

TURF MAINTENANCE FOR ATHLETIC FIELDS

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As an athletic field manager or coach, you are concerned with the safety of your athletes. You provide them with protective gear to reduce physical injury and with programs for physical conditioning. But, do you provide them with a safe playing field? Many of the knee, foot and ankle injuries sustained by football and baseball athletes are a direct result of poor athletic field construction and maintenance programs. You are also concerned with the general appearance of your athletic facility. To parents, and the public in general, it is a reflection on your program. A properly constructed and maintained playing surface is an important component of the overall athletic facility.

Field maintenance should include fertility, mowing, watering, pest control, soil modification and field working. These topics will be covered here for the municipal or school level athletic field.

PROPER CONSTRUCTION - KEY TO SUCCESS

In laying out an athletic field, you must adhere to designs relating to distances, markings, etc. Just as important, however, is the attention you must give to certain factors of construction that will ultimately affect the success of your turf sustainability and maintenance programs.

Drainage, both surface and internal, is of paramount importance in the construction of athletic fields. Grasses simply will not grow well under conditions of poor drainage. Proper “crowning” of the playing surface is necessary for surface drainage. Where internal soil drainage is poor, crown to 16- to 18-inch center on football fields. A baseball infield has an 8-inch crown (1 percent slope) from baseline to edge of pitcher’s circle. The outfield should have a 1 percent slope rearward. Soccer fields have a 1 percent slope from the centerline crown to the side edge.

Poor internal drainage may result from the use of clayey or silty soils in the construction of the field. Sandy soils generally provide satisfactory internal drainage and, consequently, better conditions for grass growth. Soil drainage may be improved by adding large amounts (80 percent) of sand at renovation. Installation of tile drainage systems, however, still may be necessary to allow internally drained water to move out of the soil.

RENOVATING THE FIELD

Renovation of our southern athletic fields is the reworking and or regrassing of the playing areas. Several good reasons point to why you may want to go to this trouble and expense.

- Poor, heavy clay soil that has no internal drainage and easily compacts
- Poor soil contours or lack of surface drainage
- Subsurface hardpan layers
- Bad, very little or the wrong grass
- Worn out, unresponsive field
- Installation of new irrigation system

For much more on renovation, see the LSU Ag Center’s other related articles on their Web site for commercial horticulture/turfgrass/athletic fields.

PROVIDE FOR IRRIGATION

Proper watering is essential for development and maintenance of good healthy sod. Many types of irrigation systems are available, and the type you select will depend on your budget. The most effective and labor-efficient system is one that is installed underground, is automatic and operates through “popup” sprinkler heads. Choose one with a small head and rubber cushion. This type is reliable and

safe for players. The irrigation system should be installed after the playing field has been prepared to rough final grade, or can be added as a retro fit.

Regardless of the irrigation system you choose, remember that newly planted grass should be watered daily until well-established. Established turf should be watered when needed to a depth of 4-5 inches. A good sign of need for immediate irrigation is commonly called "foot printing." Under droughty conditions, the grass fails to bounce back after being walked on, and you can easily see where you have been. Applying a light watering each day to established turf is undesirable since it encourages a limited root system concentrated near the surface. You can provide an excellent playing surface by applying water several days before a game is to be played, but to reduce soil compaction potential, avoid watering within a day of heavy use.

Ryegrass needs a little more attention to soil moisture since its root system is generally smaller than that of Bermuda grass. If it's been cool or cold, apply less water.

All turf is best watered early in the morning. If you must water later because of water pressure or other reasons, do so.

Irrigation systems should apply a measured amount of water evenly. Check distribution by collecting samples in a target area in cat food or tuna cans.

MAINTAIN SOIL FERTILITY AND PH

You must establish and maintain proper soil pH and soil fertility levels if the athletic turf is to be healthy and wear-resistant. Contact your county agent for procedures to follow in taking soil samples and submitting them for analysis at LSU. Soil pH should be between 6.0 and 7.0. At planting, apply recommended lime and fertilizer and incorporate to a depth of several inches. This should be done after rough grade has been established.

Fertilize established grass at 4- to 6-week intervals from April to September based on soil test results. Most fields can use a turf or fairway fertilizer blend. This has a ratio of nitrogen, phosphate and

potash in the range of 4-1-3 or 3-1-2. Apply this at a rate of about 45 lb of N per acre. A football field, between goal posts, is 1 1/3 acres.

Fertilizers such as triple 13, ammonium sulfate (21-0-0) ammonium nitrate (34-0-0) and potash (0-0-60) could also be used as effectively. The complete fertilizer (13-13-13) at 340 lb per acre could be applied in spring, summer and fall. Apply nitrogen between complete fertilizings at 130 lb of ammonium nitrate per acre or use 100 lb of urea. Where pH is high, use 210 lb of ammonium sulfate instead of nitrate. A September application of muriate of potash at about 100 lb per acre may help toughen grass for winter and foot traffic. If greener grass is required in fall, apply an iron spray, not fertilizer.



Athletic turf maintenance should be safe turf maintenance.

BERMUDA GRASS FOR THE PLAYING SURFACE

Bermuda grass sod is a tough, fine-textured, aggressive, warm-season turf, just perfect for a pretty lawn or well-performing athletic turf. It does not tolerate shade, so overhangs and trees are a big problem.

Many pesticides are labeled for Bermudas (some are restricted use), so pest control of all types is generally available. It has good wear, drought and salt tolerance and can establish quickly. Bermuda

grass is a high-maintenance turf if it is to look its best and perform well, so it is not often a good choice for home lawns. Without the higher maintenance, the quality of many cultivars becomes similar and would not warrant choosing expensive improved cultivars over Arizona common Bermuda grass. In lower maintenance budgets, common Bermuda may be the best choice because it is more sustainable under lower maintenance.

Two groups of Bermuda grasses, seeded and hybrids, are recommended for athletic fields in Louisiana.

Common Bermuda grasses may be easily established by seeding at the rate of 1 lb of pure live-hulled seed per 1,000 square feet (40-45 lb PLS per acre). This seeding rate produces a complete cover in three or four months on warm, moist soils.

More than 20 varieties of seeded turf Bermuda grass are on the market. Many perform only about as well as common Bermuda if minimal maintenance is provided; however, they may cost three or four times more. Varieties that rated best quality in 2002 test plots of 18 seeded selections grown at the LSU AgCenter's Burden Center in Baton Rouge were Savannah, Sultan, Sydney, Rivera, Southern Star, Primo and Princess. Yukon and Riviera had performed well under cold stress and would be good choices in our northern parishes.



Also worth planting in Louisiana are the varieties Bermuda Triangle, LaPaloma (blended), Contessa, Transcontinental, Sundevil-II, Black Jack, Pyramid and Jackpot.

Tifway (419) Bermuda grass is a popular hybrid Bermuda grass. It must be established by vegetative planting. This fine-textured grass produces an excellent tough playing surface and should be mowed at a lower height than common Bermuda grass. It also requires more fertilizer than common types.

MOW OFTEN AT CORRECT HEIGHT

Set mower low, and remove dead grass and weeds before spring greenup. Height of cut depends on grass type. Frequency of cut depends on height of cut and growth rate.

Tifway hybrid is cut to three-fourths to 1 inch. Use the lower heights for infields and faster turf. Common Bermuda is cut to 1 1/4 or 1 1/2 inches. Overseeded ryegrass is cut to about 1 inch.

Shorter cut grass must be cut more often. Improper cutting will weaken and thin shorter turf more than if kept taller. Never cut off more than the top third of the plant at one time. Also, we may say to mow when you get 50 percent regrowth. Example: grass cut to 1 inch is mowed whenever it reaches 1 1/2 inches. If mowing will be a problem, choose

the taller cut but still follow the one-third rule of cut. This reduces the impact of losing too much foliage. Growing Bermuda grass will require mowing every 3 to 5 days.

Reel-type mowers are preferred, especially on turf mowed at 1 inch or less. These require sharp blades and proper adjustment. Rotary mowers also can work well and must be kept sharp, too. Flail mowers will not produce a nice cut for athletic turf.

AVOID COMPACTED FIELDS

Severe soil compaction, caused by heavy traffic and clayey soils, will result in thin grass growth, poor moisture penetration and a hard, unsafe playing surface. Moist soils compact more than dry or very wet soils.

Light or moderate compaction can be altered by thorough coring and applying a cover one-fourth inch thick of sharp sand. This will require 34 cubic yards per acre. The mid-field or near goals may be the only areas in dire need of sand, but all the field should be cored several times a year. Core at least twice in late spring-summer. This can be done monthly even during heavy play periods.

Heavy compaction can be corrected only by deep plowing. This then requires a regrading and replanting renovation.



Mower with "turf" tires.

10-POINT PLAN

Here is a basic 10-point annual schedule for general athletic turf maintenance. Changes can be made to suit your particular needs.

1. LATE WINTER – The presence of winter weeds slows grass greenup and competes strongly at this time. For control:

- Non-overseeded fields apply simazine or atrazine (dormant turf) plus Trimec (3 way) or 2, 4-D to active weeds.
- If overseeded, apply 2, 4-D or Trimec alone.
- Do not apply Simazine or atrazine to overseeded Bermuda grass.

2. MID SPRING – Apply 300 lb of 13-13-13 per acre. You may apply sand or sandy soil to fill in the low spots. Make sand applications 1/2 inch at a time and allow grass to grow through the sand before making additional sand applications. If low areas persist, you may mix 25 percent of a good topsoil into the sand to fill in the low areas.

3. LATE SPRING – Monitor fields for emerged crab grass. Apply MSMA at 45 oz/A. Repeat in 7-10 days. Expect turf to be temporarily injured by MSMA.

4. A few days after the last MSMA treatment, or 6 weeks after first fertilization, apply 225 lb of 13-13-13 per acre.

5. EARLY SUMMER – Apply MSMA at the rate of 45 oz/A to eliminate unwanted grassy weeds. Add a surfactant if the label specifies. If goosegrass are present, tank mix MSMA with 5 oz of Sencor (metribuzin) per acre plus 2,4-D. Repeat in 7-10 days.

6. Apply halosulfuron (Sedgehammer), sulfosulfuron (Certainty) or trifloxysulfuron (Monument) if nutsedge (Coco) are present. Herbicides can be mixed with MSMA.

7. EARLY TO MID-JULY – Apply 125-150 lb of (33% N) ammonium nitrate per acre. Always apply fertilizer after the dew has dried, and water in. Apply MSMA for escaped Dallis grass if needed. Repeat MSMA in 7-10 days.

8. About 30 days after the previous nitrate, apply 125-150 lb of ammonium nitrate per acre.

9. EARLY SEPTEMBER – Apply 225-250 lb 13-13-13 per acre.

10. LATE NOVEMBER TO EARLY DECEMBER – Apply 1 1/2 quarts of Simazine or Atrazine per acre. This will prevent many weeds from germinating in winter and the next spring. This is for non-overseeded turf only. Atrazine is used on dormant turf only if Bermuda grass.

Note: Soil test every other winter to keep nutrients on track.

Note: Substitute metsulfuron for 2,4-D in cotton-sensitive areas.

EXTRA CARE PROGRAM

For hybrid Bermuda turf or a good common Bermuda stand that you wish to be the best it can be, follow these extra-care suggestions:

- Be sure to aerify two to four times a year.
- Fertilize Bermuda five to six times a year (plus feed the overseed during winter). If you use fewer than six applications a year, choose a turf fertilizer with some slow-release N like sulfur coat urea (SCU).
- Use plenty of irrigation as needed, but do not overwater.
- Mow often, two to three times a week in season.
- Vertical mow (dethatch) in June every year, and remove trash.
- Overseed with ryegrass or perennial rye (better) in mid-fall. This is desirable for baseball and soccer turf, but is questionable for football because ryegrass in spring holds the Bermuda spring emergence back.

Spray iron (Fe) once or twice on non-overseeded turf in mid- to late fall for better fall color.

OVERSEEDING (WINTER GRASS)

Bermuda grass usually stops growing mid-fall and turns brown after the first hard frost. It remains dormant until soil temperatures reach 60 degrees. Each fall, many athletic fields are overseeded with the cool-season grasses of either annual or perennial ryegrass to provide color, traction, uniform surface conditions and grass protection. This is particularly true for fields used extensively in winter through spring. Baseball and soccer fields are prime candidates for overseeding because of use in the early spring. The Bermuda grass base is still important, because it adds strength, footing and wear tolerance even though it may be dormant when the fields are in use.

Overseeding is expensive and adds another layer of maintenance that would mostly be avoided without it. The rye must be fertilized, watered, mowed and pest-protected similar to a Bermuda program in summer. The rye will also compete with the Bermuda as you transition in and out of it. To hasten spring transition, herbicides are often applied.

OVERSEEDING PREPARATIONS

The overseeding process is conducted in mid-fall, but preparing Bermuda for overseeding is a year-long process. Soil acidity should be the same as for Bermuda with pH 6 to 7. Bermuda grass must be healthy to withstand the turf competition associated with overseeding.

Successful overseeding can be done two to three weeks before the expected first frost date or when the soil temperature drops to 75 degrees. Overseeding in Baton Rouge is usually done in late October. In Monroe, it's done in late



The infield turf affects 2/3 of the baseball game.

September.

Close mowing just before overseeding is essential. You must strive for good seed/soil contact. Hybrid Bermuda grass is thinned using a dethatching mower and thatch removed with a sweeper, etc. It may be possible to skip the dethatching process with common Bermuda grass. The field should be cored a month or more in advance and cores dragged with a steel mat similar to that used to drag the base paths. This helps prevent spotty germination and softens the ground.

SEED SELECTION

Annual rye and perennial rye are the grass species most seeded in sports turf. Both are quick to establish, relatively inexpensive and wear-tolerant. Perennial rye cultivars are finer textured; more heat, disease and cold tolerant; and make a smoother and longer transition compared to annual rye.

Cultivars that perform very well in the National Turfgrass Evaluation Program (NTEP) southern tests include Paragon, Secretariat II, Silver Dollar and Citation Four. A turf-type of tall fescue also would be a good grass choice for spring play seasons lasting into late spring. Color contrast between the sidelines, outfield and infield can be obtained by using different cultivars or species.

Consider purchasing fungicide-treated seed or using a Pythium designed fungicide to avoid seedling losses.

With ryegrass, the sidelines and outfields can be seeded at 5 to 10 lb per 1,000 sq ft, whereas heavily trafficked areas such as the infield and around players benches should be seeded at 10 to 15 lb per 1,000 sq ft. Soccer and football fields can be seeded at 7 to 12 lb per 1,000 sq ft. Tall fescue is seeded at 8-10 lb.

Use a drop spreader and/or herbicide to define the margins of overseeded areas. Areas inside the borders are seeded using a rotary spreader, applying half the seed in one direction and the other half moving at right angles to the first pass. Intensively managed areas such as infields, entrances to goals and players' benches can be topdressed with soil to help hold the seed in place and the area dragged with a homemade carpet mat to smooth the playing surface. Less intensive areas such as outfields need not be topdressed but should be dragged to seat the seed deeper.



Ryegrass seedhead.

POST-SEEDING CARE

Irrigate three to four times daily until seedlings begin to emerge. Irrigate just enough to wet the surface while preventing lateral movement of the seed. As seedlings emerge, irrigation frequency is reduced to daily and, eventually, to an as-needed basis. Cool-season grasses are sensitive to drought during warm periods.

Begin mowing the grass at a height of at least three-fourths inch or when 30 percent higher than desired with a sharp mower. A dull blade can pull out seedlings. Weekly mowing is often sufficient in late fall and winter, but twice weekly mowing is the norm in spring.

Do not fertilize with nitrogen at the time of overseeding, because doing so may encourage the Bermuda grass to compete. Begin to fertilize shortly after shoot emergence, and reduce as cold weather halts growth. This normally requires the application of one-half to three-fourths lb of N per 1,000 sq ft every 3 to 4 weeks. Start with a complete fertilizer (13-13-13), then alternate with just nitrogen or use a turf-designed blend. Protect young grass from fall armyworms.

OVERSEED REMOVAL

Turfgrass managers often overseed with perennial ryegrass to provide a tough, dark-green turf during winter months. The spring transition from perennial ryegrass to Bermuda grass, however, can be troublesome and inconsistent. Perennial ryegrass may survive longer into the spring than is desired because of cool, wet conditions. The overseed at this point should be considered a weed that competes with transitioning Bermuda grass and delays Bermuda grass greenup. Failure to remove perennial ryegrass in a timely manner usually result in a decline in the overall Bermuda grass stand.

Several cultural practices can provide some limited success for overseed removal when night temperatures exceed 60 degrees, including:

- Scalping with mower
- Light verticutting and core aerification in late spring
- Reduced irrigation
- High rates of ammonium nitrate to burn perennial ryegrass

The most reliable method for overseed removal is chemical removal with herbicides. The speed of removal with these products, however, varies. The following table provides some insight into the approximate time needed for the herbicides to remove the perennial ryegrass overseed in Bermuda grass.

Trade name	Active ingredient	Approximate speed overseed removal
Kerb	Pronamide	6 to 8 weeks
Manor/Blade	Metsulfuron	4 weeks
Monument	Trifloxysulfuron	2 to 4 weeks
Revolver	Foramsulfuron	2 to 4 weeks
Tranxit	Rimsulfuron	2 to 4 weeks

PAINTING TURF

Numbers and lines on turfgrass are best applied with specially formulated turf paints. These materials are not toxic to leaf blades and allow them to breathe. They also wear well, are not toxic to skin and have high pigment content (3X).



Sometimes, though, specialty paints aren't available or affordable. In that case, groundskeepers can use a nonflat, water-based acrylic paint and dilute it. For football fields, we recommend a 1:1 or 2:1 water-to-paint mixture. For baseball lines, we recommend 2:1 or 3:1 water to paint. Some quality paints with high pigment content may allow a 4:1 dilution. Mix off the field to avoid spill damage.

Other features of which you might not be aware:

- Dark colors will do more damage to underlying turf.
- Paints should be washable (often indoor types are).
- Good field paints do not contain vinyl copolymers that suffocate the grass.
- A nonmildewing agent is a desirable, though not essential, ingredient in field paints.
- PRIMO growth regulator may be added to paint (1 oz/1,000 sq ft of sprayed area) to extend line life, but don't do this more often than once a month.

Teams that use powders for marking should use ground marble dust. We do not recommend powdered lime, because it causes skin irritation and soil fertility problems.

Once the paint is ready, a wide variety of equipment is available to apply turf paints. Some teams still use rollers, but most use spray equipment. This sprayer is a compressor type or "airless." Others use a hand-pumped sprayer or a striper that applies with a fixed aerosol can of marking paint. Keeping nozzles close to the ground gives a sharper edge. Painting large areas, however, is accomplished by a boom spray rig with blended, even patterns.

CONTROL WEEDS AND OTHER GRASSES

Sound cultural practices such as providing adequate fertility and correct mowing substantially reduce weed infestations. Weed management, however, is a necessary component of athletic turf maintenance. Fortunately, Bermuda grass tolerates the application of several selective herbicides that eliminate most unwanted broadleaf and grass species. The most commonly used herbicides for athletic fields include MSMA, metribuzin, halosulfuron, oxadiazon, simazine, 2,4-D or three-way herbicide blends like 2,4-D, dicamba and mecoprop (Trimec, Triplet, Strike Three, etc.). When using pesticides, always read the label and follow the instructions for their safe and effective use.



HERBICIDE CLASSIFICATION

Herbicides for turf maintenance may be classified into three types: contact, systemic (translocating) and preemergence.

Contact herbicides kill only plant parts covered by the spray. Diquat is a contact herbicide that causes a chemical burning of green tissue. The herbicide does not translocate and kill underground roots or storage structures.

Systemic or translocating herbicides are absorbed by plant roots or leaves and translocate throughout the plant. They are either selective (kill weeds without harming desirable grasses) or nonselective (kill all plants). 2,4-D is a selective systemic herbicide useful in controlling many broadleaf weeds that invade grass. Roundup (glyphosate) is a leaf and green stem absorbed nonselective herbicide that kills or injure most vegetation.

Preemergence herbicides are chemicals that kill susceptible weeds as they germinate from seeds just prior to their emergence from the soil. Application timing is very important for the products to work correctly. Preemergence herbicides must be applied ahead of weed germination, usually in late winter, spring and early fall. Some preemergence herbicides persist in the soil for four to five weeks; others may last for up to three or four months.

WEED TYPES

Weeds such as crab grass and goosegrass that germinate in the spring and mature in the summer or early fall are designated as summer annuals. Chickweed, burweed and others that germinate in fall or later winter and mature in late spring are called winter annuals. Annuals live for one season only and reestablish yearly from seeds.

Preemergence herbicide must be applied in spring to control summer annuals and in fall to control winter annuals. After weeds appear, postemergence herbicides must be used.

Perennial weeds such as Dallis grass, Bahia grass and Virginia buttonweed live more than two years but produce seed for new plants each year. Perennials also regrow yearly from underground structures such as tubers, roots and bulbs. Biennials such as bull thistle require two years to complete a life cycle. They store food in fleshy roots for next year's growth. Generally, systemic postemergence herbicides are required for complete control of perennial and biennial weeds.

TIPS FOR HARD-TO-CONTROL WEEDS

- **DALLIS GRASS** – may need 4 to 5 MSMA applications per growing season to achieve control – dry weather weed so maintain adequate soil moisture.
- **GOOSEGRASS** – apply MSMA + Sencor and repeat 2 weeks later – weed grows well in thin turf and compacted soils so relieve compaction with aerification. Consider applying oxadiazon (Ronstar) in late February.



Dallis grass.



Purple nutsedge.

- **VIRGINIA BUTTONWEED** – apply multiple applications of three-way herbicides containing 2,4-D. Consider alternating 2,4-D containing herbicides with metsulfuron (Manor/Blade). In 2,4-D restricted zones, apply metsulfuron. Note: weed is drought tolerant, so maintain adequate soil moisture.
- **NUTSEDGES (NUT GRASS, COCO)** – apply halosulfuron (Sedgehammer), sulfosulfuron (Certainty), or trifloxysulfuron (Monument). Products can be tank-mixed with MSMA.

ACTIVE INGREDIENT

The active ingredient (a.i.) is the part of a chemical formulation that produces herbicidal effects. For example, a 50 percent granular formulation (50G) contains 50 percent active ingredients (a.i.) of the herbicide. If a 100-lb. bag of granular herbicide contains 50 percent active ingredients, 2 lb of product are required to yield 1 lb of active ingredient. Treatment of 1 acre with a 50 percent granular herbicide, at the rate of 12 lb per acre, requires 24 lb of granular material per acre, or approximately one-half lb of granular material per 1,000 sq ft (1 acre = 43,560 sq ft).

Liquid formulations generally give active ingredients as pounds per gallon (lb a.i. per gal) rather than as a percentage of the formulations. For example, 2,4-D is generally formulated as 4 lb a.i. per gallon; therefore, an application of 1 lb active ingredient per acre of this herbicide requires 1 quart of liquid for each acre covered. Wettable powder type formulations give active ingredients as a percentage (for example, 80 percent WP). Therefore, if 1 lb active ingredient per acre were required, you would need to add 1.25 lb of the 80 percent formulation to a given quantity of water to cover one surface acre.

Since there can be many formulations of the same herbicide, recommendations are often given based on active ingredients or the actual weight of the formulated material. Always consult the product label for the correct rate and other application recommendations.

FORMULATIONS

Some herbicides are applied at very low rates of active ingredient per acre. Therefore, uniform application of the herbicide is essential for successful weed control.

Herbicide formulations for use on turf include: solutions, emulsions, dispersible granules, wettable powders and granulars. The granular formulations must be applied using a conventional fertilizer spreader, and the liquid forms must be applied with a sprayer. Great care should be used in calibrating the spreader or sprayer to ensure the proper spray volume is applied that provides adequate weed coverage and optimum herbicide performance. This is generally 20 to 50 gallons per acre (GPA).

CALIBRATING PUMP-UP LIQUID SPRAYERS

1. Measure 1,000 square feet of turf (a block 20 x 50 feet or equivalent), using twine to outline the block. (Most dosage recommendations are made for 1,000 square feet of area.)
2. Pour into the sprayer a measured amount of water (for example, 3 gallons).
3. Pump the sprayer up to a reasonable pressure. (On a 2- or 3-gallon sprayer, 40 to 50 full strokes of the pump are suggested.)

4. Open the cut-off valve, and walk at a reasonable pace over the measured area, spraying the surface until all of the surface is covered.
5. Release the air pressure, and measure the amount of water left in the tank.
6. Subtract the amount left in the tank (step 5) from the amount placed in the sprayer to find the amount used in spraying 1,000 square feet.

EXAMPLE:

Three gallons put in sprayer minus 2 gallons left equals 1 gallon used to cover 1,000 square feet.

The amount found in step 6 is the base for figuring how much chemical to use in each gallon of water when you actually spray. The actual amount of water used is not important, but whatever the amount, it must be a known quantity. Thus, if the suggested rate of chemical is 2 ounces per 1,000 square feet, mix 2 ounces for each gallon of water the sprayer will hold. For instance, a 3-gallon sprayer will take 6 ounces of chemical. (Ounces per 1,000 square feet can be converted to pounds per acre by the factor 2.72; $2 \text{ oz}/1,000 \text{ sq ft} \times 2.72 = 5.44 \text{ lb/acre.}$)

CALIBRATING DROP SPREADERS

1. Measure and mark 1,000 square feet of turf (20 x 50 feet).
2. Choose a setting on the feed regulating device (based on manufacturer's recommendations, if available).
3. Weigh about 5 to 10 lb of the dry material, and place it in the hopper.
4. Open the shut-off plate, and walk over the area until it has been fully covered.
5. Weigh the material left in the spreader.
6. Subtract the remainder from the original amount placed in the hopper to find how much you applied to the 1,000 square feet of turf.
7. Since most dry materials are sold ready to apply, you may have to change the feed setting and repeat the process on a different area until you find a setting which is correct for the amount per 1,000 sq ft suggested on the product label.

The calibrations apply as much to the person using the equipment as to the sprayer or spreader. For that reason, keep your walking speed and the pressure in the tank as constant as possible.

CALIBRATING BROADCAST GRANULAR SPREADERS

Centrifugal or “broadcast” spreaders cover wider areas and are most popular. They are, however, the most difficult to calibrate accurately. Calibration should be done for each specific material since there are density and size differences in many materials that affect the spread rate.

The most direct and simple way to calibrate these spreaders is to pattern it, then spread and adjust opening until it's correct. Try the following to your satisfaction.

1. Set up your spreaders as your operator's manual directs you for a uniform and centered pattern. Check the pattern with catch pans to the left and right of the spreader.
2. Determine the swath width by broadcasting the material at a comfortable pace. Mark the left and right boundaries of where the material reaches. This is the swath. These spreaders are heavy in mid swath and light on the ends. Some will use one-half the swath width (50 percent) as “effective swath width,” or ESW, but that actually varies from 20 percent to 70 percent. Your operator's manual, or pattern trials with catch pans, will give you a percent of swath width that is your ESW. *
3. Set up another test area of 100 foot length for the “rate calibration.”
4. Determine how much material you wish to spread over the 100 feet of ESW test area. (Amount desired = amount per thousand x ESW test area ÷ 1,000)

EXAMPLE:

Want 3 lb/1,000 sq ft with a 9-foot ESW (3 x 900 sq ft ÷ 1,000 = 2.7). Thus spread 2.7 lb down the 100-ft test run.

5. Put a few pounds more than determined in step 4 into the hopper, and spread down the 100-foot test path. Try a setting or opening that is manufacturer suggested or “looks right.”
6. Collect and weigh material left in hopper and subtract from starting weight. This value is what was spread over the area of 100 feet of ESW.
7. Repeat 5 and 6 until the desired amount is being applied and note material and setting.
8. When broadcasting, make a pass every effective width (ESW) allowing the tail-off areas to overlap. Put out flags or stakes every ESW distance apart across the area to be treated as target guides for your passes.

*Detailed spreader calibration can be found at Isuagcenter.com Web site in the lawn & garden, commercial, equipment, spreaders section.



Granular weed control with broadcast spreader.

CALIBRATING BOOM SPRAYERS

There are many ways to calibrate tractor sprayers. Here is an easy method. A handy formula to use is:
H-128 Method of Sprayer Calibration

COLUMN 1	COLUMN 2
Nozzle spacing or swath width "W" Inches	Length "L" per 340 ft at "W" Swath
30	136'
28	146'
26	157'
24	170'
22	185'
20	204'
18	227'
16	255'
14	291'
12	340'
10	408'

Note: Doubling "W" gives half of "L" or doubling "L" gives half of "W"

TO CALIBRATE YOUR BOOM SPRAYER:

1. Lay out required distance in column 2.
2. Measure time (seconds) to travel this distance. Use known constant speed. Note throttle setting and RPM.
3. With sprayer stopped and throttle set at same RPM (same PSI), catch the spray from all nozzle(s) within "W" swath. Nozzles at 20 inches apart; collect one for 20 inches or two for 40 inches. Measure it in ounces.
4. Each ounce equals 1 gallon/acre.

* To improve accuracy, average all nozzles.
Example: Boom, 18-inch spacing; "L" is 227 feet; for each nozzle 39 seconds of spray gives 26 ounces; thus, 26 GPA for every 26 gal adds 1 acre worth of pesticide.

Once the sprayer is calibrated and operating in the field, practical experience indicates that speed is the most common thing that throws calibration off. Invariably, operators will use the wrong gear or a different throttle setting. Of course, pressure variations and nozzle wear will also throw calibration off. Check calibration at least annually.

This works with backpack sprayers, also.

HERBICIDES FOR BERMUDA GRASS

<i>Pre-emerge (established turf)</i>	
Chemical	Herbicide
benefin	Balan
bensulide	Betasan, various
dithiopyr	Dimension
isoxaben	Gallery
metolachlor	Pennant
oryzalin	Surflan
oxadiazon	Ronstar
pendimethalin	Weed grass Control, Pre-M
prodiamine	Barricade, Regal Kade
pronamide	Kerb
simazine	Various
atrazine	various-dormant only
<i>Postemerge (selective)</i>	
chlorsulfuron	Corsair
metsulfuron	Manor, Blade
2,4-D	various or as a blend with mecoprop and dicamba (Trimec, 3-way, various)
MSMA	various
halosulfuron	Sedgehammer
metribuzin	Sencor
pronamide	Kerb
simazine	various
triclopyr + clopyralid	Confront
sulfosulfuron	Certainty
trifloxysulfuron	Monument
foramsulfuron	Revolver
rimsulfuron	Tranxit

DISEASE CONTROL FOR ATHLETIC FIELDS

BROWN PATCH

Brown patch disease, caused by a fungus (*Rhizoctonia solani*), occurs in the late spring or early fall. The disease is characterized by patches of dead grass blades. These patches in Bermuda grass range from 1 foot to several feet in diameter. Blades and sheaths are pulled easily from the stolons because of deterioration in the attachment area. Stolons often remain green. New leaves may emerge in the center of the patch in two or three weeks, giving the diseased area a doughnut-shaped appearance. The entire spot eventually may become green during a long growing season.

Disease development occurs most rapidly in temperatures between 75 and 85 degrees when free moisture is present. Fungus activity stops when the air temperature reaches 90 degrees. This explains seasonal development.

Some turf areas are affected almost every year, but others are damaged only occasionally. Fungicide application, which effectively prevents brown patch development, should be made when brown patch is expected.

Control measures. Avoid excessive applications of nitrogen, particularly in the early spring and fall. Water early in the morning only. Follow manufacturer's recommended rate for fungicides.



Brown patch.

MELTING-OUT

Melting-out is a serious problem in turf where the grass thins and becomes unsightly. This condition develops more rapidly in summer, when large dead areas appear in the turf. General turf fungi including *Curvularia* spp. can be cultured from stolons of diseased grass, but reproducing infections on healthy grass is difficult. For this reason, it is believed these fungi cause fading-out on grass weakened by thatch buildup, insect pests or nematodes.

Effective control of fading-out requires several different approaches. First, correct cultural conditions that limit plant growth. Mowing at the proper height, fertilizing according to soil test, watering properly and avoiding thatch buildup all contribute to healthy grass that resists development of weak pathogens.

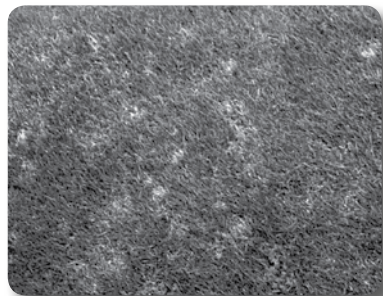
Control materials. Follow manufacturer's recommended rate.

Chemical	Trade Name
<i>(active ingredient)</i>	<i>(examples)</i>
azoxystrobin	Heritage
pyraclostrobin	Insignia
trifloxystrobin	Compass
flutolanil	Prostar
fludioxonil	Medallion
chlorothalonil	Daconil Ultrex
iprodione	Chipco 26019
mancozeb	Dithane Rainshield
myclobutanil	Eagle
thiophanate-methyl	Cleary's 3336

Chemical	Trade Name
<i>(active ingredient)</i>	<i>(examples)</i>
iprodione	Chipco 26019
fludioxonil	Medallion
mancozeb	Dithane Rainshield
azoxystrobin	Heritage
vinclozolin	Curalan
trifloxystrobin	Compass
chlorothalonil	Daconil Ultrex

DOLLAR SPOT

Dollar spot of turfgrasses is caused by the fungus *Sclerotinia homeocarpa*. It has been reported in most areas of the United States. Bermuda grass may be severely affected in the South.



Dollar spot.

The disease appears as round, brown to straw-colored and somewhat sunken spots (about the size of a silver dollar), hence the description "dollar spot." On bluegrass and fescues, the spots may reach 4 to 6 inches in diameter.

Dollar spot is distinguished from other diseases by the characteristic girdling lesions on the leaf blades of live plants at the margin of the affected area. The lesions may be an inch or so long, often near the leaf tip. They are light tan with a reddish-brown border.

When dew is present on the grass blades in the morning and dollar spot is active, white cobweblike growth (mycelium) of the causal fungus may be seen on the diseased turf. Some mycelium may persist under the leaf sheaths, but most disappears as it is dried by the sun and wind. When turf is maintained at a higher cut of 1 to 2 inches, the diseased areas are noticeably larger, with some spots 4 to 6 inches in diameter.

Optimum temperatures for disease development are usually between 70 to 80 degrees. The dollar spot fungus survives unfavorable growing conditions as black sclerotia, which appear as small black particles. The sclerotia consist of compact masses of mycelium with a specialized outer coat. They germinate by resuming mycelial growth. When turfgrasses are maintained with adequate nitrogen, less dollar spot occurs and recovery is more rapid.

Control measures. An application of nitrogen will retard this disease. Follow manufacturer's suggested rate for fungicides.

Chemical	Trade Name
(active ingredient)	(examples)
triadimefon	Bayleton 50 T&O
vinlozolin	Curalan
thiophanate-methyl	Cleary's 3336
myclobutanil	Eagle
boscalid	Emerald
iprodione	Chipco 26019
fenarimol	Rubigan
chlorothalonil	Daconil Ultrex

THATCH BUILDUP

Accumulations of fallen clippings and dead leaves, commonly referred to as thatch, provide an environment favorable for micro-organism buildup. In fact, activity of these organisms is necessary for converting this material to humus. Some types become overly ambitious, however, and begin deriving nourishment from living grass plants, resulting in the fading-out conditions. These areas sometimes are difficult to resod where grass has died.

Thatch buildup can be prevented by catching grass clippings or by removing leaf accumulations by close mowing and raking just as spring growth begins. Follow with regular mowings that remove only short clippings that dehydrate rapidly and do not contribute to thatch buildup.

Maintain adequate and even moisture when dry. Keep soil pH up to 6 or higher. Vertical mowing in June-July can also help.



Thatch buildup.

MUSHROOMS

Mushrooms are fruiting structures of fungi produced when weather conditions are favorable. Mushroom-producing fungi develop on organic matter beneath the ground and produce fruiting structures on the outer limits of the colony, causing a circular effect. Grass is often greener in the area because of nutrients liberated by decomposition of the fungus.

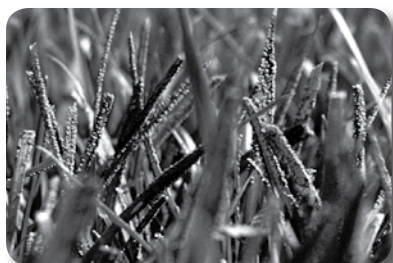
Control often is not necessary because of the condition's temporary nature and the difficulty in getting the fungicide to the mushroom-producing fungi.

SLIME MOLDS

Slime molds are fungi that develop mostly during warm, moist weather.

The most common slime mold found on turfgrass, *Physarum cinereum*, occurs as a dark gray to black crustlike material. This sootlike material rubs off easily on shoes or clothing.

Slime molds derive nourishment from decaying organic matter in the soil. They do not feed on green plants and cause no damage other than shading. Remove from grass by applying water under pressure.



Slime mold on grass leaves.

NEMATODES

Nematode injury symptoms often appear as areas of low fertility even where fertilizers have been applied. This occurs when nematodes feeding on roots reduce their ability to absorb water and nutrients. These tiny roundworms, which measure about 1/50 of an inch long, have a spear in the mouthpart that punctures plant cells and withdraws cell sap. This activity not only removes cell contents but opens points of entry for other organisms that infect injured or devitalized roots.

Where nematodes constitute the limiting growth factor, a nematocide application usually is needed yearly. Nematodes are seldom eliminated, but their populations can be reduced to allow normal plant growth. Good cultural and fertilization practices also help overcome nematode injury.

INSECTS

SOD WEBWORM

Importance and Type of Injury. Sod webworms feed only in the larval stage. As soon as the eggs hatch, the tiny larvae begin feeding on the grass leaves. It is not until they reach full size that the damage becomes apparent, and then it appears as though overnight. Worms feed only at night. Damage is usually seen only in patches, with the grass blades notched on the sides and chewed back raggedly. The grass may die if the foliage is stripped off in hot, dry weather.

Life History, Appearance and Habits. The adult sod webworm is a whitish or gray moth with a wingspread of about three-fourths inch. When it is at rest, the wings are folded closely about the body. It hides in the shrubbery during the day, and the adult moth can be seen in the early evening flying over the grass, depositing her eggs as she flies.

The eggs hatch in about one week into tiny larvae which, when full grown, are about three-fourths inch long and light brown to blackish. The larvae build burrows or tunnels close to the surface of the soil and reinforce these with bits of dirt and pieces of grass, line them with silk and live in them. They cut off pieces of grass, dragging them into the burrows to eat.

To find the larvae, part the grass and look for small worms curled up on the soil or break apart some of the drying sod in the infested area and look for the tunnels and larger worms.

ARMYWORMS

Importance and Type of Injury. Armyworms and fall armyworms (sometimes called grassworms), when numerous, may devour all of the foliage down to the ground. When they have eaten all of the food in one area, they march on to the next. They feed on a great many species of grasses, and no lawn grass is immune to their attack.

Life History, Appearance and Habits. The adult insect is a moth with a wingspread of about 1 1/2 inches. It has grayish-white hind wings with dark mottled forewings. The females lay up to 1,000 eggs in clusters of about 150 each on the foliage of plants. The newly hatched larvae begin to feed on turf near the ground and can do considerable damage before

they are noticed. The caterpillars vary from light tan to green or black with three yellowish hairlines down the back. The fall armyworm does not hide during the day and may be found feeding at any time.

Control Measures: Armyworms and sod webworms can be controlled with the following materials. Control webworms late in afternoon.

Material	Rates
Talstar 10 WP	1 tbsp/gal or 1-3.5 oz/100 gal
Dylox (80% SP)	2 1/2 - 3 3/4 oz/1,000
Dylox LS (Trichlorfon)	4-6 oz/1,000 (1/4-3/8 pt in 15-50 gal/1,000)
Conserve SC (Spinosad)	0.25 oz/1,000/10 oz/acre
Onyx	0.07-0.15 oz/1,000 sq ft
Sevin (50% WP)	6 1/2 oz/1,000
Mavrick Aquaflo	3/4 - 1 1/2 tsp/1,000
B.t.-- <i>Bacillus thuringiensis</i> Crymax, Xentari, Dipel, Condor, Javelin	Follow label
Simitar CS	1.5-0.5 oz/100 gal
Mach 2 IRG	2 qt/acre/1.5 fl. oz/1,000 sq ft

IMPORTED FIRE ANTS

Importance and Type of Injury. Fire ants are considered one of the worst pests in turf, but they are also one of the best predators. They will control many flea and tick populations in fields, yards and pastures. They are responsible for reduced spray programs in many of our commercial fields and forests.

When the colony is established in a bad location, and people and pets or animals are bitten, they become a pest. They can be very damaging to equipment such as mowers because their mounds, when dry, can be like concrete. They can damage plants by building mounds around the base. This aerifies the root system and can cause the plant to become stressed or to die, depending on its age.

Life History, Appearance and Habits. Fire ants are one of the most adaptive insects known. Since their arrival, they have spread over the entire Southeast. They build their mounds in any suitable location. They are foragers and feed on anything they can catch. Insects, seeds and other materials are collected and used as food.

Each spring the colony builds up, and reproductives are developed. Following suitable weather conditions, the reproductives swarm out to begin new colonies. This process occurs several times throughout the warmer months, causing a population explosion. Infestations may include anywhere from 60 to 300 mounds per acre, with each mound containing upward of 50,000 ants.

Control Measures. Control of the fire ant is not easy, primarily because of the potential for reinfestation from neighboring mounds shortly after treating those in your yard or field. The biggest mistake people make is not using enough water to flood a mound with the pesticide used. This causes the mound to move 6 to 10 feet and start over. It is important to know that, for each inch the mound projects above the surface, it goes down 1 to 1/2 inches, so a mound 8 inches high can go 8 to 12 inches deep for a total of 16 to 20 inches. Therefore, you can understand the need to use at least 1 gallon of solution per mound or 1 gallon of water to flush in granular materials.

Growth regulator baits act slowly (2 to 6 weeks). These must be carried back to the mound and fed to the reproductives, which become sterile before a decline in population will be observed, about four to six weeks. These materials act slowly and have short residual activity but once inside the colony very effective. The carriers of these baits and the attractants can function only for 24 to 48 hours before they break down or go bad and are no longer attractive to the ants.

Orthene 75S (OTTO) can be used as dust formulations and Indoxycarb bait for control of fire ants by mound treatments.

The following materials may be used to control fire ants. They will work more effectively when the label rates and recommendations are followed when soil temperatures get above 55 degrees.

Material	Rates
Indoxcarb (Over & Out)	Mound treatment
Top Choice	12.5 lb/acre, topical application
Logic (Award)	1-1.5 lb/acre, broadcast or 1-3 tbsp/mound
Amdro	1-1.5 lb/acre, broadcast, 5 tsp/mound
Esteem	1.5 lb/acre
Extinguish	1-1.5 lb/acre
Extinguish Plus	1-1.5 lb/acre
Fire Strike	1-1.5 lb/acre
Orthene 75S	Mound treatment only
Sevin 80S	2 lb/100 gal, 1/3 oz/gal. (use 2 gal/mound)
Sevin 50W	3 lb/100 gal
Sevin SL	1 1/2 qt/100 gal
Oftanol 1.5G	3 lb/1,000 sq ft
Oftanol 2	1 gal/acre or 3 oz/1,000
Talstar G	2.3-4.6 oz/1,000/100-200 lb/acre
Scimitar GC	1.5-5.0 oz/100 gals.

Control is best obtained by treating the mounds directly with your choice of materials and then, about two weeks later, broadcast an insecticide or growth regulator. Check to make sure ants are actively foraging before applying baits or growth regulators. Use potato chips or pieces of hot dog or sardines to determine foraging activity. The area needs to be dry before application and stay dry 48 hours after treatment.

MOLE CRICKETS

Importance and Type of Injury. Mole crickets feed primarily at night, and all stages are a problem in turf. The primary injury is in two forms. Initially the



Mole cricket.

tunneling in the soil aerifies the root system, and the plants will wilt and die. Second, they also feed on the root system of the grasses and cause direct injury to the turf. Tunneling is the characteristic means of movement

through the soil. Their front feet are highly modified for digging. The name is derived because of the similarity of the tunnel to mole tunnels, only smaller.

Life History, Appearance and Habits. Mole crickets or ground puppies overwinter as adults and emerge in early April. They mate and return to the soil to lay eggs. The eggs hatch, and the young mole crickets begin feeding in the soil. At about second instar, they begin to come to the surface and tunnel in mid June. They continue to grow and develop throughout the summer and mature in mid fall.

Mole crickets are about 1 to 2 inches long. They are velvety brown and are made for digging. The head is narrow, and the thorax is large and tapers to the anterior and is widest at the abdomen. The front legs are modified for digging and have a shovel appearance, terminating in four large claws. They have wings and fly about lights at night. They run over the surface and dig in rapidly when disturbed or frightened. They are the favorite food of birds, armadillos, skunks and opossums. The last three will do serious damage to turf sites infested with mole crickets as they dig them up for supper.

Control Measures. Several materials are available to control mole crickets, and particular care must be used to select materials and application. Some must be watered in, and others have to have the area wet and then applied. Read and follow all labels carefully.

A little lemon soap may be added to all sprays to enhance activity and contact with crickets. Sprays should be applied in late afternoon or at dusk for best control.

Material	Rates
Oftanol 2	1 gal/acre or 3 fl oz/1,000
Oftanol (5% G)	0.9 lb/1,000 or 40 lb/acre
Carbaryl (20% bait)	2-4 oz/1,000
Merit 75 WP	8.6 oz/acre, 4 tsp/1,000
Chipco Choice	12.5-25 lb/acre, 4.6-9.4 oz/1,000
Top Choice	87 lb/acre, 2 lb/1,000
Onyx	0.07-0.15 oz/1,000
Talstar F	0.5-1 oz/1,000, 10-40 oz/acre
Talstar G	2.3-4.6 oz/1,000, 100-200 lb/acre

WHITE GRUBS

Importance and Type of Injury. White grubs are the larval stage of several species of beetles that feed on grass roots, often killing areas of lawn or turf by eating the roots close to the soil surface. They cause aeration and drying of the soil by their tunneling. This adds stress to the injured grass causing it to die. In severe infestations, large handfuls of turf may be easily pulled out. On athletic fields large clumps of grass may be pulled out because of root feeding, causing loose footing and a high risk of injury to athletes.

Life History, Appearance and Habits. The adults of the white grubs are the May or June beetles or the green June beetle. They are primarily foliage feeders feeding on pecan, hickory, peach, plum and roses. The adults hide during the day but are attracted to lights at night. They overwinter as nearly full-grown larvae. They resume feeding in the spring and pupate in cells in the soil in March and April. They begin emerging in April with high numbers emerging in May or June. During years of dense populations, they may be found until late August.

Eggs are laid in the sod areas during the summer. The white grubs, upon hatching, begin feeding on grass roots until late autumn when they tunnel deeper into the soil to avoid low temperatures.

Control Measures. White grubs can be controlled with any of these insecticides.

Material	Rates
Dylox 6.2G	3 lb/1,000
Proxol 80 SP	3 3/4 oz/1,000
Sevin SL	10 oz in 30-40 gal/ water/1,000
Sevin 80S	1 7/8 lb in 150-200 gal/5,000
Merit 75 WP	3-4 tsp/1,000
Oftanol 2	1 gal/acre or 3 fl oz/1,000
Oftanol 1.5G	3 lb/1,000
Oftanol 5G	0 lb/acre or 0.9 lb/1,000
Merit 75 WP	6.4 oz/acre, 3-4 tsp/1,000
Mach 2	3 qt/acre/2.2 fl oz/1,000 sq ft
Flagship	8 oz/acre
Meridian	12.7-17.0 oz/acre, 1.5- 1.95 oz/5,000 sq ft

CRAWFISH

Apply a solution of Sevin at the rate of 8 tbs/gal or 8 lb/100 gal (using the 50WP). Pour 1 oz of this into stacks or holes.

EARTHWORMS

Earthworm populations are usually beneficial and don't require control. When populations explode on the fields and turf begins to die, thousands of small mounds, soil castings and fecal matter begin to show up on the surface as the grass begins to decline. These are usually low areas that tend to remain wet because of poor drainage.

Remove thatch and improve drainage. Where necessary, sprays with Sevin, Benomyl or Thiodan can be used.



Granular soil deposits can be signs of earthworms.

SUGGEST MAINTENANCE CALENDAR FOR BERMUDAGRASS ATHLETIC FIELDS

Management	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Comments
Fertilization			*	*	*	*	*						Monthly nitrogen during spring and summer. *Fertilize overseed.
Liming													According to soil test.
Mowing													Mow at least 2 times per week
Irrigation													As necessary; water deeply
Aerification													Core aerification if possible.
Dethatch													Aug-Sept if overseeding
Broadleaf Weed Control													See reverse for weed control information
Pre Crabgrass													Careful with damaged turfgrass (see reverse)
Post Crabgrass													Repeated applications of MSMA (see reverse)
Insect Control													Broadcast baits to reduce ant populations
Disease Control				*	*	*	*						*Monitor overseed for disease
Overseeding with ryegrass													Overseed with perennial ryegrass.
Seeding a new field													Mid to late spring is the best time for seeding bermudagrass.

 **RECOMMENDED TIME**

 **COULD BE DONE AT THIS TIME**

Thomas J. Koske, Professor (Horticulture)
Dale K. Pollet, Professor (Entomology)
Clayton Hollier, Professor (Plant Pathology)
Ronald Strahan, Asst. Professor (Agronomy)
Don Ferrin, Asst. Professor (Plant Pathology)

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Pub. 1989

(2M)

05/08 Rev.

Issued in furtherance of Cooperative Extension work, Acts of Congress of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. The Louisiana Cooperative Extension Service provides equal opportunities in programs and employment.