California Turfgrass Culture

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Liquid Fertilization of Turfgrass

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Along with the mechanization of other turfgrass production operations there is a need to mechanize the application of fertilizers. Applying the fertilizer materials with the irrigation water is one method that is being used.

The addition of liquid or gaseous fertilizers to irrigation water has been a common practice for a number of years where furrow or flooding methods of irrigation are used. The application of fertilizers through sprinkler irrigation systems is being used with vegetable, orchard, forage and nursery crops. A number of turfgrass areas have recently had equipment installed for the application of fertilizers through the sprinkler irrigation systems. It is expected that this practice will be used more widely in the years ahead.

There are four general criteria that need to be satisfied in applying fertilizers with the irrigation water. The quantities of fertilizer applied should be sufficient to obtain the desired growth of the grasses without causing injury from excessive amounts. The fertilizer should be distributed uniformly to all areas. Suitable equipment should be used that will require a minimum of labor for operation and maintenance, and will not be subject to corrosive action by the fertilizers contained in the water. Proper safeguards should be used to prevent mixing of water containing fertilizers with waters used for drinking or other domestic purposes.

The greatest benefits from applying fertilizers with the irrigation water are obtained where continuous or split applications of the fertilizer will result in better plant growth than will be obtained with single annual or otherwise infrequent fertilizer applications. This is generally the case wirh nitrogen fertilizers which can be leached from the soil or with sandy soils which have low retention properties for all fertilizers.

Fertilizers which have a high vapor pressure, such as anhydrous or aqua ammonia, may result in high volatilization losses if applied through sprinkler systems. For this reason, these fertilizers are not usually applied through sprinkler systems.

Some fertilizers, such as phosphonic acid, are highly corrosive to metals. These should only be used with extreme caution where aluminum, steel or copper pipe or fittings are used in the sprinkler system. Corrosion of metals is the result of a combination of factors including the acidity of the water, the presence of minute quantities of heavy metals and the amount of carbon dioxide dis-, solved in the water. It is difficult to product from water analyses whether corrosion will result from the addition of fertilizers to the water.

Fertilizers which have been used successfully in sprinkler systems include the solid forms of ammonium sulphate, ammonium nitrate, and calcium nitrate dissolved in water; and liquid solutions of ammonium nitrate, ammonium nitrate and urea, and urea alone.

Fertilizers applied with the irrigation water will go where the water goes. The uniformity of distribution of the fertilizers will, therefore, be no more uniform than the distribution of the water. The proper design of the sprinkler system to obtain uniform distribution of the water is of special importance where fertilizers are applied with the water.

The precipitation rate of rhe water will also effect the uniformity of application of the water and fertilizer. If the water is applied at a faster rate than the infiltration rate of water into the soil, runoff will occur. This will result in deficient amounts of fertilizers being applied on the steeper slopes or compacted areas from which the water flows, and excessive amounts being applied in the low spots where the water collects. The sprinklers should be designed with a precipitation rate less than the infiltration rate of water into the soil.

Several companies are now manufacturing equipment for injecting fertilizers into the irrigation water. Where a dilute nutrient solution is added to all the water used for irrigation it is necessary to have a proportioning type of injector that will maintain a constant concentration of fertilizer irrespective of the rate of flow of the water. A

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positive displacement type of proportioner is often used for this purpose. These are available with safeguards to prevent the accidental addition of excessive amounts of fertilizers which might be toxic to the turf. They also permit adjusting the concentration. This is desirable with golf courses where greater amounts of fertilizers are often used on greens than on fairways. This requires that the sprinkler system be operated so that the greens are itrigated separately from the fairways.

Where portable aluminum sprinkler systems are used, equipment is available for injecting a given amount of fertilizer into the system for each setting of the lateral lines. These devices make use of the Pitot or Venturi principles which require no moving parts. With this method of injection the concentration of fertilizer in the irrigation water at any one time is not important. The calculated amount of fertilizer is evenly distributed over the area during the irrigation run.

With some fertilizers it may be desirable to add the fertilizer to the water near the end of the irrigation period rather than at the beginning. Soils which have good internal drainage and where over-irrigation is practiced are conditions where leaching of the nutrients might occur. Nitrate and urea forms of nitrogen move with the water and should be applied near the end of the irrigation period. Ammonia forms of nitrogen as well as phosphorus and potash are held by the clay particles in the soil and so can be applied at any time. Ammonia and urea gradually convert to the nitrate form and can be leached by later irrigations,

The injection of fertilizers into irrigation systems may be a potential source of pollution to waters used for human consumption, The back flow of water containing fertilizers into domestic water supply systems or into wells used for domestic purposes should be avoided. Approved back pressure preventers should be installed upstream from the point of injection of the fertilizers on such systems. Drinking fountains placed in parks or on golf courses should be supplied with water entirely separated from the pipelines used for conveying fertilizer solutions.

Improved Bermudagrass

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The improved bermudagrasses are selections from common bermudagrass (*Cynodon dactylon*) or hybrids between common bermuda and other bermudagrass species. They show excellent adaptability for turf areas in much of southern California.

The improved strains have finer textures than common bermuda, better color in winter, and greater wear resistance. These tough grasses are used on heavy traffic areas, such as playgrounds, schoolgrounds, and golf courses and also home lawns where a high ‘quality rugged turf is desired,

Management

Management of improved bermudas is similar *to* that of common bermuda. Common bermuda is usually grown from seed planted at the rate of 3 pounds of seed per 1,000 square feet. The improved bermudas are planted by vegetative propagation (stolons, sprigs, ot plugs). Stolons are as easy to plant as seed and require about the same soil preparation. One to 4 bushels of stolons per 1,000 square feet are used, depending on the rate of coverage wanted. At these rates, stolons cost more than seed planting. Plant during the warm season for best results. Scatter the stolons on the prepared area and firm them into the soil. Cover with a one-fourth inch mulch. Keep the soil surface moist until growth begins; then reduce irrigation frequency.

Bermudas are deep rooted, requiring less frequent but more thorough irrigations than cool-season grasses. They tolerate drought and salts. Growth is best at high temperatures in full sunlight. Weeds are less of a problem in improved bermuda turf than in common bermuda because of the low, dense, vigorous growth. Bermudas, in general, are relativelyfree of disease and insect pests. A mite that affects areas of poor growth, causing shortening of internode length, is a recent problem. Good management is a major factor in its control. Diazinon has given effective control.

One pound of actual nitrogen applied per 1,000 square feet per month is recommended for fertilizing bermudagrass turf under heavy use. Six pounds of actual nitrogen applied per 1,000 square feet per year keeps most bermudagrass turf growing well. Spring and fall applications particularly are recommended. An annual application of 1 pound of phosphorous and 2 pounds potassium per 1,000 square feet will supply these two elements, if needed. Potassium is more apt to be deficient in sandy soils.

For normal use, mow bermudagrasses at a height of one-half inch. Mow areas subject to heavy play, such as football fields, at a three-fourths inch height, and putting greens at one-fourth inch or less. Low mowing reduces the amount of thatch buildup and helps retain a green turf

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during the cool season. Remove clippings to retard accumulation of organic matter on the soil surface. This organic mat may restrict water infiltration. Scalp or renovate the turf to remove old growth in late September, and apply nitrogen fertilizer. This stimulates new growth that retains color better in the cool season. Vertical mowing of bermuda several times during the summer may eliminate the need for scalping or renovation. Renovate football fields in the spring, if necessary, Aerification during the growing season is recommended if water penetration is a problem.

Bermudagrasses may be overseeded in the fall with creeping red fescue, Highland bentgrass, or annual ryegrass for additional winter color.

Strains

U-3, a selection of common bermuda, was the first improved variety introduced into California. It is dark green and finer textured than common bermudagrass. It has a shorter dormant period than common, retains color later in the fall, and recovers earlier in the spring. Its growth habit is more prostrate and dense than common. It is highly wear resistant and produces viable seed.

Ormond, a selection made in Florida from common bermudagrass, has about the same texture as U-3. It is dark green and rich in appearance. Color is retained better than in U-3 during the cool season. Growth is rapid and it can crowd out common bermudagrass. Seed heads are rarely produced – a distinct advantage over varieties that flower abundantly. The turf is neater in appearance and is less likely to invade other areas by seed. Ormond is excellent for home lawns, golf tees, and athletic fields. It is between U-3 and common bermudagrass in wear resistance.

Sunturf *(Cynodon magennisil)* is a natural hybrid between *Cynodon dactylon* and *C. transvaalensis*, a fine textured species of bermudagrass native to South Africa. It produces some seed heads but no viable seed. It has a prostrate dense growth habit, dark green color, and excellent quality. It is somewhat more vigorous than the Tifgreen strain. It is fairly easy to manage, and appears to be slower to invade surrounding areas than other bermudagrasses. Wear resistance is high – comparable to U-3. Cold tolerance is close to Ormond, but a purple cast may develop in cool weather. It recovers from injury more rapidly than the other recommended strains, making it particularly useful for football fields, golf tees, and similar areas.

Tifgreen is a very fine textured man-made hybrid between *C. datylon* and *C. transvaalensis.* Its growth habit is prostrate and dense. It has a deep green color and excellent quality. In cold tolerance it is one of the best, being close to Sunturf Very few seed heads form, and no viable seeds are produced. Its wear resistance and recovery rate are high, but below that of Sunturf. These characteristics make it an excellent variety for ornamental lawns and putting greens. Sunturf is preferred to Tifgreen for areas subject to heavy use because of its greater wear resistance.

Texturf - 1F (T35-A) is a fine-textured Texas selection of unknown origin. Some people prefer its light apple-green color. It is less wear resistant and less cold tolerant than Tifgreen. It is recommended for ornamental lawn use in cool coastal areas, but not for interior regions because of its rapid growth rate.

Tifway is a promising new variety now being tested in California. It is a dark-green, fine-textured, wear-resistant variety from Georgia. Specific recommendations cannot be given until it has been observed for a longer time.

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Urea Formaldehyde

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Urea formaldehyde was the first major synthetic nitrogen source developed for controlled availability, It has been commercially available for about a decade and primary uses have been with turfgrass and ornamentals. To obtain satisfactory responses, several aspects of its properties must be understood.

In the manufacture of urea formaldehyde these two components react to form polymers of various complexity. The ratio of urea to formaldehyde, and other factors affecting the reactions, influence the susceptibility of the product to mineralization – namely, conversion of the nitrogen to ammonium or nitrate forms. Commercial materials vary, particularly in the fraction of the total material that is readily available.

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In commercial materials a substantial portion of the total nitrogen (25 per cent or more) is cold-water soluble. This fraction is of low molecular weight and is nitrified readily. The bulk of this fraction nitrifies, when conditions are favorable, within a four-week period. The remaining fraction which is relatively resistant to nitrificaion is mineralized at a much slower rate.

Under typical greenhouse soil conditions, about 6 to 7 per cent of the fraction relatively resistant to mineralization is converted to nitrate or ammonium each month. There is also some evidence that this rate tends to increase as the resistant fraction ages. From a given initial supply of this type of nitrogen the yield of mineral nitrogen tends to remain more nearly uniform than would be expected,

The 6 to 7 per cent rate of mineralization per month is some 50 times as fast as natural soil humus is mineralized. Thus, nitrogen from "residual" urea-formaldehyde is much more available than nitrogen from soil humus.

Urea formaldehyde has been promoted on its ability to supply nitrogen at a slow, steady rate for prolonged periods. Its successful use in this role is dependent on the development of an adequate level of "residual" nitrogen in the soil.

A common cause of disappointment from the use of urea formaldehyde is the failure *to* develop this adequate reserve.

The level of "residual" nitrogen is influenced by management practices including soil texture and the amount of deep percolation occurring. Local management conditions will affect details regarding the successful development of such nitrogen-fertilization programs based on infrequent applications of U-F. As a point of reference, however, the establishment of about 2 1/2 pounds of nitrogen in "residual" urea formaldehyde per 100 square feet of soil area (or 0.05 per cent nitrogen in the soil from the "residual" fraction) has been shown to adequately supply nitrogen for prolonged periods for such crops as turfgrass or commercial carnations, The soil level can be maintained by making applications as infrequently as once every five months. However, many management programs would not require this large residual amount to maintain a good nitrogen supply.

Application rates

Greenhouse production data on carnations indicates that once the proper level of urea formaldehyde has been established in the soil, annual application rates are no larger than those required when frequent applications of soluble materials are made. Three pounds of nitrogen per 100 square feet per year is an ample rate. In other words, the efficiency of recovery of nitrogen from urea formaldehyde is as good and probably better (as a rule) than that from similar annual amounts of soluble materials – under otherwise similar management programs.

Since the mineralization of urea formaldehyde is dependent on microbiological attack, soil conditions which influence the activity of micro-organisms directly influence the rate of supply of nitrogen from urea formaldehyde. The availability of nitrogen from U-F declines with cooler soil conditions.

Large applications of U-F can be safely made in a single application. Since it is dependent on microbiological attack *to* yield its nitrogen, it is most effective when incorporated in the soil. Applications as large as six pounds of material (2.3 lbs. of nitrogen) per 100 square feet – or half this amount per cubic yard – of soil mix may be incorporated safely without injury to most seedlings, if the soluble salt level of the soil is low.

Biuret impurities

Since large amounts of this fertilizer can be applied in a single application there has been some apprehension about possible injury from biuret impurities in the urea from which the U-F was Made. Tests using U-F which had been synthesized with 5 per cent mole substitution of biuret for urea showed injury on radishes when used at maximum application rates if the synthesis was conducted at 90°C. When synthesis was performed at room temperature twice this level of biuret was required to produce injury, whereas mechanical mixing of biuret into U-F at the rate of 2.5 mole per cent of the urea resulted in injury. These tests indicate that if biuret is present in urea used for synthesis, a portion of it would either be condensed or occluded in the U-F reaction.

A 5 per cent mole substitution of biuret for urea corresponds to a biuret concentration of about 8.6 per cent in the urea. This degree of biuret contamination is relatively high. Since biuret is also subject to microbiological decomposition, it appears very remote that injury would develop from this source from the use of U-F materials. Manufacturers should, of course, use urea of low biuret content in the manufacture of urea formaldehyde.

We have not been consistently successful in producing short term ornamental crops such as potted chrysanthemums (about 10 to 12 weeks) from a single application of urea formaldehyde, although two applications carry the plant very well. A very desirable use for U-F materials is as a supplemental dry fertilizer in a soil mix where liquid fertilization is used. Many liquid fertilizer programs are not adequate on new plantings.

Urea formaldehyde seems best adapted to the long term maintenance programs such as for turfgrass. For satisfactory performance, the normal nitrogen requirements for a period of about a year must first be developed in a soil over a period of several months before an adequate rate of supply of mineral nitrogen will be available. Subsequently, rates must be adjusted to the normal, desired annual rate of nitrogen application. Experience has shown that the interval between applications when these conditions are reached may be as long as five months without significantly affecting the performance of the crop.

Data reported here were obtained principally from urea formaldehyde supplied by the Du Pont Co.

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Chelates Correct Micronutrient Deficiencies in Ornamental Trees and Shrubs

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Iron deficiency, one of the most troublesome of plant nutrient problems, can in most cases be corrected by the use of iron chelates. These new chemicals have been tested successfully for the past two years by the University of California Agricultural Extension Service in Los Angeles County.

Known commonly as "iron chlorosis," iron deficiency causes an interveinal yellowing or bleaching of chloro-, phyll, leaving a network of fine green veins. In severe cases of chlorosis, the entire leaf which is devoid of chlorophyll will turn yellow and dead areas will appear. Always associated with severe cases is die-back of terminal growth and the eventual death of affected plants.

There can be a multitude of causes associated with iron chlorosis. Most common of these is alkaline soils, such as those containing high amounts of lime or alkali. In such soils, iron is usually found in the form of very insoluble compounds and is unavailable for plant root absorption.

Soils high in phosphorus or the heavy metals such as copper and zinc can also result in plants becoming iron deficient. Excessive soil moisture and the associated poor aeration from this undesirable condition favors iron chlorosis, as does high or low soil temperature.

Iron chlorosis usually exists where there may be sufficient iron in the soil but it is tied up in a form unavailable to the plant. This is where chelates (meaning "claw") are effective. These chemical compounds are less subject to chemical reactions in the soil and therefore remain available to the plant.

Ornamental plants successfully treated during the past two years with the chelated iron Fe 138 include the following: azalea, gardenia, pyracantha, liquidamber (sweet gum), holly, star jasmine, acacia, pittosporum, privet, magnolia, cotoneaster, juniper, and pine.

Rates of the material tried varied with the size of the plant and severity of the chlorosis. As a general rule, it was found that the quantities of the material needed to effectively regreen the yellow plants were as follows: 2 ounces for small shrubs, 4 ounces for large shrubs or small trees, one half pound on a medium sized tree (up to about 15 feet) or a severely chlorotic smaller one, and at least one pound for large trees. It was found that pines and junipers required the larger amounts and a second treatment was required in severe cases where a partial response only was obtained from the first application.

The chelates were spread evenly beneath the plants, worked into the soil, and watered in thoroughly. Where plants were growing in grassed areas, chelates were applied in small amounts in a number of holes about one half to one inch in diameter around the plants. These were about six inches deep so as to be below the root zone of the grasses but above the root zone of the plants.

Results started to appear from one to three weeks. Pines and Junipers took considerably longer – up to several months. It is expected that one application will normally last two years. Only the recommended amounts should be used as larger amounts might cause injury,

Iron chelates tried on dichondra worked well. One fourth co one half pound of the Fe 138 per 1000 square feet (depending upon the severity of chlorosis) was used. These were applied by spreading dry mixed with fertilizer or in solution from a hose spray proporrioner. Results have lasted up to one year.

Zinc is another micronutrient sometimes deficient in plants. The most general symptom of zinc deficiency is a mottling of the leaves, pale yellow splashes between the veins with considerable green parts along the veins. In highly deficient trees of some species, leaves at the ends of shoots may be milky yellow throughout. Leaves in the upper part of branches may also be distorted in form, much smaller than normal, and sometimes bunched together in rosettes. Often the ends die back before the rosettes develop.

Several trees and shrubs showing zinc deficiency symptoms were treated with zinc chelate and favorable results received. The zine chelates were applied in the same manner as the iron only at double the rates.

Ion Exchange Fertilizers and Ammoniated Organic Matter

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The feasibility of supplying fertilizer minerals to plants by means of ion exchange resins has been known – and used for research purposes – for many years. Recently this technique has received attention as a commercial means of supplying nutrients safely and in large quantities for prolonged availability to high value plantings. Investigations have shown that the method can be very effective on commercial flower and nursery crops. It remains to be seen if this approach will be economically competitive with other controlled availability fertilizers being developed.

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In principal, the exchange resins supply nutrients in much the same way as clay in soils. The adsorbed positively charged particles on the resins may be exchanged for other positive ions supplied by the plant root or by the irrigation water. Negatively charged particles such as phosphate and nitrate are supplied by exchange reactions to the roots of plants in the same manner as are the positive ions. The analogy with soil clays does not hold too well since clays have little anion exchange capacity.

The mixture of resins being used for fertilizer carriers was found to have a positive ion exchange capacity of 109 me (milli-equivalents) per 100 g (grams) and a negative ion exchange capacity of 233 me per 100 g. The positive ion exchange capacity of the mixture is about the same as most reactive clays. Leaching losses of nutrients from the fertilizer are relatively small if iriigation waters are low in salts and only moderate even when irrigation waters are fairly high in salts. The analysis of the fertilizer is reported to be 3.2-3.5-2.5 in N, P_2O_5 and K_2O

Surface dressings of the exchange resin fertilizers are not very effective unless the irrigation water contains moderate concentrations of soluble salts. When the resin is in the root zone, the roots of plants have no difficulty in obtaining nutrients from the resins. In contrast to coated fertilizers and metal ammonium phosphates, exchange resin fertilizers can be stored in moist soils for long periods without loss of effectiveness or contributing to the salinity level of the soil. They can also be steam sterilized without apparently affecting subsequent availability of the fertilizer.

Application rates of the exchange resin fertilizers are usually expressed in terms of volume percentages to be used because bulk densities of soil mixes used for ornamentals vary greatly. Excellent quality potted chrysanthemums were produced with no further maintenance other than tap water during a three month period by incorporating exchange resin fertilizers at the rate of 10 per cent by volume. The soil mix used was highly susceptible to leaching. Several nursery plants including cyclamen, aphelandra, Philodendron selloum, sheffelera and gloxinia (grown using a sub-irrigation technique) produced good to excellent growth over a seven week period when 8 per cent, by volume, of the resin was included in the soil mix. Six per cent by volume was also very effective except for aphelandra, where it was apparently too low. A volume percentage of 12 – of the ion exchange resin fertilizer – proved to be too high for aphelandra, philodendron and sheffelera. Optimum application rates will depend on the plant species, irrigation practices and water quality.

Single applications of ion exchange fertilizers are capable of supplying nutrients at an adequate rate over periods of up to three months, under typical nursery conditions, with a relatively good margin of safety against injury from excessive application. This is adequate for the production of many of the potted plant crops.

Ammoniated sawdust

The ammoniation of sawdust or other types of cellulose-containing materials provides a means of producing organic nitrogen and improving the utility of organic wastes. The reactivity of ammonia with organic matter has been known for some time and the commercial utilization of the process has been investigated by several groups. In one process being developed commercially, sawdust is acidulated, heated to an elevated temperature and neutralized with anhydrous ammonia. The product has a charred appearance but otherwise has the shape and size of the original sawdust. Phosphoric acid may be used for acidulation, making the resultant product also a carrier of phosphorus. Of particular interest is the fact that about one half of the nitrogen has been converted into insoluble forms and the remainder is apparently intimately distributed through the particles, presumably combined with the acid negative ion. The following properties *were* found for a sample supplied by the producer.

Percentage of Nitrogen soluble in water	47
Percentage of Nitrogen soluble in normal sodium chloride	53
Percentage of Nitrogen distillable with magnesium oxide	58
Percentage of Nitrogen in exchangeable form	9
Positive ion exchange capacity per 100 g	43
Increase in soluble salts in soil mix solution per lb. Nitrogen per cubic yard of soil	3200 ppm

The moderate increase in soluble salts shows that substantial amounts of nitrogen can be applied at a single application. Using material containing 4 per cent total nitrogen, as much as 1.5 lb. of nitrogen has been incorporated into soil per 100 square feet without injury to typical ornamental plantings. About one half this quantity can be incorporated per cubic yard of soil mix. These rates are about three or four times as high as are safe with inorganic nitrogen sources. Plant response has been rapid since about one half of the nitrogen is water soluble. The water soluble fraction diffuses out of the particles slowly when the soil is not saturated with water. The organic fraction of the nitrogen is mineralized in about four to six weeks under favorable conditions.

Ammoniated sawdust is also of interest because of its contribution to physical properties of soils, Having a low bulk density of about 16 pounds per cubic foot, it is an effective diluent in fine textured soils and improves soil tilth. The chemical and physical properties of ammoniated sawdust adapt it well for use in landscaping operations – particularly new installations in subsoils or other poor soil situations. Observations extending over a five year period indicate the "charred" sawdust is decomposed very slowly, As a soil amendment the ammoniated sawdust has a long life.

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Zoysiagrass for Lawns

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Three species of zoysiagrass are grown in the United States: *Zoysia japonica,* or Japanese lawngrass; *Zoysia matrella,* or Manilagrass; and *Zoysia tenuifolia,* Korean velvetgrass. *Z. Japonica,* the most cold resistant, survives temperatures of 8° to 10° F. below zero. *Z. matrella* will survive 0° to 5° above zero, while a few degrees of frost may kill *Z. tenuifolia.*

The zoysias recommended for California are Emerald (a hydrid of *Z. japonica* and *Z. tenuifolia)* and selected unnamed strains of *Z. matrella* grown by several Calif. turfgrass nurseries, *Z. japonica* and the Meyer variety are not generally recommended for California.

Zoysiagrasses are dark green if fertilized. They make beautiful turf, resembling good Kentucky bluegrass, during most of the year in California. All zoysias are more rigid and stiff than blue, bermuda or bentgrasses. They spread by both underground stems and aboveground runners; but, because of their slow growth, zoysias do not readily invade flowerbeds or shrub plantings.

Some of the advantages and disadvantages of *matrella* and *Emerald* zoysias are:

Advantages

1. Zoysiagrass lawns are permanent, lasting many years.

2. Zoysiagrasses make a tough, wear-resistant, cushiony turf.

3. They grow slowly. The average homeowner may be satisfied with the appearance maintained by mowing 10 days to 2 weeks apart, about half as often as for bermudagrass.

4. Zoysias thrive on high temperatures of summer.

5. They grow on a wide range of soils, from sandy to heavy loams, if there is good subsoil drainage.

6. They make reasonable growth and cover with little fertilizer, but will have a better color if well fertilized.

7. The density of a mature turf will crowd out weeds.

8. Zoysias are practically free from disease and insect pests.

9. They grow well in moderate shade or full sun.

10. Zoysias are salt and chlorine tolerant. They may be used around swimming pools.

Disadvantages

1. Zoysiagrasses may lose some green color in winter. Color loss will be slight in coastal areas, but nearly complete in the desert. The length of this off-color period will vary from a few days to a month or more, depending on location and weather.

2. Ten to 15 months are required to produce sod in the various climatic areas of California. Weeds must be controlled during this time.

3. Zoysias must be planted by sprigs or plugs of turf, because seed is unreliable, slow to germinate, and variable.

4. A power mower is required for easy cutting.

5. The density of a mature turf prevents successful use of cool-season companion grasses for winter turf in cold areas where off-color period is long.

6. Zoysias will not tolerate poorly drained or excessively wet soils.

Planting

As with any other lawn, bring the area to grade, install a watering system, and prepare the soil thoroughly before planting. If you have only a small quantity of planting material, use it to grow a "nursery." Then move sprigs, plugs, or strips of sod to the lawn area as the nursery supply develops.

Plant plugs, sprigs, or strips 4 – 12 inches apart. The closer spacing will give you a solid turf in less time. Sprigs should be partially covered, leaving the tips exposed. If you have a large supply, broadcast the sprigs and chop them in or cover them lightly with shavings, peat or other mulch. Plugs of zoysia may be set into an established lawn of other grasses. The zoysia will take over in several years. A new toysia planting may be overseeded with a cool-season grass, such as bluegrass, that will allow the zoysia to gradually spread and dominate. Planting material may turn brown after setting but new green growth will appear in 1 - 2 weeks.

Irrigation

Keep the soil moist until new growth starts and is well established. Give mature stands l-2 inches of water at each irrigation (see chart). This may require several hours of slow sprinkling to permit the water to soak in. To find out how fast your sprinklers deliver water, place several tall, straight-sided cans among the sprinklers and determine the average time it takes to accumulate an inch of water in the cans.

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Fertilization

Young plantings will grow faster if given 1/2 pound of actual nitrogen per 1000 square feet every two weeks. For mature stands, see suggestion in the chart. Fall and winter nitrogen applications will help zoysias to retain green color in cool weather.

Mowing

Mow at 1/2 – 1 inch. If cut closer, the stand may be weakened. For a neat, smooth-looking lawn, mow every 10 days in hot areas, and every 2 weeks in cool parts of the state.

Summary

The new zoysia strains have many advantages which make them valuable turfgrasses for most warm areas of California. Zoysia's slow growth may be a disadvantage while establishing, but the low maintenance required after a solid turf is achieved is advantageous. Zoysias are the best permanent shade-tolerant grasses for the Southwest.

Comporisons

	ZOYSIAS	COMMON OR IMPROVED BERMUDAGRASSES	KENTUCKY BLUEGRASS
Length of turf life – subtropical regions	Many-years Many years	Many Many years	1 – 4 years
Color – Hot weather Cool weather Frost and cold	 Excellent Good Poor	 Excellent Good Poor	 Poor Excellent Fair
Leaf width and texture	1/16" - 1/8"	1/32" - 1/8" depending upon variety	1/8" - 5 1/16
Thatch	Moderate to heavy – usually not exposed by mowing	Heavy – may be exposed by mowing	Slight to moderate
Mowing frequency and height	10 – 14 days at 1/2" - 1"	5 – 7 days at 1/4" - 1/2"	7 days at 1 1/2 - 2"
Planting	Sprigs or plugs	Sprigs or plugs; common bermuda is usually planted by seed	Seed
Time to cover	10 - 15 months	2 – 4 months	2 – 3 months
Amount of water and irrigation frequency	1 - 2 inches ever 1 – 3 weeks	1 - 2 inches every 1-2 weeks	1/2 - 1 inch every 5 – 10 days
Fertilization (1 lb. of nitrogen per 1000 sq. ft.)*	Every 2 months	Monthly	Monthly, except during hot weather

*Will be obtained from 5 pounds of sulfate of ammonia containing 20.5 per cent nitrogen. Use more or less of other fertilizers in proportion to per cent N contained as shown on fertilizer package label.