area, resulting in an initially lower density rating, but density usually was equivalent to Merion within one year's time.

Not only were there differences in number and length of rhizomes, but some selections also extended rhizomes to a greater depth. In some cases rhizomes were found at depths of 10 to 12 inches, while those of standard varieties as well as the majority of the selections were largely confined to the top 2 inches of rootzone. When sods were cut at regular depths from the selection plots a marked difference was noted in the number of new crowns produced from rhizomes below the cutter depth.

These observations support the belief that those selections which have persisted through the years can produce a much greater potential for new crowns following adversity. Although many of the particular selections studied do not have the color, leaf texture, or other characteristics desired in high quality turfs, this study demonstrates the desirability of looking below, as well as above, ground level in evaluating new varieties and selections of bluegrasses.

Plant breeders can actually synthesize varieties of many grasses by controlled combinations of lines of known genetic composition. In bluegrasses, however, the very complicated problems of apomixis and variable chromosome numbers post an extremely difficult problem for the plant breeder seeking a similar approach. Most likely it will be impossible to develop that ideal variety which will be universally adapted to all conditions.

Bluegrass probably has been able to spread and adapt throughout much of the North American continent since its introduction into the early colonial areas partly because of its intrinsic mixture. It does not seem unrealistic to seek to identify and isolate the components of that successful varietal hash. Then, if mixing provides a better dish, knowing the ingredients, we should be able to duplicate it whenever necessary.

TABLE 1. Total Rhizome Growth From Single Bluegrass Crowns in 4 Growth Periods

Dates	Days Growth	Merion	K-5-47	Newport	Shade	16-B	16-C	16-F
				(Total length in feet)				
5/30 to 7/25/62	65	0.9	0.5	0.3	1.4	2.2	1.8	1.5
3/20 to 7/25/62	125	1.5	5.8	5.2	19.0	27.0	15.0	10.0
3/20 to 8/30/62	160	6.8	7.3	26.0	19.0	84.0	58.0	47.0
5/15 to 11/15/61	180	7.5	8.2	----	44.0	87.0	55.0	46.0

TABLE 2. Sod-Forming Characteristics of Bluegrass Clones in Ratio to Merion

	Average growth from single crowns						
	Merion	K-5-47	Newport	Shade	16-B	16-C	16-F
			(Ration to Merion)				
Number of rhizomes Avg. 4 experiments	1.0	1.2	2.1	3.7	8.0	4.5	3.4
Avg. rhizome length Avg. 5 experiments	1.0	1.0	0.9	1.4	1.3	1.6	1.7
Total emerged shoots Avg. 4 experiments	1.0	1.0	0.9	2.0	2.7	2.1	2.0
Shoots per sq. inch Avg. 2 experiments	1.0	1.1	0.8	0.9	0.8	0.7	1.0

TABLE 3. Number and Ratios for Rhizomes in 8 inch Core Areas.

	Originally present in 3-yr. sods 10/20/61	10/8/61 to 6/11/62	Ratio to Merion	6/11/62 to 11/3/62	Ratio to Merion
	Ratio	No.	Ratio	No.	Ratio
Merion	1.0	3	1.0	19	1.0
Delta	0.7	3	1.0	19	1.0
Newport	2.6	1	0.3	34	2.0
Shade	3.2	17	5.6	45	2.5
16-B	3.5	42	14.0	63	3.2
16-C	3.6	43	14.0	66	3.5
16-F	3.2	55	18.0	64	3.5

CURRENT NEMATODE-TURF RESEARCH AT THE UNIVERSITY OF ILLINOIS

Clinton F. Hodges

Parasitic nematodes are known to occur in rather large numbers in most turf-grass throughout the state of Illinois. Several parasitic genera are usually present in these nematode populations, but very little is known about the relationship between the nematodes and the turf. In most cases, the turf-grass does not show any injury, and the ability of the grass to produce a lush green turf is not impaired. Some turf-nematode relationships are known to be parasitic in nature; however, the effects on the grass plants, if any, are unknown. One of the major objectives of our present research program is to determine how these parasitized plants are affected regarding development of roots, rate and amount of leaf growth, and leaf color.

Nematodes of the genus Tylenchorhynchus are generally found throughout the state in all types of turf-grass, but without any parasites of other crops. Tylenchorhynchus specimens are quite large compared to most of the other parasitic genera found in turf-grass, averaging slightly over 1mm. in length, and as many as 1,500 of these nematodes have been recovered from 100 ml. of soil collected from around bluegrass roots. Members of this genus are classified as migratory semi-endoparasites, i.e., they move freely through the soil and do not become permanently attached to plant roots. However, they are semi-endoparasitic because when they feed they are known to force the anterior end of their bodies into the root. Three main factors make this nematode worthy of investigating: first, it occurs in extremely large populations in bluegrass soil; secondly, some of the species of this genus are known parasites of other crops, and it is probable that the species associated with bluegrass are also parasitic; and thirdly, the grass does not show any visible symptoms of damage from the presence of thenematodes which is very unusual.

In the fall of 1962, an investigation of Tylenchorhynchus was started using microcinematography to determine the exact nature of the relationship between this nematode and bluegrass. Living nematodes and grass roots were mounted on a microscope slide, and the activities of the nematodes on the roots were recorded on 16 mm. film. It was thought that direct observation of the nematode feeding on the bluegrass roots could be recorded. Unfortunately, direct feeding was not observed; however, the observations have provided enough information to suggest that these nematodes are capable of parasitizing bluegrass roots. The behavior of this nematode on the roots, and the functioning of two separate organs within the nematode associated with the feeding process have led to this belief. On the slides, nematodes would almost invariably seek-out the root and move along its surface, probing with its stylet as it proceeded. The stylet is the needle-like structure that the nematode uses to puncture cells of the root. During the observations made on this nematode, the stylet was in almost constant use, probing the surface of the root, and in at least two instances the anterior part of the nematode was found four to five cell layers below the surface of the root. The metacorpus is the other organ associated with feeding that was observed functioning in these studies. Essentially, the metacorpus is a pumping structure which enables the nematode to suck the contents of a plant cell into its body. In the cases where this organ was functioning, the anterior end of the nematode was out of sight making it impossible to be certain that it was really feeding.

Microcinematography, although an extremely useful tool, sets up conditions that are very different from those encountered in nature. When a nematode is placed on a microscope slide, it is exposed to many different factors that may affect its behavior, such as a deficiency of oxygen, high light intensity and heat of the microscope lamp, the affect of drying, and a substrate other than soil. These factors combined may have an adverse affect on the nematode resulting in an abnormal behavior. During the course of this investigation, it was found that this nematode was sensitive to the heat created by the microscope lamp causing all activity to cease. Despite the obvious problems, microcinematography possesses one great advantage over other methods of study in that the nematode can be directly observed, and its activites can be permanently recorded on film.

Last June, Dr. M. P. Britton[1] received samples of Toronto C-15 creeping bentgrass (Agrostis palustris) from DuPage County that was infected with Helminthosporium. Some of this grass was forwarded to Dr. D. P. Taylor[2] to be examined for nematodes. The examination disclosed that the roots were moderately infected with root-knot nematodes.(1) In October, another sample of Toronto C-15 creeping bentgrass was brought to our attention, from DuPage County, by Mr. Jackie Butler.[3] On examination, it was found that a moderate to heavy infestation of root-knot was present. However, it is not known if the nematodes were responsible for any damage because other pathogenic organisms were also present. The discovery of root-knot nematodes attacking creeping bentgrass is important for at least two reasons. First, this is the first report of this grass being attacked by root-knot nematodes. In fact, creeping bentgrass has been reported immune to attack by at least one species of root-knot nematode.(2) Secondly, root-knot nematodes are well known for their ability to devastate other crops. Therefore, the potential of this nematode to injure creeping bentgrass should be thoroughly investigated.

Work was started on this problem during the summer of 1963, and at the present time the nematode has been tentatively identified as Meloidogyne incognita acrita. At the same time a host-range study was initiated with nineteen varieties and species of bentgrass, and one species of bluegrass. These twenty grasses were potted in soil from the DuPage area, and galled roots from infected plants were added to insure sufficient inoculum.

After ten weeks, the soil was washed from the roots of each variety of grass. The roots were then stained with cotton-blue and lactophenol and examined microscopically. The results of this study disclosed that of the twenty selections of bentgrass tested for susceptibility, six were capable of supporting the nematode through its entire life cycle, i.e., the larvae entered the roots, developed into adult females and produced eggs. These six selections were Cohansey C-7, Toronto-C-15, Igreen 445, Velvet, Nimisila, and Old Orchard C-52. The nematode was also found in the roots of North Moor 9, and Penncross. However, in the case of these two grasses the nematodes were near maturity, but eggs were not present. Arlington C-1, Astoria, Highland, Twin Orchard, Congressional C-19, Evansville, and Redtop (Agrostis alba) were also infested with larvae, but for an unknown reason they did not develop within the roots.

At the present time, the affect that this nematode has on the growth and general welfare of the bentgrass selections it can attack is not known. However, it is known that this nematode is capable of parasitizing the roots of creeping bentgrass. Also, it is known that this parasitism is pathogenic, resulting in distortion and galling of the roots. At the position where the female buries her

1. Assistant Professor of Turf Pathology, Dept. of Plant Pathology
2. Assistant Professor of Nematology, Dept. of Plant Pathology
3. Instructor in Turf Management, Dept. of Horticulture

head in the stele of the root, distortion and swelling of the vascular tissue has also been observed. The symptoms produced on the roots are typical of those caused by other root-knot nematodes. However, an unusual symptom has been noted in which the root tip apparently grows in the direction of 360°, causing the roots to form circular rings. These "root rings" are usually heavily galled. At the present time, a more thorough investigation of the pathogenic capabilities of this nematode is in the planning stage, and it is hoped that a more complete report will be available in the not too distant future.

REFERENCES

1. Hodges, C. H. Taylor, D. P., and M. P. Britton. 1963. Root-knot Nematode on Creeping Bentgrass. Pl. Dis. Reptr. 47 (12): (In press).

2. Ichinohe, M., and I. Yuhara. 1956. (Ecology of the Root-knot Nematode in the Northern part of Hokkaido.) Jap. J. Ecol., 6(1):24-28. (English summary p. 24-25.)

RECENT DEVELOPMENTS IN TURFGRASS PRODUCTION

R. E. Engel
Rutgers University

"What" happens to turf is often unknown. "Why" it happens is more of a mystery. All of us hope research and experience will change the situation. Research is usually quicker and cheaper than waiting for experience to teach the answers. As we know, too much trial and error on the job is dangerous. You may recall the story of a golf course superintendent who was asked if he had tried one of the current season's new products. His answer was, "No, my course is already in too poor condition." Study of research results costs little, and down-to-earth use of new ideas will help grow better turf as well as avoid past mistakes.

What is research? There is nothing mysterious about it. The purpose of research is to answer questions that have not been answered before. The technique is to prove a point beyond reasonable doubt.

I trust this simplification has not misled you. Finding the facts through formal research requires imagination, ingenuity and hard work. Also, knowledge of basic science is frequently necessary. Even with the tools of specialized training, many frustrations greet the formal research worker. We have reached a time when it is necessary to keep a close eye on technical turfgrass developments. Things we consider impossible may become possible. Forty years ago only a fool would have shot at the moon. Whether we like it or not, times have changed for turf maintenance and they will change more and more. It is unsafe to fall too far behind on new techniques as it seems our society cannot stand anyone who is contented.

Pre-emergence Control of Crabgrass

As with most other institutions, pre-emergence crabgrass control studies have consumed a considerable amount of our research time over recent years. We started our first tests in 1955 and my comments on this subject could fill a small book. A summary of our current views may be of interest to your work:

We classify dacthal and zytron the most useful to date. These are recommended only for established Kentucky bluegrass turf. Also, we consider these or any of the other chemicals too risky for the bentgrass lawn or fairway.

Chlordane and calcium arsenate are utilized in various ways, but we cannot place them as high for general use. Calcium arsenate gives long-term control but its action and safety varies greatly with soil conditions. More comments on chlordane follow.

Bandane at 45 and 60 pounds per acre has given good control. Thirty pounds per acre has appeared too light for best performance. Also, we would like to know more about its safety.

Newer products are being tested and more will come. Among the current group, Stauffer R-4461 and Hercules H-9573 have shown crabgrass control. These and others merit more study. Anyone concerned with pre-emergence must look at new products.

Our greatest concern for the pre-emergence technique is safety to the turfgrasses. I have observed or seen reports of injury for virtually all chemicals to date. Two types of injury are of concern: first, danger to the established turfgrasses; and second, danger to seedings made at a later date. Injury to established grass is very subtle. For example, we used chlordane for the 1959 season and saw our first serious injury to the turfgrasses in the 1962 season. A similar result was observed for tests made in 1960 and 1961. The injury appears to be associated with drought. While some damage occurred on most plots, it was far more severe on chlordane treated plots than the check or those treated with other chemicals.

We have observed a few very significant increases in clover content with dacthal and zytron. Any material that thins the turf cover should be of concern. Such experiences as I have just listed warns us that we must make long careful study of pre-emergence chemicals if we hope to minimize turfgrass injury.

Goosegrass Control

Work at New Brunswick in 1957 and 1958, which was USGA supported, showed chlordane had appreciable promise for goosegrass control. This project was not continued, but Bob Dunning and some golf course superintendents have reported worthwhile field results. For the past three seasons we have conducted limited work with current pre-emergence crabgrass herbicides. In 1960, standard rates of chlordane, dacthal and zytron applied on April 28 gave inadequate goosegrass control. In fact, the latter two were so effective on crabgrass that goosegrass was worse in these treatments. In 1961, bandane, chlordane, dipropalin, trifluralin at standard rates and double rates of dacthal and zytron failed to give a high degree of crabgrass control. In fact, all showed slight or severe damage to the annual bluegrass turf. It was of interest to observe the double rate of dacthal and zytron treatments showed appreciable bare ground as late as early November. This might be explained by the chemical residue acting on seed of annual bluegrass and the seeded turfgrasses. Several chemicals used in 1962, showed appreciable goosegrass control. However, most appeared to give turfgrass injury on the basis of appearance and clover ratings. Diphenatrile at 60 to 120 pounds per acre appeared most promising. Laboratory studies have shown that light is a great aid to germination of goosegrass. This result plus observation has convinced us that good turf cover is important for minimizing goosegrass.

Thatch Control

A thatch control study has been conducted for a period of seven years with aid from the USGA. The results after six years of treatments are summarized briefly as follows:

1. Cultivations tend to destroy or prevent thatch. We have no data on how this happens, but it is logical that the cutting of the thatch, the mixing of thatch with soil, and the removal of some material through cultivation should bring a degree of relief from thatch problems.

2. Lime appears to discourage thatch accumulation. The explanation for this might be that residues can become too acid for good decay activity.

3. Topdressing appears to encourage decay.

4. It appears that an increase in surface accumulation occurs with use of wetting agent. Whether this result outweighs the help this material can give in some situations where water penetration is poor has not been determined.

5. High nitrogen gave an increase in surface accumulation. Again, it is difficult to say if this factor offsets the tendency for turf to wet more readily when it is growing with a good nitrogen supply.

6. Topdressing was most effective in improving quality.

Annual Bluegrass Control

Some have proposed pre-emergent herbicides for annual bluegrass control. Certainly, we have too many unknowns to attempt this on any basis other than experimental. Most appear too unsafe for the grass and it seems this is a technique that needs much formal research.

You may recall that light, repeat applications of sodium arsenite have been considered useful when annual bluegrass and clover were excessive. We tested a series of chemicals some years ago with the hope of destroying the seed crop of annual bluegrass. A chemical that might prevent or kill the flowers might succeed. We found a chemical, maleic hydrazide, but it was too severe on bentgrass. During this work we discovered that endothal could selectively attack annual bluegrass in bentgrass turf. This was reported some years ago. This chemical does not have a large safety margin for bentgrass, but it differs greatly from the pre-emergence type of chemical in that it is a shortlived contact type herbicide. This is a desirable factor in that lingering effects should not occur to any appreciable extent.

We never pushed anyone to use the endothal treatment because we felt the situation was somewhat complex. Our work showed that two to three treatments of endothal in early spring at a rate of 1/2 pound per acre eliminated a majority of the annual bluegrass without significant harm to the bentgrass. We found that treatment after early May or after warmer weather arrived was unsafe. Other factors were: (1) annual bluegrass control is unlikely to be complete (possibly this would be undesirable), and (2) 30 to 50 % bentgrass is required throughout the turf or appearance will be intolerable until more bentgrass becomes established.

Endothal, as used in our tests, gave good kill of clover. There is increasing interest in this point for growers of our area as we become more concerned about safety of the 2,4,5-T and 2,4,5-TP types to bentgrass. It is no secret that the phenoxy compounds such as 2,4,5-T and 2,4,5-TP have given considerable injury to bentgrass. This is an unfortunate realization to face when we know the great effectiveness of these herbicides.

With financial support of the USGA, we developed a study of the effects of 2,4,5-TP on turfgrasses (this work was primarily on bentgrass). The work to date has shown this chemical produces severe interference with normal food reserves of the grass plant. As one would expect from this result, severe hindrance of good rooting can occur and this has been shown repeatedly in our tests to date.

Also, it was of interest to find the effects of 2,4,5-TP appear less severe when the grass is growing with cooler temperatures and optimum moisture. Normally, we prefer to say little about a study until it is complete, but we feel the dangers are serious enough that men in our area should do some thinking.

With regard to the use of 2,4, 5-TP, we recognize its ability to kill troublesome turf weeds such as clover and chickweed. However, we have warned our turf growers in New Jersey against indiscriminate use of this chemical.

We suggest they use the lowest effective rate. A rate of 1/2 pound per acre is much safer than rates of 3/4 to 1 pound per acre. While we are not sure of the safest season for treatment, we would suggest avoidance of late spring and warm weather treatment if at all possible.

Growth Control

Chemicals for controlling growth of turfgrasses is fascinating and the subject seems to persist in thought and in some research programs. Some years back we took a look at maleic hydrazide. With a few new ones on the scene, we decided to observe some of these this past season. We did not find adequate promise in any of the materials. Also, it may be of interest to you that all chemicals tested seemed to interfere with best growth of the grass before the test was completed.

The effects of soil moisture level on turfgrass quality and growth rate were studied recently by one of our graduate students. Merion bluegrass was permitted to remove varying amounts of water from the soil before water was added again. Re-watering when only about one-third of the available water was removed seemed to give the most vertical growth and it gave a measurable increase in shoots per unit area. However, delaying water until two-thirds of the water was removed gave the best color, quality rating, and the greatest weight for each individual shoot. Delaying watering until seven-eights of the moisture was used, produced only slightly inferior turf than the higher water ranges. Delaying water until all but one-twenty-fifth of the available water remained gave an open and inferior turf. In other words, this work showed maintenance of the water level in the lower range of available moisture did not harm quality, provided the wilting stage or near-wilting stage was avoided.

Nitrogen Studies

Results from the first year of a U.F. nitrogen fertilization study indicated a large nitrogen release approximately one month after treatment with single large applications. Second and third year results have shown similar behavior. In contrast to the surge from single, heavy applications of ureaformaldehyde we have obtained uniform growth from small, repeat applications. For those turfgrass growers in our area, smaller and more frequent applications are suggested rather than a single, heavy treatment if the maximum uniformity of stimulation is sought. Also, we have considered the tendency for ureaform to give less total growth. This led us to study the fate of this material after application. After three years of treatment with ureaform and various fertilizer materials, the total N near the surface of the soil was measured. Higher quantities of nitrogen were found where ureaform had been used the three previous seasons. This gave a moderate delayed growth effect the following season, but the quantity of this carry-over was not great enough to appreciably reduce the need for additional fertilizer. While some of our newer forms of fertilizer are very useful, it is my opinion that we still have not found the ideal type of slow release nitrogen.

Nitrogen has very great effects on turf other than to increase top growth. It tends to increase leaves more than the roots. In some cases, excessive use of nitrogen decreases the total quantity of roots. Rhizomes are less abundant on Kentucky bluegrass that is grown with a high level of nitrogen. This fact along with several others appears to discourage survival of high nitrogen Kentucky bluegrass turf in very hot, dry weather, Our work to date suggests September and October are the best months for Kentucky bluegrass fertilization. This may not be true for your climate. Test plots have shown that summer survival of bentgrass becomes far more difficult with increased use of nitrogen. Very light and more frequent nitrogen fertilization seems most appropriate on bentgrass fairways in our section.

With fear that my statements on new developments and New Jersey procedures may lead to their indiscriminate usage, I wish to give a bit of philosophy on new items and techniques. What are some of the guide lines to wise adoption of new developments?

1. First, observe experimental and trial results on turf on every occasion. This is the best type of proof.

2. Evaluate each item for your situation. This will continue to be as necessary as ever. We are in a day and age when we cannot delay the use of everything new until all the facts are in. Also, some of the untested which should not be marketed will be around. To some degree this is the fault of Experiments Stations and Turf Superintendents as well as the seller.

3. Read on the new subject. This will give you information and stimulate critical thinking which will help you choose.

4. Ask if the new item fits your turf situation with regard to grass type, soil, maintenance, etc.

5. Separate the facts from your feelings.

6. Weigh possible value versus risk and cost.

7. Begin use of the new conservatively.

Controlling Grass Diseases

Malcolm C. Shurtleff

Americans spend at least $9 to 10 billions annually on the care of some 35 million home lawns, parks, athletic fields, cemeteries and other non-golf turfgrass areas. The accepted standards for all types of turf are constantly rising. People now expect a uniform, living green carpet for their money.

The maintenance of this carpet of millions of grass plants crowded together--growing under the "artificial" conditions of close mowing, high rates of fertility, extra water, and pest control--is no easy task. We are now trying to grow many more grass plants with more leaves in a unit area than we were 10 and 20 years ago.

All of these factors--plus the elimination of many weeds and insects, low or unbalanced fertility, compaction, and other turfgrass problems--has led to an upsurge in the importance and recognition of turf diseases.

Diseases Just Don't Happen

In general, the more grass plants that are growing in a unit area the greater is the potential danger from diseases. Crowded grass plants compete for air and soil space, light, water nutrients--and diseases. The humidity among such plants is higher, and the chances for disease spread from plant-to-plant are greater, than in a thin grass stand.

With the exception of nematode injury, all of the important diseases of turfgrasses are caused by fungi.

Fungi are plants that lack the green pigment chlorophyll. Unlike green plants, fungi are unable to produce their own food from water, carbon dioxide, and the sun's energy. To get food, they feed on dead or decaying green plant parts or attack and feed on living green plants. Most of the fungi that attack turfgrasses are microscopic. Usually you can see only the results of action by these fungi after they have attacked and fed on grass tissues. A few fungi produce fruiting bodies or structures that are visible to the unaided eyes. These include mushrooms and puffballs of fairy ring fungi, the cobwebby or dusty fungus growth associated with brown patch, dollar spot, snow molds, powdery mildew, rusts, and smuts.

Fungi spread from plant to plant and one turf area to another by wind- or water-borne spores; use of infested seed, soil, or topdressing; in clippings; or soil adhering to shoes, and various types of equipment.

Diagnosis

For successful disease control, early and accurate diagnosis is essential. Different fungicides and cultural practices are effective against different disease-causing fungi. An incorrect disease diagnosis may easily lead to serious loss of turf before an effective fungicide and cultural control program are used. When a new problem arises, determine the real cause and the best possible methods of control.

We use the plural--methods, --instead of method, because a disease is an "end result" commonly brought about by a series of conditions. These are the right temperature, the right humidity and moisture, a susceptible grass, the presence of a disease-causing fungus, and an effective method for its distribution. All of these factors must be present and in balance before a disease can develop.

Successful Disease Control

This is preventive in action and requires the timely application of the correct fungicide plus the correction of cultural practices that may contribute to the diseased condition. Modern turf fungicides are so effective that we tend to depend more and more heavily on them and relegate good cultural practices to second place. Yet, some slip in turf management usually leads directly to disease situations! Why not carry out the best cultural practices--that are also best for growing grass in most cases--and use fungicides only where these are not completely effective?

Many home owners, plus those who maintain our parks, athletic fields and cemeteries, are frequently not in a position to apply fungicides on a regular basis. This means primary disease control must be placed on a sound management program.

Table 1 lists a number of cultural practices that help, collectively, to keep lawn and turf diseases in check. We have placed the timely application of fungicides last because other presentations and publications have stressed their use.

When Disease Strikes

1. Make an early and correct diagnosis

2. Carry out recommended control practices.

3. Try and figure out "What went wrong?" and correct the situation.

4. Keep records of disease occurrence, application times and amounts of fungicides used, weather conditions, and other factors.

TABLE 1. Cultural practices that aid in controlling lawn and fine-turf Diseases found in the Midwest. Many of these practices are naturally closely related.

Practice	Helps Control
1. Resistant varieties	Dollar spot, snow molds, leaf spot and melting-out, rust, powdery mildew, brown patch
2. Grass mixtures--varieties and species	Leaf spot, brown patch, rust, powdery mildew, dollar spot
3. Adequate, balanced fertility. Avoid overfeeding. Should be based on a soil test	Dollar spot, snow molds, powdery mildew, brown patch, Pythium, melting-out, rust, slime molds, seedling blight and seed decay, nematodes, soil deficiencies
4. Keep grass growing steadily	Rust, powdery mildew, leaf spot and melting-out, dollar spot, brown patch, nematodes, seedling blight, moss and algae
5. Cut at proper height--mow frequently	Leaf spot and melting-out, snow molds seedling blight, brown patch
6. Dew removal	brown patch, dollar spot
7. Good soil and surface drainage	Brown patch, Pythium, melting-out, snow molds, root rots, slime molds, seedling blight and seed decay, moss and algae
8. Watch that watering!	Leaf spot and melting-out, Pythium, brown patch, dollar spot, snow molds, powdery mildew, slime molds, seedling blight and decay, nematodes, moss and algae
9. Thatch removal-vertical mower, hand raking	Brown patch, leaf spot and melting-out, snow molds, Pythium, root rots, dollar spot
10. Good air movement	Brown patch, dollar spot, snow molds
11. Reduce shade, Prune or remove dense trees and shrubs	Powdery mildew, brown patch, dollar spot
12. Eliminate compaction--aerification, reduce traffic	Root rots, melting-out, Pythium, snow molds, moss and algae
13. Collect clippings	Rust, powdery mildew, smut, brown patch, dollar spot
14. Control insects	Root rots, melting-out

Practice	Helps Control
15. Timely application of recommended fungicides [1]	Leaf spot and melting-out, dollar spot, brown patch, rust, powdery mildew, snow molds, seed decay and seedling blight, Pythium, moss and algae

1. See NC Regional Extension Publication No. 12, "Lawn Diseases in the Midwest," and Report on Plant Diseases No. 402, "Turfgrass Disease Control," for current fungicide recommendations.