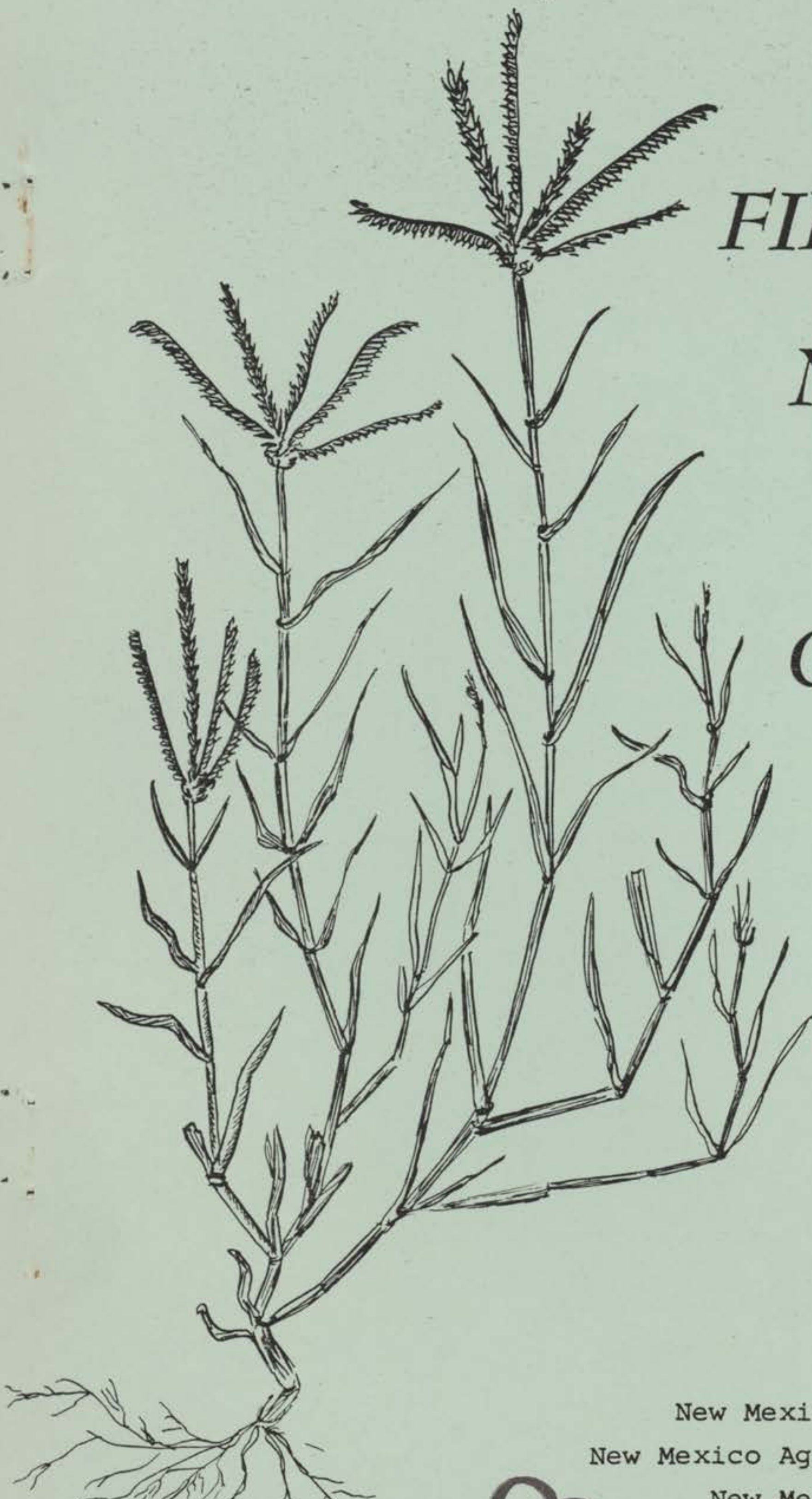
Proceedings of the



FIFTH ANNUAL NEW MEXICO TURFGRASS CONFERENCE

Oct. 5-6, 1959

Sponsored by

New Mexico Turfgrass Association

New Mexico Agricultural Experiment Station

New Mexico Extension Service

Foreword

The Fifth New Mexico Turfgrass Conference was a complete success. There were forty-five individuals registered for the meeting. Several individuals heard only one or two papers and therefore did not register. There was an excellent cross-section of workers in the turf field represented at the conference. These individuals represented golf courses, city park systems, military installations, cemeteries, nurseries, commercial dealers, and Extension and Experiment Station personnel.

We wish to take this opportunity to express our thanks to those who worked toward making the meeting a success. We would especially like to thank Frank Halla and the Myers Company of El Paso for arranging the field trip and dinner.

The personnel of the Experiment Station and Extension Service of New Mexico State University were glad to have each of you on the campus for the Conference. We are looking forward to seeing each of you and others interested in turf at the 1960 New Mexico Turfgrass Conference.

Clarence E. Watson
Secretary-Treasurer

FIFTH ANNUAL NEW MEXICO TURFGRASS CONFERENCE

New Mexico State University
Faculty Club Room, Milton Hall
University Park, New Mexico

October 5 and 6, 1959

October 5

8:00 ---------- Registration

10:00 ---------- Welcome
Marvin L. Wilson

10:15 ---------- Value of Research
Dr. Robert H. Black

11:00 ---------- Announcements
Leave for El Paso

1:30 ---------- Tour of El Paso Area
El Paso Country Club - Jack Hardin
Coronado Country Club - Harry Bell
El Paso Parks Dept.- Bryce Lammert

October 6

8:30 ---------- Annual Business Meeting

9:30 ---------- Turfgrass Research at Middle Rio Grande Substation
Harbour Jones

10:00 ---------- Coffee Break

10:20 ---------- Turfgrass Engineering
J. R. Watson

11:05 ---------- Producing Better Turfs
C. G. Wilson

12:00 ---------- Lunch

1:15 ---------- Turf Damage From Foot Traffic
Dr. Marvin H. Ferguson

2:00 ---------- New Developments in Turf and Ornamental Insect Control
John J. Durkin

2:45 ---------- Coffee Break

3:10 ---------- Native Plants for Use as Ornamentals
W. A. Dick-Peddie

TURFGRASS RESEARCH AT MIDDLE RIO GRANDE SUBSTATION

Harbour Jones 1/

Let us first look into the reasons for having turfgrass research at the Middle Rio Grande Substation.

First to consider is the area designated as the Middle Rio Grande area. This area, in the Rio Grande valley, is almost centrally located in New Mexico. It lies mostly between 34° and 35° latitude which places it at the approximate northern boundary for Bermuda grass or some of the other warm season turfgrasses and at the approximate southern boundary for blue grass and some of the other cool season turfgrasses.

Within the total area there are the urban areas of Albuquerque, Los Lunas, Belen and Socorro. These urban areas have home lawns, parks, school grounds, fairways, golf greens, airports and cemeteries which require a grass cover. Many of them require a varied type of grass cover from the others.

The interurban areas, especially around the city of Albuquerque, are thickly populated and most home owners desire a nice home lawn.

Within the area the soil types are many and varied. Within the valley proper, the soils vary in texture from heavy textured clay soils to light textured sandy soils. The mesa soils, outside of the valley proper, are mostly light textured soils. Each of the different soil types present their own particular problems in the variety of turfgrass grown and management practices in growing the grass.

Climatic conditions within the area vary considerably and thus affect the species or varieties of turfgrasses that are grown. Blue grass does remarkably well in lawns from early spring until about June 15 when daytime temperatures reach the high nineties and the relative humidity is rather high. From June 15 through July and August very careful management practices are required to retain stands of blue grass in areas that are not fairly well shaded.

The average frost free days for most of the area are from April 15 to October 15, which means that Bermuda grass would be green only for the period of May 1 to October 1. Most home owners and greens keepers desire a longer green season for lawns or turfs.

Thus we see some of the problems encountered in lawn and turfgrass production within the area.

Turfgrass research was started at the Middle Rio Grande Substation in the spring of 1958 when 69 strains and varieties of hybrid Bermudas and two Zoysia varieties were transferred from the main station at New Mexico State University and plugged in at a deep sandy soil site at the Middle Rio Grande Substation at Los Lunas, New Mexico. Since

1/ Superintendent and Associate Professor of Agronomy the Substation was in an early stage of development, the sandy soil was the only site accessible to both gravity flow pump irrigation water and sprinkler irrigation water from the domestic well.

The sandy soil was very low in organic matter, due to the removal of the top soil in the leveling operation, and as a result the growth and spread of the Bermuda plots was relatively slow. Bermuda strains and varieties had completely covered the plot area by October 1 but the two Zoysias had spread very little.

Growth characteristics of most of the Bermudas were different from those of the same Bermudas at the main station. Excessive production of seed heads was evident on a high percentage of the Bermuda plots. This characteristic was attributed to the relative low soil fertility and also to the wider fluctation between day and night temperatures than is normal at the main station at University Park.

The 69 Bermudas and 2 Zoysias were transplanted to a medium textured soil in early September of 1958. All plots made sufficient root growth before freezing temperatures in late October that they went through the winter without loss of stands.

The 1959 spring and summer growth of Bermudas on the medium textured soil was much more rapid than the 1958 growth on the sandy soil. The color of all plots on the medium textured soil was much darker green than on the sandy soil. Other plant characteristics, such as seeding, turf density and turf texture on the medium textured soil closely paralleled those on the sandy soil.

In early September, 1959, there was started the process of elimination of the undesirable Bermuda strains and varieties. A total of 27 strains and varieties were eliminated on the basis of their undesirable characteristics of texture, density, color and seeding. Texture and seeding were the two main factors considered in eliminating strains or varieties. Twenty of the Bermudas eliminated were coarse textured and 7 were fine textured.

There are three Bermudas that showed promise during the 1959 season.

T-82 (Ormond) - Ormond had a very high turf density; the texture was considered as medium for coarse type Bermudas; there was very little seeding and the color was a pleasing dark green. Ormond grows faster than some other Bermudas but considerably slower than Kentucky bluegrass. Ormond browned off with the first fall frost and showed some winterkill in January 1959.

T-47 - low in seeding, vary dark green, slower growing than T-82 in spots at different times during the growing season.

Tifton 421 - Medium to high turf density, very low seeding, fine textured. Somewhat light in color but possibly could be darkened in color by the use of proper rate and time of application of fertilizer.

Out of eleven blue grass varieties that were spring planted in 1959, there was only one, Newport C-1, that went through the summer season without heat injury. Kentucky blue grass showed about 70 per cent heat kill.

Ranier, Creeping red, Chewings and Sheep fescues, spring planted in 1959, were very susceptible to summer heat and killed out to a great extent.

One bentgrass introduction, Agrostis transcaspica, withstood the summer heat without any loss of stand. This bentgrass is a bunch grass and has an undesirable yellowish green color, but is low growing and forms a soft, dense turf when planted thick.

Buffalo grass, Buchloe dactyloides, planted in late May, made a nice summer growth and although not of the color most people desire in a lawn or turfgrass, it may have a place in a landscape holding with a grass native to New Mexico.

This has been a very interesting season working with turfgrasses and we hope that within the near future we will have some information on turfgrasses that will be beneficial to the large number of people that are concerned with the growing of turfgrass for various purposes.

TURFGRASS ENGINEERING

J. R. Watson 1/

The title of this discussion may, at first thought, appear somewhat ambiguous. The culture and management of turfgrass is usually considered, and rightly so, to be a biological science. One of the basic concepts of biology - the science of life or the branch of knowledge which treats of living organisms - is one of change. The magnitude of the "change" may vary from the scarcely detectable such as individual cell division to the obvious such as partial to total cessation of growth resulting from severe disease infestation. The rate and kind of change occurring in turfgrass is directly influenced by environment. One of the most obvious changes which affect maintenance of turfgrass areas is growth which results in the necessity of mowing.

Engineering, originally defined as the art of making engines, has come to mean "that applied science concerned with supplying human needs in the form of structures, machines, manufactured products, precision instruments and providing the means of lighting, heating, communication and transportation and other productive works". Engineering also may be defined as maneuvering or contriving.

1/ Director, Division of Agronomy, Toro Manufacturing Corp., Minneapolis 6, Minnesota.

An engineer is one who follows, obviously, any branch of engineering. An engineer, however, may be described as one who skillfully manages or carries through some enterprise. Certainly in this sense the turfgrass Superintendent or Manager is an "engineer".

In engineering one thinks in terms of mathematical exactness and precision. Two plus two is always equal to four - there are no if's, and's or but's, this is a certainty! In turfgrass culture such is not the case - two ounces of a chemical applied to a thousand square feet may, if it's the right chemical and if the environmental conditions are right produce the desired results, but it may rain or turn cold two hours after application and your efforts will have been to no avail. When dealing with biological materials, nothing is ever certain. Herein lies the apparent ambiguity of the title - the certainty of engineering - the uncertainty of turfgrass culture.

A closer examination of the title will, however, reveal a close relationship between turfgrass and engineering. Engineering is involved in the design and layout, the construction, establishment, irrigation, in many maintenance practices and in design and production of all equipment used for turfgrass care and management. Application of sound engineering practices with particular emphasis on design, layout and construction from the standpoint of future maintenance will pay substantial dividends in the form of reduced operating costs. Turfgrass culture, to be efficient and economical, should be carried out on a foundation produced by the application of sound engineering principles.

Design and Layout

Today, with the ever-increasing demand for land and the continual pressure for expansion of industrial and home building, suitable sites for turfgrass areas are at a premium. Even when available property located in or near cities and towns commands such high prices and produces such high taxes that it is economically unfeasible to choose or select a centrally located site for future turf areas, especially golf courses and parks.

The club or city seeking locations for golf courses, parks and school grounds is often forced to accept sites quite some distance away and, more often than not, these sites are marginal as far as their suitability for turfgrass areas is concerned. Such necessitates very careful attention when planning the layout and design of future turfgrass areas. Marginal property, unless carefully developed, will intensify problems of soil modification and drainage. Unless thoroughly planned and constructed, player and user dissatisfaction may develop and maintenance costs become excessive. The necessity for rebuilding of golf greens, often only a few years after initial construction, is an excellent example of the importance of doing the job right to start with.

To assure a well engineered layout, the first step after securing the property is to prepare a topographical map of the area. Musser, in his book "Turf Management", recommends that the topographical survey should show the elevation of the property by contours of one foot intervals. Single large trees should be carefully located and groves shown in mass. The boundaries of the property, all streams, ravines, swamps, bogs, stone out-croppings and various soil types also should be carefully located or outlined. From such a map the preliminary plans for development of the site can be made. Several alternate plans should be developed especially for golf courses and parks. These should be studied in detail by all concerned with the project and agreement reached on the final version. The ultimate plan should be the one that most nearly meets the requirements from a functional and economical construction and maintenance standpoint.

When planning a golf course, Musser points out that a gently rolling site is normally preferred. Such avoids strenuous hill climbing which reduces the enjoyment for many players. A steep hilly course also may limit the use of motorized golf carts which have become such an integral part of the game today. A flat almost level course in addition to being monotonous may fail to present an adequate challenge. These factors can be offset somewhat by rotating the yardage and, of course, completely by altering the terrain.

When developing a park site, location of the athletic fields, picnic areas, wild flower and woodland sites is all important. Athletic fields should be easily accessible from streets yet secluded enough or protected from homesites to prevent property damage and vandalism. Picnic sites should be shady and tables located in such a manner as to provide partial seclusion. Play areas large enough for group games should be situated near by. Picnic areas should also be reasonably close to any particular natural or historical feature located within the park. Botanical gardens, rose gardens, etc. must be located in areas easily accessible to the public, yet blended into the overall landscape.

School grounds as well as parks must be organized to accomodate people - in the case of school grounds, the student body. Walkways, landscape areas, recreational and service areas all must be planned and developed for maximum utilization. Pathways and walks should be planned with the idea of handling traffic - they must be located where students walk or will walk - not where they best fit from a landscape standpoint.

These are only a few of the total number of considerations that must be taken into account when planning the development of turfgrass areas. The more marginal the property the more important it becomes to carefully plan the development of a future turfgrass area.

Construction

The next phase in the development of an area is the actual construction. This phase involves, almost altogether, the application of civil engineering techniques. Construction begins with the installation of all grade lines, staking of fill and cut areas, locating mains and laterals of the irrigation system, and staking rough outlines of tees, fairways, greens or playing fields, etc. All this is laid out before the actual "moving of the dirt" begins.

With the modern high speed, large capacity earth moving equipment available today, major terrain modification is economically practical. Entire hillsides may be moved and ravines filled and leveled thus creating sites which will be more functional, attract more people and thereby produce more revenue.

The problem of soil modification becomes more critical when large scale shifting of terrain becomes necessary. Modification of chemical properties (addition of plant food) of all soil - disturbed and undisturbed - is usually considered essential. Modification of the physical properties, other than providing for drainage, is normally impractical on large scale sites. On intensively used sites such as golf greens and tees, shrub and flower beds and athletic field modification is practical and should be given very serious consideration. The expenditure of a few additional dollars at the time of construction will generally preclude excessive and recurring expenses for maintenance and operation of the future turfgrass area. Too, a much higher quality of turf can be grown if the foundation is correct.

Physical soil properties (texture, structure, porosity) govern the infiltration, retention and movement of moisture in the soil; control the air-water relationships; and because of their interrelationship with the chemical and biological properties, exert a major influence on the productivity of soils. Physical soil properties are modified to: (1) improve water infiltration (getting water into the soil), (2) improve water retention (water holding capacity), (3) facilitate percolation (movement of water through the soil, and (4) facilitate drainage (getting rid of the excess). When these functions proceed in a desirable manner, the air-water relationships are properly balanced.

Often we are prone to think of physical soil modification as a rather inexact procedure; a rather hit and miss process in which some sand, clay or peat is added and then a few rather crude tests on percolation, compactability, etc. are run. Today, this need not be so. Information collected from work supported by the U. S. G. A. Green Section at Texas A & M is precise enough to permit a high degree of accurateness in preparing mixtures for golf greens. Similar standards could be developed for athletic fields. With the application of these techniques soil modification could become a rather exact procedure. The dividends in the form of reduced maintenance costs and better quality turf would more than offset the cost involved in making the determinations.

Landscaping

Following, and often during the final stages of construction, landscaping of the area can begin. Employment of a competent Landscape Architect is always a desirable move. Among other things which should be considered in the landscape design is the location and spacing of plantings. In so far as possible, they should be spaced to permit mowing with high speed, large capacity equipment. Such eliminates the need for trimming with small equipment which adds to the cost of maintenance.

Management

While the actual culture of turfgrass is a biological science, the techniques and procedures of applying chemicals - fertilizer, fungicides, herbicides, insecticides, etc. is, or at least should be, very exacting. Proper calibration of equipment, calculations involving amounts and areas are all a part of turf engineering. Properly done these and other maintenance techniques eliminate a great deal of the uncertainty of turfgrass management.

Summary

Turf engineering is a term which may be applied to practically all phases of turfgrass establishment and maintenance. Engineering techniques are involved in the design and layout, the construction, landscaping and management of turfgrass areas. Certain phases of construction, particularly modification of physical soil properties, lend themselves to more exacting techniques than have been employed in the past. I believe that if "turf engineering" were given more serious attention, many mistakes in construction which contribute ultimately to excessive maintenance costs and sometimes rebuilding expenditures could be eliminated. On established areas application of "turf engineering" will produce better results and eliminate in many cases dissatisfaction with the performance of materials.

PRODUCING BETTER TURFS

C. G. Wilson 1/

To produce better turf one must first understand the eight basic factors that govern plant growth. In fact, when the "big eight" are in balance one does not have better turf, he has perfect turf.

The first is the right grass suited to the local climate and weather. Obviously Bermuda or Zoysia has no place in the land of the northern lights. Conversely, cool season grasses in the tropics are equally out of place except, perhaps, as an overseeding for winter cover. The point overlooked by the layman is the tremendous variation

1/ Agronomist, Milwaukee Sewerage Commission, Milwaukee, Wisconsin

in weather in a restricted area. Dr. Keen, Kansas State University, tells us a plant transplanted from the north to the south side of a home in his zone can be the equivalent of a 500 to 600 mile journey due south!

Secondly, grass must have light to thrive. Kentucky blue grass and Bermuda are good examples of sun loving plants. Where shade is a factor, ones choice should be red or chewings fescue in drouthy soils, or Poa trivialis under moist shadded conditions in cool humid areas. In the south Zoysias and St. Augustine are noted for their ability to do well under partial shade. If light is extremely limited, ground covers must be used instead of grass.

The third factor is favorable air temperature. This might be likened to the oppressive heat experienced in many metropolitan centers on a hot summer day as compared to the relative comfort of a suburb in the same area. On golf courses the trouble greens invariably lie in a pocketed area. Often, the clearing of underbrush and trees in the line of prevailing breezes will correct the bad condition because air movement lowers the temperature.

We have listed enough water as factor number four, although in this list each factor is as important as any other. None can stand by themselves in attaining our goal of perfect turf. About 80 per cent of growing grass is water. It has been estimated that it takes 1000 pounds of water to produce 1 pound of dry matter on a bentgrass putting green. Yet most turf ills relate to the improper use of water. When the voids between soil particles are saturated with water, vital oxygen is excluded. Grass roots must have air as well as water. In fact, grass can wilt when standing in water. All of this emphasizes the importance of deep, infrequent watering. Frequent, shallow irrigations encourage disease, compaction and weeds.

Factor number five is a favorable soil environment. To be truly productive, soils must be uniform and as deep as grass roots are capable of growing. Grass will grow on any textured soil. Excellent turf is maintained on the peats of Minnesota, the sands of Florida, and the adobe clays of California. Man errs in attempting, but seldom succeeding in his efforts to modify soil. Topping an area composed of any of the afore mentioned with 2 or 3 inches of garden loam before planting is a criminal practice, in our opinion. Roots will be restricted during periods of stress because layers of any kind hamper drainage.

This does not mean to imply that clay, sand or peat is a better medium for growing grass, or that modification is never necessary. Ideally, grass grows best on a medium sandy loam. When properly mixed, it will contain about 50 per cent solids of which 10 to 15 per cent is organic matter. This leaves 25 per cent for water storage and 25 per cent for air. Such a soil drains readily, yet still acts as a storehouse for needed plant food elements. On intensively used areas like putting greens and play fields every attempt should be made to approach this goal. Preferably, the ingredients of this soil should be mixed off site and allowed to compost or weather before use. Again it must be uniformly deep. Some may be satisfied with a rooting depth of 1-foot. However, it is interesting to note that research at the University of California's Davis Campus indicates Kentucky blue grass is capable of sending out live roots to a depth of almost 4 feet. Bent and fescue will root to 2 feet and Bermuda feeds below 6 feet on uniform soil. This, by the way, is on turf plots mowed between ½ and 1½ inches depending on the grass.

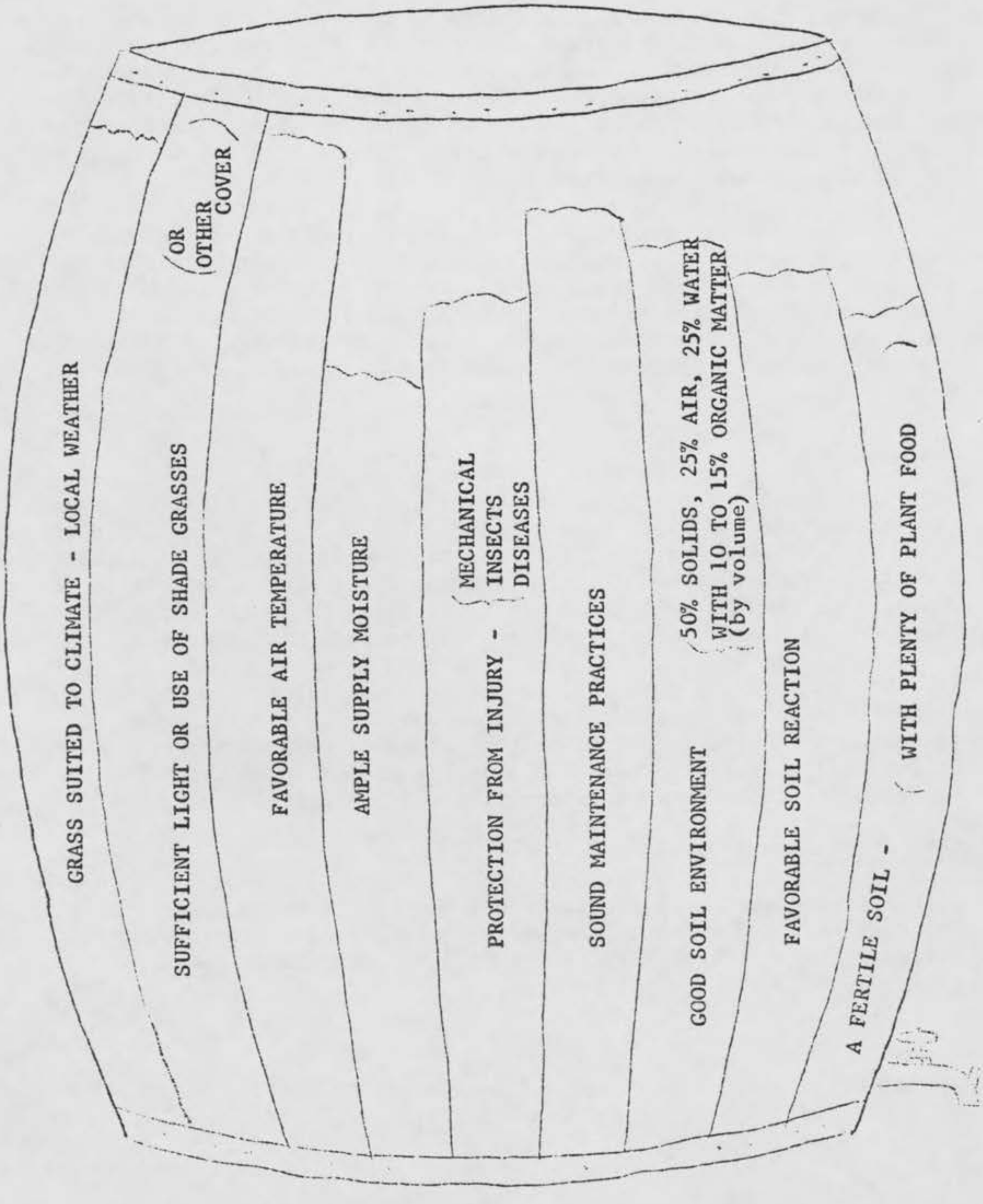
Number six is favorable soil reaction. Soils can be too acid or too alkaline to support good growth. A pH range of slightly acid 6.0 to slightly alkaline 7.5 (7.0 is neutral) is considered ideal by turf experts. The professional turf grower should have a soil analysis made periodically by a competent laboratory. Sampling depth should never vary (we specify exactly 2-inches) and the results must be interpreted by a turf authority to be meaningful. When soils are too acid, trace element toxicity can occur, and one lowers the efficiency of nitrogen use by the grass. Under alkaline conditions, sodium, carbonates, and soluble sulphates and chlorides can prevent growth. Only a chemical soil analysis will provide this information along with corrective procedures.

The seventh factor is a fertile soil. Nitrogen is considered the key element in growing grass since it is required in greater amounts than any of the others. Actually, some fourteen or fifteen elements are needed. The plant manufactures three of these - carbon, hydrogen, and oxygen. The remainder must be supplied. Needs for phosphorus and potash are determined by soil analysis as is calcium and magnesium. Overlooked by some is the fact that turf requires as much sulphur as phosphorus. The so called minor elements are present in most soils or are provided as a fringe benefit in a few of the natural organic fertilizers used. Iron is probably the most important minor element, although copper, zinc, molybdenum, manganaese and boron are also needed in trace amounts. Most of these are subject to "tie-ups" in the soil that make them unavailable to the plant. This is another reason to have soil tests made periodically, and adjust soil reaction to prevent this from happening.

Our final factor is protection from injury. Even the best maintained turf is subject to attacks from insects and diseases, and an improperly adjusted mower can ruin excellent grass in a matter of hours. When disease, or an insect, or traffic, or a poor mowing job thins out the turf, weeds invariably enter. Prevention, then, is the best approach to the protection from injury factor. There are several good fungicides and insecticides available, and the use of aeration tools to alleviate compaction is common-place today. Mower manufacturers and their distributors furnish operating manuals with each piece of equipment. It is foolish when one doesn't follow their suggestions on equipment maintainance to the letter. And last but not least, when weeds invade there are many selective weed killers at your disposal.

In our "barrel diagram" we mention another factor - sound maintenance practices. Actually, this involves all of the others. The factors never change whether one lives in Alaska or Alabama. However, timing or knowing when to do the job depends on location. As an example, Fall is the preferred month for seeding in the north. In the south, Spring or early Summer is the proper time to plant.

Thus, the importance of management cannot be overstressed. Toro Manufacturing Company's, Dr. Watson noticed the first three letters (MAN) and suggested they be capitalized. The MAN of management is, of course, you. You must decide when to plant and when to fertilize, or whether it is a bug or a disease that needs treating. The next three letters spell AGE. This refers to experience. Dollarspot disease and sodwebworm injury can look the same. Experience tells you which one is causing the trouble. MEN falls next in line. Most of you do not grow grass alone. Your labor, or men, must work for you and not against you. Any knowledge or enthusiasm that you pass on to them is a direct measure of your success in growing grass. This leaves the letter T to complete the word MAN-AGE-MEN-T. It stands for Thoroughness to each and every factor that makes up perfect turf. Their effect can be likened to the capacity of a barrel. The amount of water it can hold is governed by the shortest stave. As each short stave is lengthened, the next shortest determines the capacity. The same prevails with grass. Satisfactory performance can only occur when all factors affecting growth are favorable.


GRASS SUITED TO CLIMATE - LOCAL WEATHER
SUFFICIENT LIGHT OR USE OF SHADE GRASSES
(OR OTHER COVER)
FAVORABLE AIR TEMPERATURE
AMPLE SUPPLY MOISTURE
PROTECTION FROM INJURY -
MECHANICAL
INSECTS
DISEASES
SOUND MAINTENANCE PRACTICES
GOOD SOIL ENVIRONMENT
50% SOLIDS, 25% AIR, 25% WATER
WITH 10 TO 15% ORGANIC MATTER
(by volume)
FAVORABLE SOIL REACTION
A FERTILE SOIL -
WITH PLENTY OF PLANT FOOD

TURF DAMAGE FROM FOOT TRAFFIC

Dr. Marvin H. Ferguson 1/

Traffic effects on turf become increasingly troublesome. The numbers of golfers are increasing, the amount of cart traffic is increasing, and maintenance is becoming more intensive. These facts provide a good reason for trying to evaluate the damage caused by traffic on turf.

Damage from traffic is manifested in at least three ways. First, there is attrition to the grass plant itself, the bruising and tearing of the plant structures. Second, the soil is compacted and it loses desirable structural qualities. Third, there are the resulting effects of encroachment of weeds, infection by diseases, and infestation by algae. These troubles come about partly because of thin, worn turf and because of soil compaction.

During the last two years, some rather simple experiments involving the effects of different types of shoe soles have been conducted by students in agronomy at Texas A. & M. College. These tests have provided some interesting information with regard to the degree of damage caused by various types of shoe soles but they have provided also some insight into the relative importance of the various manifestations of damage.

1958 Studies

The results of the first series of tests, which were conducted in the early summer of 1958, were published in the USGA Journal of November, 1958. The traffic described in these tests consisted of paths which were traversed 630 times during a period of six weeks. Of the shoes employed in the test, it was found that the ripple-soled shoes were least damaging and that conventional spikes were most damaging.

Several methods were used in attempts to measure and report the degree of damage. Visual observations and the DQ (double quadrat) technique were used in recording the amount of wear on the plants making up the turf. An indication of the degree of soil compaction was obtained by measuring the amount of deformation which occurred across the paths.

1959 Studies

A second series of studies was conducted in the spring of 1959. Mr. Dale Darling, a senior student in agronomy at Texas A. & M., and a recipient of the Trans-Mississippi Golf Association scholarship, did this research as a special problem.

1/ Mid-Continent Director and National Research Coordinator, United States Golf Association Green Section.

There were numerous criticisms of the techniques employed and the conclusions drawn from the first series of tests. The following complaints were typical.

1. Golfers do not make paths in putting greens. The test measured only the effects of walking in a straight line.

2. There was no effect of turning such as the golfer does when he applies "body English" and when he retrieves his ball from the cup.

The 1959 tests were set up in such a way that these faults of technique would be corrected. Squares of turf ($2\frac{1}{2}$' x $2\frac{1}{2}$') were marked off and a cup was set in the middle of each square. The tests were replicated three times. Each replication consisted of four plots. Of these, three were subjected to traffic from different shoe sole types and one plot received no traffic. This plot served as the check.

The traffic was applied in the following manner. A man took a putter and one golf ball and spent ten minutes each day putting the ball into the hole. He dropped the ball, putted it into the hole, retrieved it, dropped it on another part of the plot, moved around the cup, assumed his stance, putted the ball again, etc. Thus, with each type of shoe, ten minutes traffic each day was applied to the appropriate plot. The tests were continued for a period of five weeks.

In the 1958 tests, there was some indication that the shoulder surrounding the spike used on conventional golf shoes was contributing to the compaction of the soil. Therefore, in these tests, the three shoe types employed were the conventional spiked shoes, the ripple soled shoe, and one with modified spikes. The modification consists of removing the shoulder from around the spike. The threaded receptacle which fits between the layers of the shoe sole is enlarged by the addition of a metal disk. Thus the only protrusion from the shoe sole is the spike itself.

The damage to the grass plants appeared to be about the same in the case of both conventional and modified spikes. Damage was considerably less severe on plots on which the ripple sole shoe was used.

The degree of damage to the soil did not become fully apparent until several weeks after the termination of the experiment when the plots began to recover. All plots had recovered with the exception of the ones on which conventional spikes were used. These plots still showed some bare areas and an infestation of algae and weeds.

Conclusions

These tests, while not extensive, point up clearly several facts about traffic damage on turf. They indicate a need for much more attention to this matter of wear.

The first visible effects of traffic are the footprints which may be only temporary in nature. Then comes the bruising of stems and leaf structures which becomes noticeable when the damaged tissue dies and begins to dry out. As bruising continues, the crown of the plant, the stolons, and the upper part of the root system begin to be damaged.

Concurrent with injury to the structure of the plant, the soil is compacted. Air is excluded from the root zone and infiltration of water is retarded. A weakened turf, and the encroachment of weeds and algae, are almost certain results.

Grass plants which are injured may recover and heal any bare areas that may exist, but the correction of soil structural deterioration is a very slow and difficult matter. Thus some of the most serious traffic damage is not visible on the surface.

In the light of observations reported here, it would appear that frequent changes of cup locations and tee markers is extremely important. If one waits until the turf area begins to show visible damage before changing the cup location, he has allowed far more serious invisible damage which may not show up until some later period when conditions are unfavorable to turf growth.

NEW DEVELOPMENTS IN TURF AND ORNAMENTAL INSECT CONTROL

John J. Durkin 1/

Before I go into a discussion on what's new in insect control on turf and ornamentals, I would like to remind you why we have problems with insects on golf courses, parks, and recreation areas.

Most of you are dealing with areas that are man-made. In most cases trees, shrubs, and lawn grasses have been introduced into an area where they would never exist or be able to survive under natural conditions. When a park or golf course is so established, it can be compared to the building of a shopping center and housing development because that is exactly what you have done for the insects that attack the various species of trees, shrubs, and grasses that you have planted. You are giving them a wide variety of food and shelter. And, once the insects begin to move into your recreation area, they gradually become established and begin to multiply.

Just as you are equipped to irrigate, fertilize and carry out maintenance work, you should be prepared and equipped to control insects. Insecticide application equipment and the way it is used is just as important as the insecticide that you choose.

1/ Extension Entomologist, New Mexico State University.

You should always be on the alert for insect infestations. Very often, insect build-ups and the extent of their damage is very gradual and goes unnoticed until the population reaches outbreak proportions and drastic measures have to be taken to control the infestation. This is true of many of the insects that live in the soil and feed on grass roots.

On the other hand, some insect infestations develop quite rapidly and they cause extensive damage in a very short time. Watchfulness and preparedness really pay big dividends in such cases.

Many new and useful insecticides are coming on the market. Most of them are filling in the gaps in insect control that the older compounds have left. Many have a wide spectrum of insect killing activity so that one chemical will do the job that it took a combination of two or three to do before. Some are finding a place because they are easier to handle with less danger to the applicator. Others are useful because of long residual action, systemic action or quick knock-down.

But just because there are many new insecticides appearing on the market, it is no reason to forget the old stand-bys like DDT, chlordane, malathion, and lead arsenate. It is still hard to beat a combination of DDT and malathion for general foliage insect control from the standpoints of safety, ability to kill a wide variety of insects and economy.

Some of the insecticides that I mention won't be new to some of you and others are so new that there is very little information on their uses for turf and ornamental pest control. As you probably know, most agricultural chemicals are first developed for use on crops and then adapted for use on turf and ornamentals.

Dieldrin is a relatively new insecticide that most of you are probably familiar with. It is mainly used in the ornamental pest control field for control of soil insects such as grubs, wireworms, sod webworms, billbug larvae, cutworms, armyworms and ants. It is gradually replacing chlordane because it is more economical to use. A gallon of chlordane liquid concentrate may cost less than a gallon of dieldrin liquid concentrate but the gallon of dieldrin will control the insects on a much greater area of turf than the gallon of chlordane will. There is also less danger of injuring turf with dieldrin.

Heptachlor is another insecticide that has been on the market for several years. It is similar to chlordane and dieldrin and controls most of the soil infesting insects. It is a little more economical than dieldrin but it is not readily available in New Mexico.

Dieldrin and heptachlor are also very effective against adult mosquitoes when applied as sprays to mosquito resting places and the granular forms can be used to control the larvae in breeding areas that are not used for fish or drinking water.

One of the major problems on golf courses, parks, and recreation areas is keeping spider mites or red spiders under control, especially on evergreens such as cypress and arbovitae. In recent years many very effective and safe-to-handle mite killers have been developed. Some that are now readily available are Kelthane, Aramite, chlorbenzilate and Diazinon. One that will soon be available is Tedion.

These chemicals, with the exception of Diazinon, are strictly spider mite killers; they will not kill insects.

Aphids or plant lice are another problem on most ornamentals. Malathion is still one of the most effective aphid killers available. However, Diazinon and a new compound that you will be hearing more about, Dibrom, are very effective aphid killers.

For control of chewing insects that defoliate shade trees and other ornamentals, DDT is still one of the most effective insecticides. As mentioned before, it is even more effective when combined with malathion.

Diazinon is one of the new insecticides that is showing great promise for use against chewing insects.

Sevin is a new insecticide that you may be hearing more about as a general purpose insecticide for use against most chewing insects and many aphids. However, it has one bad characteristic that can't be overlooked. It usually stimulates spider mite build-ups.

Systemic insecticides are insecticides that are taken up by plants and make the plant juices poisonous to insects. Systemic insecticides are very effective against aphids and spider mites. Systox is widely used on agricultural crops but because it is so poisonous to man it cannot be generally recommended for use around recreation areas unless extreme caution is used when spraying it.

Thimet and Di-Syston are two new systemic insecticides that are showing great promise for use on ornamental plantings. The big advantage that they have over Systox is that they can be applied to the soil in granular form and the roots take up the poison. Both Thimet and Di-Syston are as poisonous to man as Systox, but since they don't have to be applied as sprays they are not as hazardous to handle.

Although Thimet and Di-Syston are being used as seed treatments for agricultural crops, it will probably be a few years before they can be adapted for general use on ornamentals.

Another pest problem that is becoming more apparent every year is that of nematodes. Nematodes are small, almost microscopic, worms that feed on the roots of plants. The most common one in New Mexico is the root-knot nematode. It derives its name from the type of injury that it causes, that is, it makes galls or knots on the roots as it feeds. Root-knot nematodes attack most broad leafed plants and can cause considerable damage. Their feeding prevents the roots from taking up necessary moisture and food. Therefore, the above-ground symptoms are stunting, wilting, lack of vigor and eventually death of the plant.

The root lesion nematode is another microscopic worm that attacks the roots of plants. However, its presence is not as obvious as that of the root-kno nematode because it doesn't form the knots on the roots. The above-ground symptoms are essentially the same as those shown by plants that are being attacked by root-knot nematodes.

The answer to the nematode problem is a chemical called Nemagon. Nemagon can be mixed with water and applied directly to the soil. Nemagon fumigates the soil, killing the nematodes without injury to most ornamental plants.

If you have ornamental plantings that don't respond to water and fertilizer the way they should, you should look at the roots for signs of nematode infestations. Plants grown on sandy soils are usually damaged more severely by nematodes.

Chemicals alone will never solve all of our insect control problems. Cultural practices are very important in keeping down insect damage. Plan ahead and plant trees and shrubs that aren't hosts for a wide variety of insects. Prevent over-crowding and keep plants well supplied with water and fertilizer. Vigorous plants can take more insect damage and suffer less from insect attack than unhealthy plants.

If chemicals have to be used, apply them when the infestation starts - not after insects have caused extensive damage. Use machinery designed for insecticide application and apply chemicals thoroughly.

Above all, be alert and prepared to fight insects.

NATIVE PLANTS FOR USE AS ORNAMENTALS

W. A. Dick-Peddie 1/

If native plants could be successfully grown and propagated, many could be used to landscape areas that receive no supplemental water. Time and money could be saved by discontinuing the present supplemental watering on certain areas. Areas where the use of native plants would be desirable might be corners and borders of playing fields, park corners, cemetery boundries, golf course extremities, road side parks, shoulders, and barrow pits. Some native plants are attractive enough for landscaping public buildings and private homes.

Very little work has been done with the use of native plants for ornamentals. A few, of course, such as the cactus, yucca, ocotillo, and century plant are old standbys. However, there are many other natives that would have considerable appeal if they could be grown and propagated. A few have been tried, while most have not.

1/ Associate Professor of Biology, New Mexico State University.

I have made a brief list of some of the most attractive and promising native plants that should be tried as ornamentals. I shall now show you colored slides of these plants.

A. These have been used in southern New Mexico and found to be useful.

1. Creosote Bush - Larrea divaricata. Found over most of the southern lowlands of the state. Evergreen, may be transplanted, prunes well and may be used as hedge or solitary shrub. Will respond to supplemental water.

2. Desert Willow - Chilopsis linearis. Found in lower southern areas of the state in washes. Blooms for many weeks and has attractive flowers. May be trained as a tree and transplanted or grown from seed.

B. The following plants hold promise and should be tried. They are largely from the southern one-third of the state and there are as many, or more, from the northern and mountain regions that could be tried.

1. Medium to large shrubs, shrub-like annuals, and vines.

a. Feather pea-bush - Dalea formose - purple and yellow.
b. Winterfat - Eurotia lanata - silver-white.
c. Turpentine bush - Haploppapus laricifoliua - yellow
d. Trumpet flower - Tecoma stans - yellow-orange
e. New Mexican Locust - Robinia neomexican - pink-purple
f. Shrubby cinquefoil - Pontentilla fruticosa - yellow
g. Apache plume - Fallugia paradoxa - white
h. Snake weed - Gutierrezia Sp.. - yellow

2. Low shrubs, shrub - like annuals

a. Rock daisy - Melampodium leucanthum - cream
b. Prairie zinnia - Zinnia gradiflora - yellow with orange center
c. Prairie zinnia - Zinnia pumila - white with yellow center
d. Paper flower - Psilostrophe tagetina - yellow
e. Mouse ears - Tidestromia lanuginosa - silver-white with minute yellow flowers
f. Lemon weed - Pectis papposa - yellow with orange center
g. Desert marigold - Baileya multiradiata - yellow gold
h. Bladder-pod mustard - Lesquerella gordoni - yellow with orange center
i. New Mexico buckeye - Ungnadia speciosa - pink-purple
j. Gaillardia sp. - Gaillardia sp. varigated
k. Nama - Nama demissum - purple
l. Othake - Palafoxia linearis - lavender - pink
m. Locoweed, milkweed - Astragalus spp. - varied

The following books may be useful for the identification of the listed plants, and others in which you may be interested.

1. Flowers of the Southwest Deserts - Southwestern Monuments Association.
2. Flowers of the Southwest Mesas - (These may be purchased at any National Monument in the Southwest)
3. Flowers of the Southwest Mountains -
4. The Trees and Shrubs of the Southwestern Deserts - Benson & Darrow, University of New Mexico Press.

REGISTRATION LIST

1. Allsup, Herby F. - Greenkeeper, Municipal Golf Course, Truth or Consequence, New Mexico.
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3. Barkman, Samuel O., T/Sgt. - Golf Assistant, Cannon Air Force Base, Clovis, New Mexico.
4. Bedker, Irving J. - 901 Princeton, S. E., Albuquerque, New Mexico.
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14. Ferguson, Marvin H. - U. S. Golf Association, Green Section, Texas A & M College, College Station, Texas.
15. Garley, Adan - 2709 Floral Rd., N.W., Albuquerque, New Mexico.
16. Getchell, John S. - c/o Base Engineers Office, Sandia Base, Albuquerque, New Mexico.
17. Gilbert, Richard - Southwest Fertilizer and Chemical Co., El Paso, Texas.
18. Goodman, Joe G. - Restlawn Memorial Park, El Paso, Texas.
19. Hager, Frank L. - Golf Course, New Mexico Military Institute, Roswell, New Mexico

20. Halla, Frank - President, Myers Company, El Paso, Texas.

21. Heathman, Homer W. - Las Cruces Public Schools, Las Cruces, New Mexico.

22. Howey, Lee - Truth or Consequence, New Mexico.

23. Jensen, E. R. - Department of Horticulture, N.M.S.U., University Park, New Mexico.

24. Johnson, Herman R. - Four Hills Country Club, Albuquerque, New Mexico.

25. Jones, Harbour - Middle Rio Grande Substation, Las Lunas, New Mexico.

26. Kieth, Lewis - Las Cruces Public Schools, Las Cruces, New Mexico.

27. Kinkade, Geral D. - Clovis Country Club, Clovis, New Mexico.

28. Lessau, Heinz - New Mexico Institute of Mining and Technology, Socorro, New Mexico.

29. Mann, Billy - Pro., Municipal Golf Course, P. O. Box 842, Carlsbad, New Mexico.

30. Martinez, Alberto - Base Engineers Office, Kirtland AFB, Albuquerque, New Mexico.

31. Martinez, Felipe - Ascarte Golf Course, Greenkeeper, El Paso, Texas.

32. Palmer, C. L. - The Myers Company, El Paso, Texas.

33. Parman, Guy - The Myers Company, El Paso, Texas.

34. Patterson, A. S. - 3341 Wilway Drive, N.E., Albuquerque, New Mexico.

35. Ray, Elie D. - Box 895, Holloman AFB, New Mexico.

36. Seemen, Carroll - Green Thumb Garden Center, El Paso, Texas.

37. Serna, Julian A. - Albuquerque Country Club, Albuquerque, New Mexico.

38. Sheridan, Paul A. - Physical Plant, University of New Mexico, Albuquerque, New Mexico.

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43. Wilson, Charles - Sewerage Commission, Milwaukee, Wisconsin.

44. Wilson, Marvin L. - Head, Department of Agronomy, P. O. Box 306, New Mexico State University, University Park, New Mexico.

45. Zuloaga, Ray - Pro. - Greenskeeper, Heuco Club, El Paso Natural Gas Company, El Paso, Texas.

CALCULATIONS IN TURFGRASS MANAGEMENT

James B. Moncrief 1/

The golf course superintendent is a man who can do many things. He is a plant growth practitioner, an accountant, and he serves as a personnel and public relations man. He may also be a construction man and a chemist. Besides these things the superintendent still has to rely upon some mathematics to properly perform his duties. Figures must be used in expressing golf course measurements, in calculating the application of fertilizer and pest control materials, and in reporting expenditures. This is not to say that a superintendent must be a mathematical wizard, but there are a few fundamental calculations that must be made.

Golf course measurements are important to the superintendent. He is not so much interested in the length of golf holes but he must know the areas involved in the various golf course parts. It is essential that his knowledge of areas be accurate. Otherwise he may make some rather serious errors in the application of materials. As an example, superintendent "A" has a green 70 feet in diameter and he intends to apply 2 ounces of fungicide to 1000 square feet. He knows that to find the area of a circular green he uses the formula: area = pi (3.1416) x radius squared. Substituting, he finds that $3.1416 \times 35^2 = 3847$ square feet. Therefore, 8 ounces of fungicide will provide just a little more than the amount required to treat at the 2 ounce rate. Superintendent "A" also believes that he should treat the collar of his green to a width of about 10 feet all the way around. To provide for this he decides to add a little extra fungicide, so he puts in 2 more ounces, making a total of 10 ounces. If he distributes this evenly, how much has he <u>really</u> applied to each 1000 square feet? Let's see. His circle is now 90 feet in diameter, so the radius is 45 feet. Using the same formula, the area = $3.1416 \times 45^2 = 6359$ square feet. He has applied 10 ounces of fungicide to 6359 square feet or 1.57 ounces to 1000 square feet. Therefore superintendent "A" has applied only 3/4 as much material as he intended even though he has "allowed" for the additional area. Guess work such as this has, at times, been responsible for a fungicide's failure to give the desired results. This little example is not an exaggeration. It has happened. It does serve to indicate a need for accurate measurements.

Some golf course superintendents have provided themselves with a chart on which each hole is listed together with the areas involved in teeing grounds, fairways, greens, collars, and sand traps. Such a chart provides a source of information for ready reference and it helps to insure accuracy.

Calibration of Equipment

The calibration of distribution equipment to apply any given material at a prescribed rate is a necessary operation and one that can, at times, be quite difficult. The difficulty may arise from several sources. Among them are clogged, or partially clogged, nozzles

1/ Agronomist, USGA, Green Section

on spray equipment; slipping of adjustments after they are fixed in the case of distributors of dry materials; and human error.

Human error can be reduced to some extent by making sure that the equipment operator is well-informed about the job he is expected to do. If the operator of a fertilizer distributor does not understand the importance of checking his output of fertilizer at frequent infrequent intervals, he may neglect to do so. He is also likely to guess at his output rather than to measure and calibrate carefully.

The operator should be acquainted with the material he is to apply; he should know what the results of a properly applied treatment will be; he should know the consequences of improper application; and he should know whether or not there is an element of danger in the material that he is handling. With a knowledge of these matters, an operator may proceed with confidence to do his job.

Distribution machinery or spray equipment should be kept in good condition. All parts should be clean, well-lubricated, and working properly. When these things have been checked, then the machinery must be adjusted to spread the right amount of fertilizer, lime, or other material. With spray equipment the correct amount of solution per unit of area must be applied.

Let us examine the mechanics of calibrating a fertilizer spreader. Determination of the output must be done while the distribution machinery is moving over an area at the same speed that is maintained during actual application. This is necessary because rate of output is affected by the roughness of the ground surface and the speed of forward movement. Usually the speed of application will be that of a tractor in second gear. As an example, a Ford tractor in second gear with the tachometer registering 1500 r.p.m. moves at a speed suitable for fertilizer distribution.

A tray or pan must be carried below the fertilizer outlets to catch the material being discharged. This tray may be a piece of metal "eaves trough" or "rain gutter," or it may be a piece of sheet metal crimped to a "V" shape. It is better to use two trays and to fasten one beneath each side of the spreader.

The circumference of the wheels of a distributor should be determined and a string or other marker should be fastened to a point on the wheel to enable the operator to count the turns made by the wheel. The hopper should be filled about half full of fertilizer.

You are now ready for the actual calibration test run. The operator can turn on and off the control lever but it is advisable to have an extra person to operate the lever. Regardless of who may operate the lever, be sure an accurate count is made as the wheel turns. At the end of ten turns of the wheel cut the lever off as close as possible to the position of the marker on the wheel when you pulled or pushed the lever to "on" position. Take the trays off and weigh the material in each tray separately. This will permit the synchronization of both sides of the distributor. Usually a scale graduated in ounces will be accurate enough for the determination of fertilizer rates.

The wheel circumference will have to be known as well as the width of the distributor hopper. These figures permit the determination of the area covered. Example: the wheel is 7 feet, 2 inches in circumference and the hopper is 8 feet wide. The 7-foot, 2-inch wheel will have covered in ten turns of the wheel 70 feet plus 20 inches, or 71 feet, 8 inches. Convert 71 feet 8 inches into 71-2/3 feet. The distance of travel, 71-2/3 feet, multiplied by the width, 8 feet, gives 573-1/3 square feet. This is the number of square feet covered when you count ten turns of the wheel marker.

If the amount of fertilizer to be applied per acre is compared with that applied to this part of an acre, in ratio, we can arrive at the amount needed to be caught in the trays. For example, if you wish to apply one pound of nitrogen per 1000 square feet, then you would have to apply 43.56 pounds of nitrogen per acre. There are 43.56 one thousand square feet units in one acre. (43,560 square feet equals one acre). If your nitrogen is derived from ammonium nitrate you should apply 132 pounds per acre provided the material is 33% nitrogen. (43.56 divided by .33 equals 132 pounds). Since we want 132 pounds of fertilizer per acre we can set up our ratio and determine the amount of fertilizer that should have been spread on the area covered in our calibration run.

We want to apply 132 pounds to 43,560 square feet. At this rate, how much would be applied to the 573-1/3 feet in our calibration run? A rather simple mathematical procedure will give us the proportionate amount needed.

In this procedure, let Q (or any other symbol) represent the unknown quantity.

Then

132 pounds is to 43,560 square feet
as Q pounds is to 573-1/3 square feet (573.33)

The proportion may be written like this,

$$132 : 43{,}560 :: Q : 573.33$$

To solve this proportion and find the value of Q, one rule must be remembered. Multiply the two middle figures and the two on the extremes. The products will be equal.

$$43{,}560 \times Q = 573.33 \times 132$$
$$43{,}560 \times Q = 75{,}678.56$$

Continuing to solve for Q, we may divide 75,678.56 by 43,560

$$Q = \frac{75{,}678.56}{43{,}560}$$
$$Q = 1.73$$

Therefore, 1.73 pounds of fertilizer should be caught in the pans. This amounts to about 14 ounces in each of the two pans.

After the correct amount is obtained on the trial run, it is advisable that the procedure be repeated at least three times to insure consistent accuracy. After your accuracy has been checked, tighten the adjusting devices so no slippage will be experienced. It is amazing how often these adjusting devices will come loose and cause a variation in your distribution.

Because of the fact that adjustments sometimes slip or work loose, it is advisable to check fertilizer output at frequent intervals. It is fairly simple to do this and very little time is lost in making the check. On a humid day, output may change following the exposure of fertilizer to the air. Nitrogenous materials have a tendency to absorb moisture and this causes the flow characteristics of the fertilizer to be changed appreciably.

Calibrating Spray Equipment

Since World War II spray equipment has been improved remarkably and is far superior to that of pre-war days. Most herbicides and other pest control materials are applied to turf in liquid form. Therefore calculations involving liquid solutions are important.

Water is the most commonly used liquid solvent used for spraying herbicides or other types of chemicals. Unless the addition of the spray chemical changes the viscosity of the water solution, one may use plain water during calibration.

The factors involved in application of solutions with a boom sprayer are:

1. Amount of chemical applied per acre or per 1000 square feet.

2. Amount of solution applied per acre or per 1000 square feet, usually in terms of gallons.

3. Concentration of solution.

4. Output of sprayer, usually in gallons per minute.

5. Width of boom.

6. Rate of travel of sprayer.

Most companies that handle spray equipment have tables that give the nozzle number, recommended liquid pressure in pounds per square inch, capacity of nozzle in gallons per minute at given pressures, and the gallons per acre applied when traveling at a given rate of speed, whether it be two, three, or four miles per hour.

Calculating the output of a sprayer involves a procedure similar to that in calibrating a fertilizer distributor. The difference is that the output of a given nozzle is rather difficult to change with any degree of accuracy. Therefore, adjustments must be made in the speed of travel or in the amount of liquid used in dilution of the active material.

As an example let us suppose that we wish to apply 10 pounds per acre of disodium methyl arsonate. We plan to use 100 gallons of solution per acre. Our sprayer has a boom that covers a ten foot swath.

100 gallons will cover 43,560 square feet
10 gallons will cover 4,356 square feet

Because the sprayer boom is 10 feet wide, 435.6 linear feet will have to be covered to put out 10 gallons. It is not difficult to calculate the time required to drive 435.6 feet at 4 miles per hour, but it is simpler to drive the tractor at any given speed 435.6 linear feet, a distance which will have been measured previously, and to measure the time required. If the tractor moves at 4 miles per hour, we find that the 435.6 feet is covered in one minute and 14 seconds.

Now, turn on the sprayer and catch the solution sprayed in one minute and 14 seconds. Again a piece of "eaves trough" or guttering may be used to lead the solution into a suitable container. The equipment may sit still while the spraying is being done. Unlike a fertilizer distributor, the spray output rate is not affected by movement. If 4 miles per hour is the correct speed, 10 gallons of solution should have been sprayed. If a smaller output is measured, speed should be reduced accordingly. If a larger amount is distributed, drive the tractor faster. Of course, where the amount of dilution is unimportant, one may keep the tractor speed constant and alter the amount of water (or other diluent) added.

Another point to be considered in sprayer operation is whether nozzles are discharging solution uniformly. This may be checked rather easily by placing the spray boom over a piece of corrugated metal roofing, spraying a small amount of solution, and catching the run-off from each valley of the corrugation in a separate container.

Active Ingredients in Commercial Formulations

How many times have you heard pest control authorities say "Follow the directions on the package"? This is good advice because manufacturers of such materials package them in various formulations and concentrations. The manufacturers have good reasons for doing this. We need not examine their reasons but it is recognized that such practice does lead to confusion when one tries to figure rates of application.

Chlordane is an example. It is packaged as a 5% dust, a 10% dust, a 25% wettable powder, a 50% wettable powder, a 48% emulsifiable concentrate, and a 75% emulsifiable concentrate. There may be even more formulations of this material. One of the standard recommendations for chlordane is 10 pounds of "actual" per acre. Two hundred pounds of a 5% dust are required for this amount. But only 13.3 pounds of a 75% emulsifiable concentrate are needed.

Usually calculations such as those in the foregoing paragraph may be done "in the head" without resorting to formulas. However, some more complicated ratios may be a little difficult. For an example let us suppose that we want to apply 10 pounds of "actual" chlordane per acre. How much 5% dust do we need?

Let Q = quantity needed.

Since 5% actually means 5 parts to 100, we can set up this proportion,

5 is to 100 as 10 is to Q, expressed as follows,

$5 : 100 :: 10 : Q$

Then the product of the end figures, multiplied together, is equal to the product of the two middle figures, multiplied together. Therefore,

$$5 \times Q = 10 \times 100$$
$$5\,Q = 1000$$
$$Q = \frac{1000}{5}$$
$$Q = 200$$

Two hundred pounds of 5% dust delivers 10 pounds of actual chlordane. Now let's apply this formula to our other example, in which we have a 75% emulsifiable concentrate. In that case

75 is to 100 as 10 is to Q

$$75 : 100 :: 10 : Q$$
$$75\,Q = 1000$$
$$Q = \frac{1000}{75}$$
$$Q = 13.33$$

Therefore, 13.33 pounds of concentrate are needed.

Fertilizer rates may be calculated in the same way. One may wish to apply 120 pounds of nitrogen per acre, using a 12-6-6 fertilizer. The proportion is as follows:

Let Q equal the quantity of fertilizer needed.

Then, $12 : 100 :: 120 : Q$

$$12\,Q = 12000$$
$$Q = 1000$$

Therefore, 1000 pounds of fertilizer will be required.

Another calculation that must be made frequently is that of interpreting acre rates in terms of 1000 square foot units and vice versa. This is a fairly easy conversion. There are 43,560 square feet in an acre or 43.56 one thousand square foot units. Therefore, if rates are given in pounds per 1000 square feet, one may convert by multiplying the figure by 43.56. Example: 5 pounds per 1000 square feet is equivalent to 217.8 pounds per acre. (5 x 43.56 = 217.8) For rapid calculations, round off the 43.56 and use 40 as a conversion factor. (5 x 40 = 200) This is not a precise conversion factor but it is useful for rapid mental calculations.

Conversely, one may convert acre rates to 1000 square feet rates by dividing the rate by 43.56 or by 40 in the case of rapid approximations.

To use arithmetic efficiently requires practice. If you are a little "rusty" along these lines, why not try brushing up a little bit by working out a few extra problems during the season when you aren't too busy. It may save you some time when you need it most. Calibrations and the figuring of rates will come much easier.

NEW DEVELOPMENTS IN NUTGRASS CONTROL

Walter L. Gould 1/

Of the many weeds which infest turf, flowerbeds, gardens and field crops, nutgrass is one of the most difficult to control. Nutgrass maintains itself by developing nutlets, or tubers, on the roots. These tubers are produced abundantly and have been found to depths of two feet under the soil surface. The tubers may remain dormant in the soil for an indefinite time, so any control program using cultural practices or foliar treatments is at best a long-term proposition. In the arid sections of the country the nutlets will become desiccated and lose viability when they are exposed to hot, dry conditions for extended periods of time. Only the tubers in the top 2 to 4 inches of soil can be killed this way, so an area must be plowed repeatedly to the depth of infestation to obtain control.

Soil fumigation, using methyl bromide, ethylene dibromide, or other soil fumigants, and soil sterilization with heavy rates of soil sterilizing herbicides have been used to reduce nutgrass stands. Both types of treatments are expensive. They generally kill out desirable vegetation as well as nutgrass, so are impractical for use in controlling nutgrass except in special cases. A new chemical, Eptam, is reported to cause dormancy of the nutgrass tubers. By inhibiting growth from the tubers it appears effective in controlling nutgrass.

Work was initiated at New Mexico Agricultural Experiment Station in July, 1958, to test the effect of Eptam on nutgrass growth. Liquid and granular formulations of Eptam at rates of 2.5 to 20 pounds per acre of active material were applied on one-half square rod plots to a

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vigorous growth of nutgrass and also to a freshly disked area having a nutgrass infestation. The Eptam was incorporated into the top 2-4 inches of topsoil on one-half of each plot with a rotary tiller. The plots were then irrigated.

Eight weeks after treatment stand counts of the nutgrass were made. The results indicate that tilling the soil either before or after chemical application increases the toxicity of the Eptam. The granular formulation was more effective in inhibiting nutgrass growth than the liquid formulation. Five pounds per acre of Eptam applied as granules provided 90 per cent reduction in stand on the tilled portion of the plots and 80 per cent stand reduction in the untilled portion of the plots. Twenty pounds per acre of either formulation, when incorporated, reduced the stand by 95 per cent or more. This degree of control was maintained until the end of the growing season, sixteen weeks after treatment.

The tolerance of various grass species, ornamentals, field crops and vegetables to Eptam has not been fully explored. However, present work indicates that nutgrass may be controlled, if not eradicated, where it is found among plants tolerant to Eptam by a single Eptam treatment yearly over a period of years. Continued research is needed before Eptam can be recommended for nutgrass control.

GROUND COVERS AND ANNUAL PLANTS IN LANDSCAPING

E. R. Jensen 1/

Ground Covers

Of the many different plants (250 used for ground covers) well maintained grass is certainly the neatest and in many ways the most satisfactory of them all. Actually, all plants are ground covers, for even trees can cover the soil well.

The ground cover plants under consideration today include only those low perennials, shrubs, and trailing vines which require a minimum of care and have the ability to maintain foliage close to the ground. The major interest is in those plants whose mature height does not exceed three feet. The lower the height of the plant, the more uses it has as a ground cover.

These plants are used on home, institutional, and commercial landscape and highway plantings. They are used primarily in areas where costly and troublesome maintenance can be reduced by the planting of a suitable ground cover as a substitute for grass.

The values and uses of this type of planting are:

1. Esthetic value - flowers, fruit, color, or evergreen foliage.
2. Use where grass does not grow well; in heavy shade, where feeding roots of trees or shrubs are near the surface, in wet or dry soil areas, and on steep banks or rocky slopes.

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Cultural Practices

Planting: Spacing of plants is dependent on ultimate size of plant or rate of increase, the area to be planted, and the money available. Spacings vary from 6 to 24 inches apart each way.

General Maintenance:

Watering as necessary to maintain the planting.

Generally an annual application of a complete fertilizer at the rate of 20-40 pounds per 1,000 square feet is desirable. This is especially important where the plants are growing in the shade or in root competition with trees or shrubs. The broadcast method is the most practical method of application. It may be desirable to mix the fertilizer with sand, soil, or a finely divided peatmoss in order to obtain even distribution over the area. After the fertilizer has been applied it should be watered in to wash it off the foliage.

Mulching may be used for weed control and as an aid to maintaining moisture.

Weeding will be required until the young planting is established, after which none or infrequent weeding should be required.

Pruning - This may be required on some ground covers to force and increase branching, especially at the base of the plant. On others it may be desirable to remove flower and fruit stalks. In others, especially the vigorous growing ones, prune to keep them in scale with the remainder of the planting.

GROUND COVERS

Common Names	Scientific Name	Height	Grows Best In
Carpet Bugle	Ajuga reptans	1'	Partial shade
Chamomile	Anthemis nobilis	1'	Sun
Stonecrop	Sedum sp.	1'	Sun
Mexican Sedum	Sedum amecanum	6"	Sun
Silver Yarrow	Achillea argentea	6"	Sun
Ground Morning Glory	Convolvulus mauritanicus	1'	Sun
Wintercreeper	Euonymus fortunei	4"	Sun or shade
Wintercreeper	Euonymus fortunei radicans	4"	Sun or shade
Evergreen Candytuft	Iberis sempervirens	1'	Sun
Thyme	Thymus sp.	1" to 1'	Sun
Dwarf Periwinkle	Vinca minor	6"	Sun or shade
Tamarix Juniper	Juniperus sabina tamariscifolia	2'	Sun
Waukegan Juniper	Juniperus horizontalis douglasi	12-18"	Sun
Dwarf Rosemary	Rosmarinus officinalis prostrate	15"	Sun
Creeping Buttercup	Ranunculus repens	2'	Shade
Ponyfoot	Dichondra carolinensis	4"	Shade
Turfing daisy	Matricaria tchihatchewi	4-6"	Sun
Hall's Japanese Honeysuckle	Lonicera japonica halliana	1-2'	Sun
Virginia Creeper	Parthenocissus quinquefolia	6"	Sun
Ground Ivy	Nepeta hederaceae	3"	Sun or shade
Sunrose	Helianthemum nummularium	1'	Sun
Moneywort	Lysimachia nummularia	2"	Shade-p. shade
Peppermint	Mentha piperita	1-2'	Sun-p. shade
Bishops Goutweed	Aegopodium podograria	12-14"	Sun
Creeping Lippia	Lippia canescens	1-4"	Sun-p. shade
Rock Soapwort	Saponaria ocymoides	9"	Sun

Annuals

The plants called annuals provide some of the most desirable flowers. Their lives are short; they germinate from seed, grow, flower, produce seed, and die within a growing season.

The primary assets of annuals are their free blooming habits if flowers are removed and they flower in the year they are sown.

Annuals serve as an understudy for the shrubs and perennials in the so-called permanent plantings. We might think of them as the frosting on the cake.

Some annuals such as the petunias have a long flowering season, others may flower for only a short period of time. Some of these are larkspur, poppies, and pansies, which should be used only as fillers among the dependable annuals, perennials, and shrubs.

Another advantage of annuals is the flexibility the grower has in that a complete change of a planting can be made the following year.

Many color combinations may be used in planning the planting plan for annuals, i. e., orange and scarlet, lavender or violet with orange, pink and blue, deep blue and yellow, light pink and pale yellow, maroon and white, deep purple, yellow and maroon, lavender and white.

Sixty slides of annuals were shown through the courtesy of Geo. J. Ball, Inc. West Chicago, Illinois.

ANNUALS
Color and Habit of Growth

Common Name	Scientific Name
A. White	
(1) Low	
Flossflower (Ageratum)	Ageratum houstonianum
Sweet Alyssum	Alyssum maritimum
Snapdragon	Antirrhinum majus
Annual Chrysanthemum	Chrysanthemum
Pinks	Dianthus chinensis
Candytuft	Iberis amara
Petunia	Petunia hybrida
Common Portulaca	Portulaca grandiflora
Pansy	Viola tricolor
(2) Medium	
Snapdragon	Antirrhinum majus
Cornflower	Cantaurea cyanus
Annual Gypsophila	Gypsophila elegans
Shirley Poppy	Papaver rhoeas
(3) Tall	
Snapdragon	Antirrhinum majus
Cosmos	Cosmos bipinnatus
Larkspur	Delphinium ajacis
Strawflower	Helichrysum bracteatum
Sweetpea	Lathyrus odoratus
Sea Lavender	Limonium sinnuatum
Flowering Tobacco	Nicotiana sylvestris
Annual Scabiosa	Scabiosa atropurpurea
(4) Vines	
Hyacinth Bean	Dolichos lablab
Mock Cucumber	Echinocystis lobata
Sweetpea	Lathyrus odoratus
Cypress Vine	Quamoclit pinnata
B. Yellow & Orange	
(1) Low	
California Poppy	Escholtzia californica
Common Portulaca	Portulaca grandiflora
Sanvitalia	Sanvitalia procumbens
Mexican Marigold	Tagetes signata pinnata
Nasturtium	Trapaeolum minus
Pansy	Viola tricolor

Common Name	Scientific Name
(2) Medium	
Snapdragon	Antirrhinum majus
Pot Marigold	Calendula officinalis
Garland Chrysanthemum	Chrysanthemum coronarium
Calliopsis	Coreopsis tinctoria
Gaillardia	Gaillardia pulchella
Drummond Evening Primrose	Onethera drummondi
	Rudbeckia bicolor
Painted Tongue	Salpiglossus sinuata
French Marigold	Tagetes patula
Common Zinnia	Zinnia elegans
(3) Tall	
Snapdragon	Antirrhinum majus
Calliopsis	Coreopsis tinctoria
Sunflower	Helianthus annuus
Strawflower	Helichrysum bracteatum
Leptosyne	Leptosyne stillmani
Painted Tongue	Salpiglossus sinuata
African Marigold	Tagetes erecta
Nasturtium	Tropaeolum majus
(4) Vines	
Balsam apple	Mormordica balsamina
Cypressvine	Quamoclit pinnata
Blackeyed Susan	Thunbergia alata
Nasturtium	Tropaeolum majus
C. Blue & Violet	
(1) Low	
Floss Flower	Ageratum houstonianum
Browallia	Browallia speciosa
Candytuft	Iberis umbellata
Heliotrope	Heliotropium
Pansy	Viola tricolor
Alpine Forgetmenot	Myosotis alpestris
Harebell Phacelia	Phacelia campanularia
Drummond Phlox	Phlox drummondi
Common Verbena	Verbena hybrida
(2) Medium	
Browallia	Browallia speciosa
Cornflower	Centaurea cyanus
Larkspur	Delphinium ajacis
	Didiscus caeruleus
Painted Tongue	Salpiglossus sinuata
Scarlet Sage	Salvia patens

Common Name	Scientific Name
(3) Tall	
Larkspur	Delphinium ajacis
Lupine	Lupinus hart wegi
Painted Tongue	Salpiglossus sinuata
Annual Scabiosa	Scabiosa atropurpurea
(4) Vines	
Cobea	Cobea scandens
Hyacinth Vine	Dolichos lablab
Morning Glory	Ipomea purpurea
Sweetpea	Lathyrus odoratus
D. Rose & Red	
(1) Low	
Cockscomb	Celosia cristata
China Pink	Dianthus chinensis
California Poppy	Escholtzia californica
Godetia	Godetia grandiflora
Purple Candytuft	Iberis umbellata
Flowering Flax	Linum grandiflorum
Common Petunia	Petunia hybrida
Drummond Phlox	Phlox drummondi
Common Portulaca	Portulaca grandiflora
Periwinkle	Vinca rosea
(2) Medium	
Snapdragon	Antirrhinum majus
Feather Cockscomb	Celosia plumosa
Cornflower	Centaurea cyanus
Gaillardia	Gaillardia pulchella
Garden Balsam	Impatiens balsamina
Gloxinia Pentstemon	Pentstemon gloxinoides
Scarlet Sage	Salvia splendens
Common Zinnia	Zinnia elegans
Periwinkle	Vinca rosea
(3) Tall	
Snapdragon	Antirrhinum majus
Spider-flower	Cleome spinosa
Common Cosmos	Cosmos bipinnatus
Larkspur	Delphinium ajacis
Straw Flower	Helichrysum bracteatum
Sander Tobacco	Nicotiana sanderae
Painted Tongue	Salpiglossus sinuata
Annual Scabiosa	Scabiosa atropurpurea
Butterflyflower	Schizanthus pinnatus
(4) Vines	
Cup & Saucer Vine	Cobea scandens
Sweetpea	Lathyrus odoratus
Scarlet Runner Bean	Phaseolus coccineus
Cardinal Climber	Quamoclit coccinia
Cypress Vine	Quamoclit pinnatus