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Identification of Turfgrasses by Vegetative Morphology

Victor B. Youngner and June Latting
University of California at Los Angeles

Our natural classification system for grasses is based upon the flowers and fruits. Vegetative characters are seldom used for anything but confirming evidence in identification. However, when grasses are grown for turf purposes they are seldom allowed to reach the flowering stage and it is then necessary to use other characters for identification. A key based on vegetative characters, while useful for identification, is highly artificial and does not necessarily group related species together.

It is usually best to use fresh material for identification as some characters may be difficult to see in dried material. Since some of these features are quite small a hand lens of about 10 power is useful.

The principal vegetative characters useful for identification of grasses are features of the leaf which typically consists of the following parts:

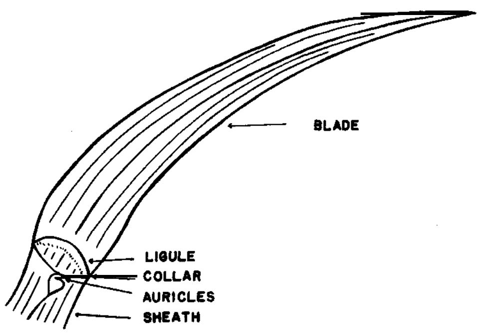

FIG. 1

The presence or absence of the rhizome is often important for identification. The rhizome is a modified stem which grows under ground, usually parallel with the surface. Roots and shoots are produced at the nodes where scaly rudimentary leaves called bracts are found.

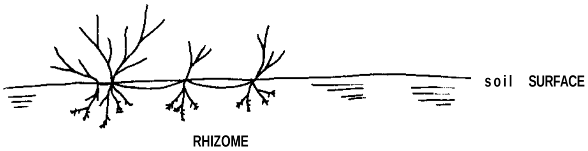

FIG. 2

The stolen, which is a modified creeping stem growing above ground and producing roots and new shoots at the nodes, also serves to aid in the identification of many grasses.

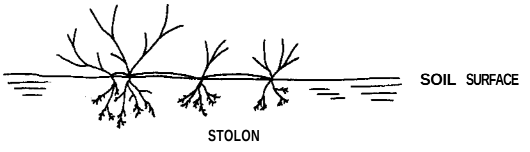

FIG. 3

The following key for the identification of grasses based on vegetative characters separates the species into two large groups on the basis of vernation, or the arrangement of the leaves in the bud-shoot. These two groups are: grasses with the leaves folded in the bud and those with the leaves rolled in the bud. The best way to see this character is to cut a cross section of the shoot just below a leaf blade and examine it with the hand lens.

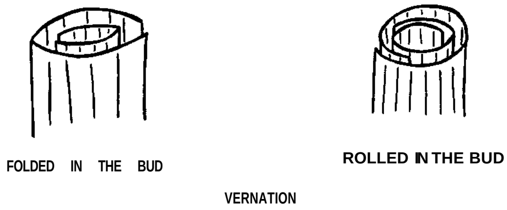

FIG. 4

The leaf blade, that part of the leaf which is expanded and usually projects out from the shoot, may have several characters useful for identification. The blade may or may not be pubescent or hairy. The margin of the blade may be smooth or scabrous, which means finely toothed or rough. The color of the blade may be important - there may be variations in the intensity of the green color or a red pigment may be present. The outline of the leaf in cross sections is often very characteristic. Three types of leaf outlines are shown below.

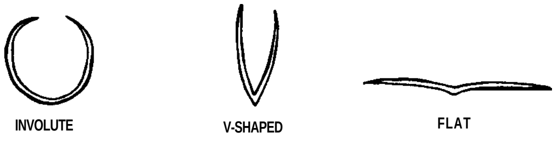

FIG. 5

The shape of the leaf tip serves as a means of separation of some species. Three major types of leaf tips are:

FIG. 6

A heavy midvien or midrib runs through the center of the grass blade from the base to the tip. On each side of this midrib a number of secondary veins run parallel to it. The prominence of these veins serves as an excellent distinguishing character in some grasses. It may be possible to actually feel these prominent veins in some species, but generally they must be observed with the aid of a hand lens.

Some grass species show a white line on each side of the midrib. These white lines are bands of thin almost transparent tissue and therefore can be most readily observed by holding the leaf against the light.

The leaf sheath is the lower portion of the leaf which surrounds the stem. The margins of the sheath generally overlap, but in a few species they may be separated, or they may be fused as in the case of some fescue and bromus species.,

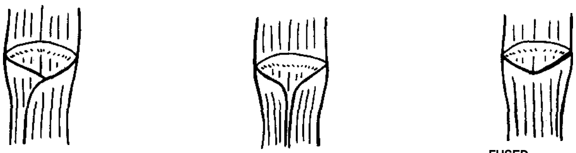

FIG. 7

Other features of the sheath are the presence or absence of hairs, conspicuous or inconspicuous veins, and presence or absence of green, yellow, red or purple color. The sheath is either cylindrical or compressed. The lingule is the tissue or thin appendage on the inside of the leaf at the junction of the sheath and blade. The ligule may be membranous as in Kentucky bluegrass, a fringe of hairs as in common bermudagrass, or lacking as in barnyardgrass.

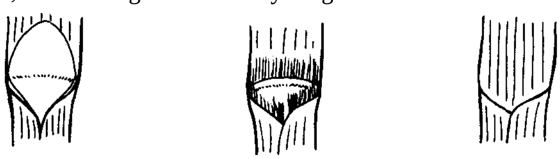

FIG. 8

The membranous type of ligule can in turn be separated into three general shapes as follows:

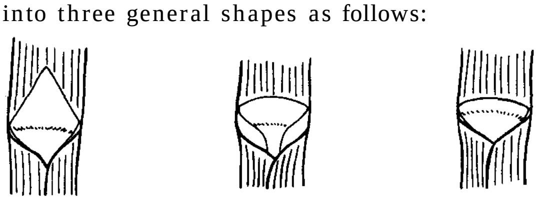

FIG. 9

These types of membranous ligules can in turn be divided into several types on the basis of variations in the margin.

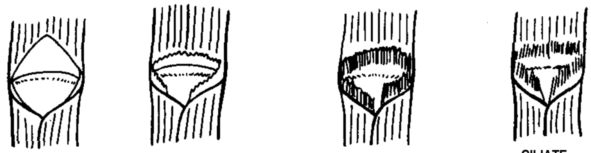

FIG. 10

The collar, which is a thickened band on the outside of the leaf at the junction of the blade and sheath, is quite distinctive in some species. It is commonly lighter in color than the rest of the leaf and the veins through this area are often very inconspicuous. In some grasses it may be hairy while in others it may be smooth and glossy.

FIG. 11

Some species have appendages projecting from each side of the collar, clasping the shoot. Because of their ear-like appearance they are known as auricles. In many species the auricles are missing but when present they serve as distinctive characteristics for identification.

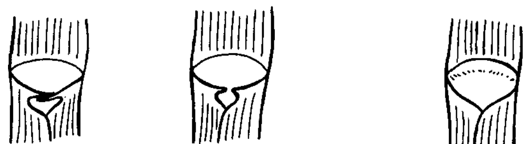

FIG. 12

"Keying out" a grass is merely selecting one of two alternatives which more nearly describes the specimen being keyed. Begin by selecting the first of the two alternatives as indicated by "I Leaves folded in bud", or "II Leaves rolled in bud" then compare the two alternatives under this choice and continue until the name of the species is shown.

The key which follows should be used only if the grass to be identified is a turfgrass or a common turf weed. This key is not applicable for most forage or wild grasses.

I Leaves folded in bud

A Auricles present, veins of blades prominent, ligule truncate membrane, blades glossy on under surface, auricles long claw-like

1. *Lolium perenne,* perennial ryegrass

AA Auricles absent

B Creeping by means of stolons

C Blades petioled, sheaths greatly compressed

D Ligule fringe of very short hairs. Sheaths with few hairs at margins and summit of keel, collar glabrous, blades blunt and rounded at tip

2. *Stenotaphrum secundatum*, St. Augus tinegrass

DD Ligule a ciliate membrane, collar pubescent, blades ciliate

3. *Eremochloa ophiuroides*, centipedegrass

CC Blades not petioled, sheaths compressed

D Ligule fringe of hairs

E Collar broad pubescent, leaves and sheaths heavily pubescent, blade 4-5 mm wide, long, tapering, and V-shaped

4. *Pennisetum clandestinum*, Kikuyugrass

EE Collar continuous, narrow, glabrous or sparingly ciliate. Sheaths and blades glabrous or sparingly pubescent

F Blades 2-3 mm wide, tapering, rhizomes present

5. *Cynodon dactylon*, bermudagrass

FF Blades 4-10 mm wide, blunt and rounded at tip, rhizomes absent

6. *Axonopus compressus*, carpetgrass

DD Ligule a very short truncate membrane

E Blades 1 mm or less wide, margin of ligule lacerate, stolons and rhizomes long and slender

7. *Cynodon transvaalensis*, African bermudagrass

EE Blades 4-8 mm wide, margin of ligule entire, stolons and rhizomes short and thick

8. *Paspalum notatum*, bahia grass (Vernation of *P. notatum* variable, may also fall in group II. Leaves rolled in the bud)

BB Stolens absent

C Blades narrow, involute, and bristle-like, prominent veins on upper surface

D Rhizomes present, forming dense sod, leaves green, culms red at base

9. *Festuca rubra*, creeping red fescue

DD Rhizomes absent, forming spreading tufts

E Leaves bluish-green, 5 to 1.5 mm wide, culms green or pink-tinged at base

10. *Festuca ovina*, sheep fescue

EE Leaves bright green, 1.5 to 2.5 mm wide, culms red at base

11. *Festuca rubra* var. *commutata* Chewing's fescue

CC Blades flat, veins inconspicuous

D Blades with boat-shaped tip and transparent lines on either side of midvein

E Rhizomes usually absent, forming tufts

F Base of culms swollen and bulb-like, blades usually dark green, usually perennial

12. *Poa bulbosa*,, bulbous bluegrass

FF Base of bulms not swollen and bulb-like, blades usually light green, usually annual

13. *Poa annua*, annual bluegrass

EE Rhizomes present, forming dense sod

F Blades tapering, sheaths strongly compressed and keeled

14. *Poa compressa*, Canada bluegrass

FF Blades parallel-sided, sheaths not strongly compressed or keeled

G Ligule short truncate membrane, sheaths smooth

15. *Poa pratensis*, Kentucky bluegrass

GG Ligule acute membrane, sheaths rough

16. *Poa trivialis*, rough staked bluegrass

DD Blades without boat-shaped tip, without transparent lines on either side of midvein

E Blades parallel-sided, tip blunt, prostrate growth habit, annual

17. *Eleusine indica*, goosegrass

EE Blades tapering with pointed tip, upright growth habit, perennial

F Ligule truncate membrane, blades 4-10 mm wide, light green

18. *Dactylis glomerata*, orchardgrass

FF Ligule fringe of hairs, fused at base, blades 2-4 mm wide, gray-green

19. *Distichlis spicata*, saltgrass

II Leaves rolled in the bud

A Auricles present

B Sheaths reddish at base, blades glossy on underside

C Margins of blades smooth, auricles long claw-like, ligule obtuse membrane

20. *Lolium multiflorum*, Italian ryegrass

CC Margins of blades scabrous (rough), auricles short, ligule short truncate membrane

D Auricles generally without hairs orcilia on the margins

21. *Festuca elatior,* meadow fescue

DD Auricles generally with a few ciliate hairs

22. *Festuca arundinaceae,* tall fescue

BB Sheaths not reddishat base, blades not glossy on underside

C Rhizome present

23. *Agropyron repens,* quack-grass

CC Rhizomes absent

D Auricles long claw-like, collar divided

24. *Agropyron cristatum,* created wheatgrass

DD Auricle small or rudimentary, collar entire

25. *Hordeum spp.*, wild barley

AA Auricles absent

B Sheaths round

C Collar hairy, at least at base

D Sheaths not hairy, rhizomes present

E Blade 4-6 mm wide, collar broad, continuous, stolons present, ligule a fringe of hairs

26. *Zoysia japonica,* Japanese lawngrass

EE Blades 2-3 mm wide, collar only sparingly hairy; otherwise as above

27. *Zoysia mattella,* manilla-grass

DD Sheaths hairy, rhizomes not present

28. *Bromus tectorum,* downy bromegrass

CC Collar not hairy

D Rhizomes and/or stolons present, perennial

E Ligule a fringe of hairs, collar broad, continuous

F Rhizomes present, blade smooth

29. *Zoysia tenuifolia,* Korean velvetgrass

FF Rhizomes absent, stolons well developed, blade pubescent or pilose, 2-3 mm wide, gray green

30. *Buchloe dactyloides,* buf-falograss

EE Ligule membranous, collar narrow

F Sheath closed to near top; ligule obtuse; smooth on back

3L *Bromus inermis,* smooth btomegrass

FF Sheath split with overlapping margins, ligule acute, minutely pubescent on back, blades with prominent veins on upper surface

G Stolons absent or weak, forming tufts

H Blade 4-6 mm wide, ligule long

32. *Agrostis alba,* red top

HH Blade 2-3 mm wide, ligule short

33. *Agrostis tenuis,* colonial bentgrass

GG Stolons well developed, not forming tufts

H Blades 1-1/5 mm wide

34. *Agrostis canina,* velvet bentgrass

HH Blade 2-3 mm wide

35. *Agrostis palustris,* creeping bentgrass

DD Rhizomes absent, annual or perennial

F Sheaths white with pink veins, annual

36. *Bromus secalinus,* cheat or chess

FF Sheaths without pink veins

G Base of culms bulbous, perennial

37. *Phleum pratense,* timothy

GG Base of culms not bulbous, annuals spreading, sometimes rooting at lower nodes

H Sheaths pubescent

38. *Digitaria sanguinalis,* hairy crabgrass

HH Sheaths smooth

39. *Digitaria ischaemum,* smooth crabgrass

BB Sheaths laterally compressed

C Sheaths smooth, not pubescent

D Rhizomes present, tall coarse perennial

40. *Sorghum halepensis,* Johnson grass

DD Rhizomes absent, annuals

E Ligule absent

41. *Enchinochloa crus-ealli,* barnyardgrass

EE Ligule present

F Ligule a truncate membrane

42. *Sorghum sudanense,* sudangrass

FF Ligule a fringe of hairs

43. *Setaria lutescens,* yellow foxtail

CC Sheaths pubescent

D Ligule membranous

E Sheaths white with pink veins

F Ligule margin even, hack of ligule pubescent

44. *Bromus unioloides,* rescue-grass

FF Ligule margin notched, not pubescent on back

45. *Holcus lanatus,* velvetgrass

EE Sheaths light green, often tinged with red

F Stolons present, blades pubescent

G Ligule long rounded membrane, stolons long

46. *Paspalum distichum,* knot-grass

GG Ligule short truncate membrane, stolon short, thick

47. *Paspalum notatum,* bahia-grass

FF Stolons absent, blades smooth ligule long notched membrane

48. *Paspalum dilatatum,* dallis-grass

DD Ligule a fringe of hairs, rhizomes absent

E Sheaths pubescent

49. *Setaria viridis,* green fox-tail

EE Sheaths smooth, not pubescent

50. *Eragrostis cilianensis,* stinkgrass

Three Graduate Students Study Turfgrasses at U.C.L.A.

Mrs. June Latting entered the graduate school fall semester 1959, and holds a research assistantship in the Department of Floriculture and Ornamental Horticulture. She is working for her PhD degree jointly in this department and the department of Botany. Her interests are in the fields of grass taxonomy, morphology, and anatomy.

Mrs. Latting received her BS degree in Botany from Tulsa University in 1956 and her MS degree also from Tulsa University in 1959.

Mr. Donald Steinegger began working for his PhD in the spring semester of 1959. He also holds a research assistantship in the Department of Floriculture and Ornamental Horticulture. His special interest is grass breeding and genetics.

Mr. Steinegger is a native of Wisconsin and received his BS degree in Plant Science from the University of Wisconsin-in 1958.

Mr. Allen Wilson came to UCLA in June of this year from Colorado. Mr. Wilson is a recent graduate of Colorado State University with a major in Floriculture and Ornamental Horticulture. He will be working for his PhD degree under a National Science Foundation Grant. He is especially interested in grass genetics and ecology.

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Some Common Causes of Turf Failure in Southern California

R.M. Endo
University of California, Los Angeles

Turf failure problems, involving dead or dying areas of turf of variable size and shape, are generally most common and damaging in California in summer and early fall. Unfavorable growing conditions, scotch, and fungus diseases were found to be the factors most often involved.

With respect to unfavorable growing conditions, high temperatures, heavy soils, soil compaction, thatch accumulation, improper fertilization, improper watering, unfavorable drainage, and excessive removal of foliage by mowing, appear to be the main factors contributing to the poor growth and failure of turf. A discussion of some of these factors and methods for their correction have been considered in previous issues of "California Turf Culture."

Soil compaction, and the use of heavy soils unsuitable for turf are considered to be the two factors most frequently responsible for turf failure. Because tutf tends to die in small, restricted areas, diseases are frequently held responsible. Although diseases were sometimes present, these pathogens were usually very weak ones and were considered incapable of killing vigorously growing plants. There is a general and widespread lack of appreciation of the importance of maintaining favorable aeration (high oxygen and low carbon dioxide levels) for the continued growth and development of grass toots. With heavy soils, this is a very difficult task. Few people realize that soil compaction occurs unevenly over a turf area and that certain small areas may be much more severely compacted than others, particularly those receiving heavy traffic or play when the grass is wet. Plants in compacted soil not only grow poorly from lack of favorable aeration, but also tend *to* suffer from water deficiency due to water run-off and to reduced water penetration. If turf growing in compacted soil is over watered, aeration is still further reduced. Nearly all turf areas suffer from some degree of compaction. One solution is a regular program of aerificaation. Cores of soil are removed from the compacted turf with an aerifiet, and the resulting holes are filled with a suitable light soil mix that is capable of resisting compaction. Aerification is rapidly becoming an accepted practice on golf courses and athletic fields throughout the country.

Scorch is a special case of water deficiency that appears as localized dry spots, usually following hot, dry, windy weather. Plants in areas of variable size and shape turn blue, wilt, and die rapidly from lack of water. The cool season grasses such as blue grass and bent grass are especially subject to scorch since they grow poorly at high temperatures. Frequent and excessively low mowing as practiced on golf greens results in further impairment of growth, and the development of a very sparse and shallow root system (1/2 to 1" in depth). During hot, dry, windy weather plants lose water at a greatly accelerated rate, the top layer of soil dries out rapidly, the leaves wilt and scorch, and the plants die from lack of water.

Almost always associated with scorch is a compacted condition of the soil, and an accumulation of undecomposed or partially decomposed layer of grass clippings, roots, and stems. Both conditions result in a greatly reduced ability of water *to* penetrate into the soil. As a result such areas when dry, are extremely difficult to wet and water tends to run off the compacted and thatched areas. Turf growing in such compacted and thatched areas are particularly subject to sudden drastic changes in watet supply. On golf greens the high areas around the greens are particularly subject to scorch. A regular program of aetification, thatch removal, and renovation procedures will help greatly to reduce and control the localized dry spot problem.

Work conducted to date on turf diseases at UCLA indicate that the most damaging and common fungus diseases on turf in southern California are caused by various species of Helminthosporium. H. sativum, on the basis of greenhouse and field observations, appears to be extremely common and destructive in the leaf spot, foot rot, and root rot stage on Kentucky blue grass. It is believed to be largely responsible for the short life of Kentucky blue grass in California. The blue grass plots at UCLA have developed excellent natural Helminthosporium infection. Kentucky blue grass has been severely affected, and plants in numerous spots have been completely killed. Newport blue grass appears to possess a high degree of resistance, whereas Merion blue grass, although resistant to Helminthosporium, is highly susceptible to rust. The leaf spot stage of Helminthospotium may be controlled with captan, PMA, kromad, actidone, GAB-5, Thimer, Panogen and Tersan OM.

Brown patch, caused by Rhizoctonia solani, and water mold infection of leaves and roots caused by species of Pythium, have also been isolated commonly. In some cases, all three fungi were observed in the same diseased material as in the two Seaside bent plots at UCLA. The multiple infection appeared as numerous small spots in which the leaves were wilted and killed. It was controlled readily by a single application of Gab-5, a mixture of actidione and thiram, at the rate of 4 ounces in 10 gallons of water per 1000 square feet.

Infection of plants by more than one pathogen has been the rule rather than the exception. This fact complicates the problem of diagnosis and control.

RESPONSE OF MEYER ZOYSIA TO LIME AND FERTILIZER TREATMENTS

Meyer Zoysia will grow and persist over a wide range of soil types and at very low fertility levels but will respond with more satisfactory turf if given good management. So reports Dr. Felix Juska of the A R S, USDA in a recent Agronomy Journal paper. Dr. Juska reports that best Zoysia turf was produced at a pH near 7 and adequate amounts of nutrients. Significantly more rapid stolon and root development was obtained when nitrogen, phosphorus and potash were all in good supply.

It seems safe to assume that Emerald and Mattella Zoysia which are more popular in the Southwest than Meyer will respond in a similar manner.

Climate and Growth of Turfgrasses*

Victor B. Youngner
University of California, Los Angeles

Only a few of the many factors affecting the growth of the grass plant can be controlled by the superintendent and then for the most part only partially. He can control the mowing height and frequency but only to the extent which the use requirements of the turfpermits. He can apply the required amount of nitrogen, but he has only partial control of the rate at which this nitrogen is available to the grass plant. Partial protection from insects and diseases at the best is all that he can give. Examine any operation in turfgrass management and you will see that the same condition is true. Some factors affecting grass growth are almost completely outside the range of influence by the superintendent. The most obvious of these are the climatic factors, temperature and light. However, directly or indirectly they are related to every aspect of turfgrass management.

If this is true, from a practical viewpoint, why should we conduct research on the effects of climatic conditions on plant growth? The answer is simple. Only through a greater understanding of the basic principles of grass growth can we arrive at better rules for turfgrass management. From the moment the grass seed is placed in the soil, it comes under the influence of these and other environmental factors. For example, if the soil temperature is too high or too low, germination will be poor and many seedlings will be deformed. And so, throughout the life of the turf, every phase of grass growth and development being primarily controlled by weather and climate, the activities of the superintendent, particularly in timing of operations, can work with nature to develop better turf. When incorrectly done or improperly timed these same activities may work with nature to weaken or destroy the turf.

Through research of past years we have slowly gained a considerable knowledge of these environmental growth factors, but when we look for specific details, our lack of information becomes appalling. However, the recent development of new techniques for the study of environment and plant growth has opened a future full of promise for greatly increasing this knowledge. Such a new technique is the creation of the "phytotron," controlled environment growing rooms, like the one recently constructed for the UCLA Department of Floriculture and Ornamental Horticulture. With the "phytotron" we can regulate accurately the temperature, day length, light intensity, etc. at which the plants are grown to study the effects of specific conditions on growth of the grass plant.

Now let us look at some of the things we already know about this subject. First we must divide our discussion into two phases, the cool season and the warm season grasses, as their behavior in respect to climatic conditions, is vastly different. Of course, individual species within each group also often behave quite differently.

Research work of recent years indicates that with many of our cool season grasses root and top growth are opposing growth phases. That is, conditions which promote top growth are not the same as those that promote maximum root development. This is especially true when we superimpose mowing, as we do in turf culture, over all other conditions.

If we recognize three temperature points in respect to growth; minimum, optimum, and maximum, we find that the three points for root growth are several degrees lower than for top growth for many cool season grasses. This is confirmed by field studies which have shown that maximum root development occurs during the late winter and early spring before much top growth is evident and again in late fall when top growth is slow. In late spring and early summer, the period of maximum top growth, root development has practically ceased.

Food reserves, carbohydrates stored in roots and other plant parts, increase during the period when top growth is very slow. On the other hand, during the periods of rapid foliage growth these food reserves are rapidly used. As temperatures increase above a certain optimum, the rate of food storage decreases until eventually there is a utilization of previously stored food materials. To further complicate this picture, it has been demonstrated that clipping retards both root development and rate of food storage. This is because the plant, in order to renew its top growth following clipping, must have additional food in the form of carbohydrates (sugars, starches, etc.)

High nitrogen feeding which stimulates top growth, when coupled with clipping has a further restrictive effect on root development. When temperatures are high, activity of soil micro-organisms which convert unavailable nitrogen to a form available for plant growth is increased.

Now, where does this information lead us in turfgrass management? First, it is an accepted premise that in order to have a good durable turf there must be a healthy well developed root system below, and in order to have a good root system we must have a vigorous top. On the surface, it would appear that we are fighting a battle against ourselves when we feed and mow. This indeed may be true if good judgment is not used. We see that as warm summer temperatures arrive, natural root development slows and top growth increases. However, we continue to fertilize and mow further retarding root growth and perhaps actually damaging the root system. At the same time organic nitrogen in the soil is being converted to available forms to stimulate more top growth which must be removed. While all this is occurring disease organisms in the soil and organic matter are multiplying as the soil becomes warmer. The result is familiar to nearly everyone working with turfgrasses. The time comes when the turf has a shallow weak root system, a soft succulent top and little food reserve. Then if weather conditions develop favorable for disease infection, practically nothing can stop it.

What can be done to prevent this from occurring? At the present time there is no satisfactory solution but there are a few things which will help to some degree. First of all, time fertilizer applications so as to have only enough nitrogen available during the hot weather to keep satisfactory color. Do not apply large amounts of nitrogen when high temperatures may be expected. Secondly, if possible, raise the mowing height during this season but retain the same mowing frequency. Thirdly, do not apply herbicides or other chemicals, fungicides excepted, which may damage either top or root system at this time. Finally, control water as much as possible to avoid having a saturated soil but at the same time prevent wilting. It should be quite obvious that turf disaster may result at this time from anything which will damage the root or crown of the plant.

Warm season grasses, particularly bermudagrasses, do not exhibit the differential response to temperature. Minimum, optimum, and maximum temperatures for root development closely parallel those for top growth. Similarly food reserves continue to be built up during periods of high temperature. Both food reserves and root development appear to be affected less by mowing than in the case of cool season grasses.

We have some other interesting temperature problems with these grasses, however. These are in respect to low temperatures. It is a common observation that as temperatures drop in the fall of the year, growth of bermudagrass ceases and eventually the turf discolors even though freezing weather has not been experienced. We have found that the minimum temperature for growth of bermuda is approximately 50 degrees Fahrenheit. However, growth will continue at even much lower night temperatures provided day temperatures are sufficiently high – 70 degrees Fahrenheit or above. Some improved strains, Ormond and Tifgreen for example, appear to have a somewhat lower minimum growing temperature.

Zoysiagrasses have an even higher minimum – approximately 60 degrees Fahrenheit for Meyer and around 55 degrees Fahrenheit for Emerald and Matrella.

Discoloration or winter dormancy of these grasses is an interesting reaction to climatic factors. It is generally assumed that this is caused by temperatures between 30 degrees and 40 degrees Fahrenheit. However, this is only partly true as we have kept U-3 bermuda alive and green at a constant 34 degrees Fahrenheit for over a month. This would indicate that another factor is involved in discoloration. We have found that this factor is light intensity. The plants held at 34 degrees Fahrenheit without discoloration were under artificial lights of low intensity. When plants are exposed to high intensity, light comparable to natural sunlight in conjunction with temperatures of approximately 45 degrees Fahrenheit or less, typical winter discoloration develops. Low temperature and high light intensity interact to destroy the chlorophyll (the green coloring material in plants) and at the same time to prevent the synthesis of new chlorophyll. However, if day temperatures are approximately 70 degrees Fahrenheit or above, discoloration will not develop even though night temperatures are just above freezing. Of course, freezing temperatures will stop all growth and bring about discoloration because of tissue destruction and disruption of physiological processes.

Discoloration of Meyer zoysia occurs at slightly higher temperatures and lower light intensities than for bermuda. Emerald and Matrella toysia are more comparable to bermudagrass.

Application of soluble nitrate, ammonia, or urea nitrogen in the fall will prolong the period of green color and will cause earlier greening in the spring. How nitrogen functions in relationship to temperature and light to do this is not at the present time known.

Winter hardiness at temperatures well below freezing is a distinctly different response than the above. There is a consistent inverse relationship between the two reactions to temperature. Varieties which hold their color best in cool weather and continue to grow are the least winter hardy when subjected to freezing conditions. For example, Tifgreen and Ormond which hold color well into the winter in Los Angeles are less winter hardy than common or U-3 which discolor early. Similarly Meyer zoysia which discolors early in the fall is considerably more hardy than Emerald or Matrella which hold good color in cool weather.

It is recommended practice to apply nitrogen in the late fall on these grasses in sub-tropical areas for better winter color. However, in the colder parts of the bermuda belt, this practice is not recommended as it definitely appears to reduce winter hardiness.

**Part of a talk given at the National Turfgrass Conference, Houston, Texas, February, 1960.*

Extension landscape Horticulturist Appointed

The University of California will increase its effectiveness to the public in the field of landscape horticulture with the appointment of William B. Davis on July 1 as extension landscape horticulturist. Through the Agricultural Extension Service, he will assist professional horticulturists with turfgrass, ground cover, shrub, vine and tree problems in the landscape. These horticulturists include park, street tree, highway, school ground, golf course, and cemetery people; landscape contractors, arborists, nurserymen, gardeners, and sales and service people.

Davis will work closely with Marston Kimball, extension ornamental horticulturist located on the Los Angeles campus on the University, with county Agricultural Extension Advisors, and with the Department of Landscape Horticulture on the Davis campus. He will be stationed at Davis.

Davis was landscape and agricultural instructor at Lodi Union High School. He has had experience as a landscape contractor, landscape inspector, and nurseryman. In 1959, he won the American Institute of Landscape Architects award for designing a garden and presenting his solution to the group. He now is senior nurseryman with the University at Davis, where he is completing graduate work for a master's degree in horticulture.