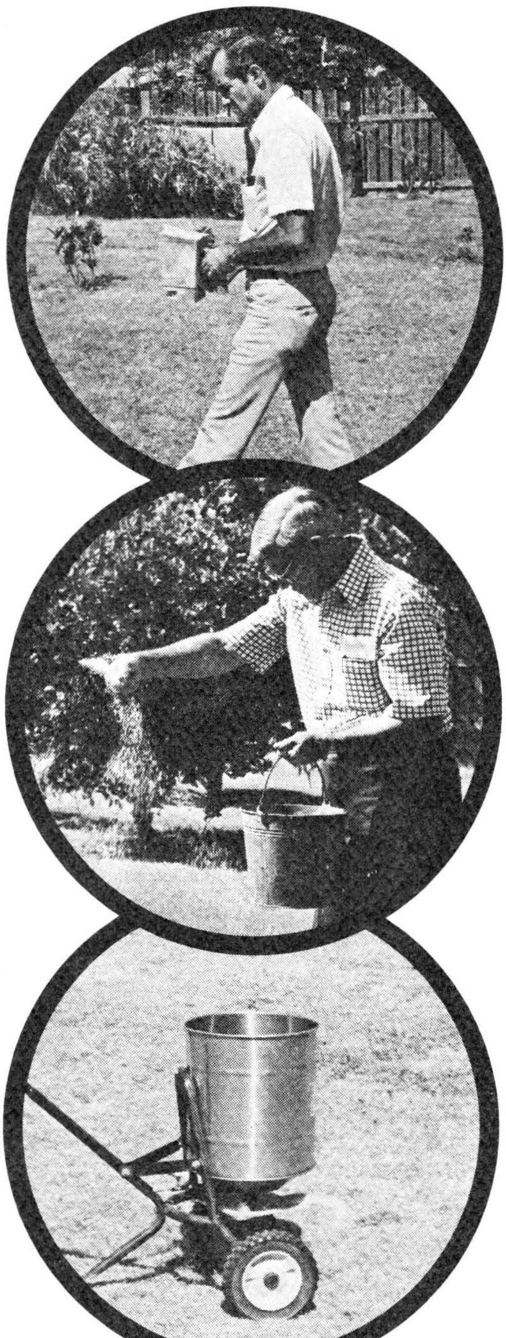
Cooperative Extension Service · College of Tropical Agriculture & Human Resources
University of Hawaii at Manoa · CIRCULAR 495



TURFGRASS FERTILIZATION IN HAWAII

CHARLES L. MURDOCH
WADE W. McCALL

TURFGRASS FERTILIZATION IN HAWAII

Charles L. Murdoch and Wade W. McCall*

Proper fertilization is essential for the maintenance of attractive turfgrass areas. It is necessary for uniform appearance and growth of established turf. Poor fertilizer practices, including excess, insufficient, and/or poor distribution of fertilizers, are responsible for many of the common problems associated with turfgrass maintenance.

Fertility requirements of different grasses vary greatly. Bermudagrasses have the highest fertilizer requirements of all the grasses commonly grown for turf in Hawaii. Zoysiagrasses and St. Augustinegrass are intermediate, and centipedegrass requires the least fertilizer. Fertilizer requirements for a given grass will also vary greatly depending upon its intended use, the desired level of appearance, soil conditions, amount of rainfall or supplemental irrigation, and other environmental conditions.

The following recommendations are intended for maintaining the excellent appearance of established turf, and are intended primarily for private homes rather than large areas of turf. However, the principles do apply to all sizes of turf areas.

BEGINNING THE PROGRAM

It is essential that a definite fertilization schedule be followed. In Hawaii, where the growing season is yearlong, it is necessary to apply fertilizers throughout the year. Failure to follow a regular schedule will result in uneven appearance and may increase weed, insect, and disease problems.

Have the Soil Tested

A soil test should be made before starting a turf fertilization program in order to determine the existing fertility level and pH of the soil. The soil test will show the pH of the soil, and the amounts of available phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg). Soil tests do not show the amount of nitrogen (N); however, most soils are inherently low in nitrogen as it is leached rapidly from soils, and will be needed continually in a turf fertilization program.

When the results of the soil test are returned, any deficiencies should be corrected before beginning the program. Table 1 lists the optimum pH range and minimum pounds per acre of the nutrient elements as shown by the University of Hawaii soil test (modified Truog test) for the major turfgrasses grown in the State.

*Associate Horticulturist and Associate Turf Specialist and Soil Management Specialist, respectively.

Table 1. Approximate minimum amounts (lb/acre) of nutrient and optimum pH range for Hawaii turfgrasses

Grass	pH	Ca	Mg	P	K
Bermudagrass	6.0-6.5	6,000	500	200	320
St. Augustinegrass	6.0-6.5	6,000	500	150	240
Zoysiagrass	6.0-6.5	4,000	500	150	240
Centipedegrass	5.0-6.0	3,000	250	100	80

Correction of Soil pH

Agricultural limestone or finely ground coral may be used to raise the soil pH to the desired level. Table 2 gives average amounts (lb/1000 sq ft) of ground coral required to raise the pH of the soil to the desired range for the various grasses.

Add only the recommended amount of ground coral to correct the acid condition. An over-application of lime will result in alkaline soil conditions which are as detrimental as the acid condition. It is not advisable to apply more than 50 lbs/1000 square feet of ground coral at any one time as alkaline conditions may be created at the soil surface. If more than 50 lbs/1000 square feet are required, then split applications, spaced 6 months apart, are advisable.

Acid-forming fertilizers, such as ammonium sulfate, used regularly are effective in lowering the pH of alkaline soils. Elemental sulfur (95 percent wettable) may also be used; however, care must be taken not to apply excessive amounts of elemental sulfur because of the danger of foliar burn. No more than 10 lbs/1000 square feet should be applied at any one application. Table 3 gives suggested rates of 95 percent elemental sulfur required to lower the soil pH to 6.5 from different original soil pH's.

Table 2. Suggested amount of finely ground coral required to raise the soil pH to the desired level for Hawaii turfgrasses

	Centipedegrass	Bermudagrass zoysiagrass, St. Augustinegrass
Original soil pH	lbs/1000 sq ft	lbs/1000 sq ft
6.3-7.0	0	0
5.8-6.2	0	46
5.3-5.7	0	92
4.8-5.2	35	140
5.0-4.7	100	185

Table 3. Amount of 95% sulfur required to lower the soil pH to approximately 6.5

Soil pH	Amount of sulfur to add lbs/1000 sq ft
7.5	25-30
8.0	35-50
8.5	50-60

If multiple applications of sulfur are required, they should be spaced at least 60 days apart. The pH of the soil should be corrected before the turfgrass is established. This provides optimum conditions for plant growth throughout the root zone of the plant. Once the turf is established, the lime or sulfur must be applied to the surface. These materials must be washed from the leaves of the plant to reduce the danger of foliar burn and to get as much as possible into the soil. When applied to the surface, the change in pH will occur only at the surface; then, as the material moves very slowly into the soil, changes occur at lower levels. The best way to apply lime or sulfur to established turf is to use a plug type aerator to provide small holes in the soil. This will increase the rate of pH change to the depth of these holes.

Correction of Soil Nutrient Levels

Low phosphorus and potassium levels may be corrected by applications of treble superphosphate and muriate of potash, respectively. They may also be added in a complete fertilizer such as a 10-20-10 analysis. The amount to apply will depend upon the soil test results and the analysis of the fertilizer used. Magnesium deficiencies may be corrected by application of magnesium sulfate or magnesium ammonium phosphate.

Nitrogen Sources

Nitrogen is required in the greatest amount by turfgrasses. It is also subject to leaching to a greater degree than the other elements essential for plant growth. This necessitates more frequent additions of nitrogen to meet the needs of turf.

Nitrogen sources include inorganic, natural organic, and synthetic organic materials. Each has certain advantages and disadvantages for use as turfgrass fertilizers and these should be recognized when choosing a nitrogen fertilizer.

The most common inorganic nitrogen fertilizers in Hawaii are: ammonium sulfate, ammonium nitrate sulfate, and calcium nitrate. Inorganic nitrogen fertilizers are water soluble and, therefore, the initial response of plants to the fertilizer is rapid. They generally are much cheaper per unit of nitrogen than the other types. Disadvantages of inorganic nitrogen fertilizers are their tendency to

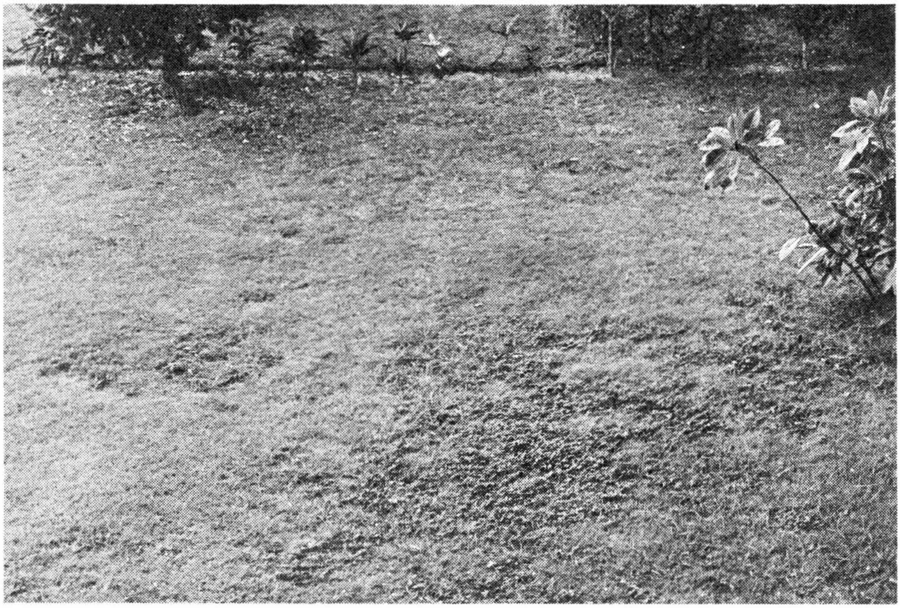


Fig. 1. Poorly fertilized turf showing weed invasion of area due to low fertility.

cause foliar burn when applied at excessive rates or to wet turf, and the short residual nitrogen response (4 to 6 weeks).

Natural organic nitrogen sources include sewage sludges, seed meals, animal tankage, and animal manures. The nitrogen content of natural organic fertilizer is relatively low and very expensive in terms of cost per unit of nitrogen. These fertilizers do not cause foliar burn and the residual nitrogen response is longer than that of the inorganic materials (6 to 8 weeks).

The synthetic organic nitrogen fertilizers are of two types: (a) those which are water soluble and behave much as the inorganic sources, and (b) those which are either insoluble in water or slowly soluble in water and last for longer periods when applied to the soil.

Urea is the most common synthetic organic nitrogen source which behaves much as the inorganic material. It is an excellent quick-acting source of nitrogen for turfgrasses when properly applied. Much of the nitrogen contained in urea may be lost as nitrogen gas if it is applied to alkaline soils and not properly watered in. Application of ½ to 1 inch of water immediately after the application of urea will reduce the loss of nitrogen as gas.

Ureaformaldehyde and IBDU (isobutylidene diurea) are compounds of urea which are essentially insoluble in water. Advantages of these materials include their freedom from causing foliar burn and their long residual nitrogen release 3 to 6 months. Disadvantages include their high cost per unit of nitrogen and the fact

Table 4. The nitrogen content of some nitrogen fertilizers recommended for turf in Hawaii[1]

Material	Nitrogen %	Type	Effect of 100 pounds of material on soil[2] acid	alkaline
Ammonium nitrate sulfate (ANS)	26–30	Inorganic	65	
Ammonium sulfate	21	Inorganic	110	
Calcium nitrate	15.5	Inorganic		20
Potassium nitrate	13–14	Inorganic		23
Animal tankage	6–9	Natural organic	16–23	
Animal manures				
steer	2	Natural organic	n	
chicken	3	Natural organic	n	
Seed meals				
castor pomace	5.2	Natural organic	5	
cottonseed	6	Natural organic	10	
Sewage sludge				
activated	5–6	Natural organic	n	
digested	2–3	Natural organic	n	
Isobutylidene diurea (IBDU)	31	Synthetic organic		
Urea	46	Synthetic organic	84	
Ureaformaldehyde	38	Synthetic organic	68	

[1]The percentages given in this table are average figures or ranges in composition. Always purchase according to the guaranteed analysis of nitrogen in the product.

[2] The effect of 100 pounds of material is given as the calcium carbonate equivalent. Acid requires that amount of calcium carbonate to neutralize the effect and alkaline has the same effect as an equal amount of calcium carbonate. The symbol "n" = no effect.

that much of the total nitrogen content is never recovered by turf. Effective use of these synthetic organic nitrogen sources is dependent upon the buildup of large reserves of insoluble nitrogen in the soil. A single heavy application is insufficient to provide an adequate level of nitrogen to meet the needs of the turf. Supplemental applications of a water-soluble nitrogen source will be necessary during the first 6 months to 1 year that the synthetic organic sources are used. After this, quarterly applications of the synthetic sources will provide adequate nitrogen to maintain the turf. Table 4 contains the analysis of some nitrogen materials suitable for turf.

Table 5. Suggested fertilizer program for turfgrasses in Hawaii

Grass		MONTH											
		Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bermudagrass	Lb. ammonium sulfate per 1000 sq ft	5.0	0	5.0	5.0	7.0	0	7.0	7.0	0	5.0	5.0	5.0
	Lb. 10-20-20 per 1000 sq ft		15				15			15			
St. Augustinegrass Zoysiagrass	Lb. ammonium sulfate per 1000 sq ft	3.5	0	3.5	3.5	5.0	0	5.0	5.0	0	3.5	3.5	3.5
	Lb.10-20-20 per 1000 sq ft		15				15			15			
Centipedegrass	Lb. ammonium sulfate per 1000 sq ft	0	3.5	0	0	3.5	0	3.5	0	0	0	3.5	0
	Lb. 10-20-20 per 1000 sq ft	0	0	10	0	0	0		0	10	0	0	0

Fertilizer Programs

Suggested fertilizer programs for the various turfgrasses grown in Hawaii are shown in Table 5. Water-soluble nitrogen sources are used throughout these programs because of their low cost. If the advantages of natural or synthetic organic fertilizers appeal to the homeowner, they may be substituted for all or part of the nitrogen requirement, keeping in mind that the slowly soluble synthetic organic materials will require supplementing with water-soluble sources when the program is first started.

The materials used in Table 5 are for illustrative purposes only. Other fertilizers may be used; however, the total amounts of nutrients should be similar to those used in the program in Table 5.

Calculations of Fertilizer Rates

Calculating the amount of fertilizer to apply to a given area is simply a matter of dividing the amount of nutrient element needed by the percent composition of the fertilizer. For fertilizers containing one nutrient element, this is quite simple. For complete fertilizers, the rate is usually based on applying sufficient fertilizer to supply 1.0 to 1.5 pounds of nitrogen per 1000 square feet.

The following examples illustrate how to calculate amounts of fertilizer from a single nutrient material and from a complete fertilizer.

Example A: You wish to apply 1.0 pound of N/1000 square feet using ammonium sulfate as the nitrogen source (21% N).

$\frac{1.0}{0.21}$ = 4.8 pounds ammonium sulfate/1000 square feet. This may be rounded to 5.0 pounds to simplify the application of the material.

Example B: You wish to apply a 10-20-10 fertilizer to supply 1.0 pound N/1000 square feet.

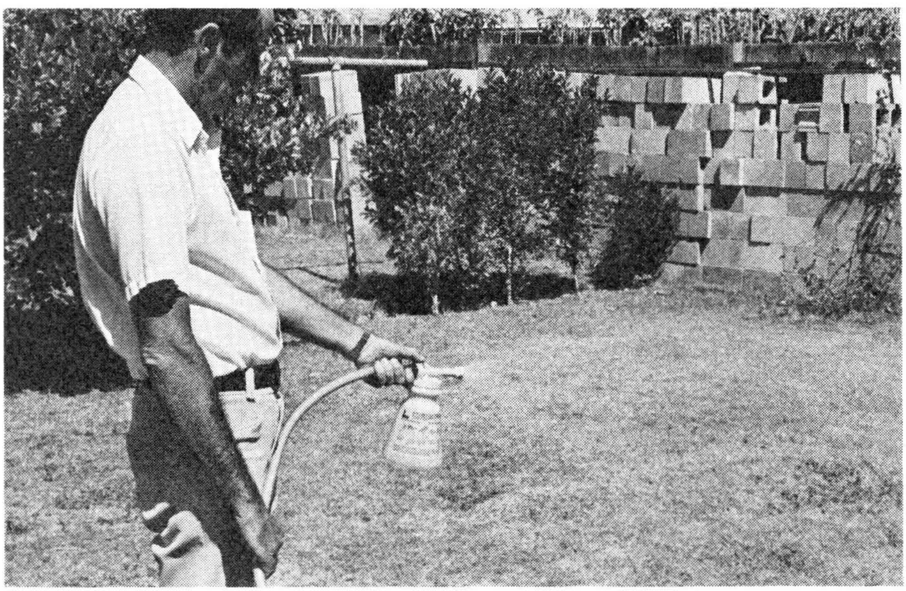
$\frac{1.0}{0.10}$ = 10 pounds of 10-20-10 needed/1000 square feet. This also applies to 2 lbs/1000 square feet of phosphate and 1 lb/1000 square feet of potash.

METHODS OF APPLYING FERTILIZER TO TURF

Several methods of application may be used to apply the desired fertilizer to turf. Each has certain advantages and disadvantages that should be considered when deciding which method to use. The methods most commonly used are hand application, liquid application, and use of fertilizer spreaders.

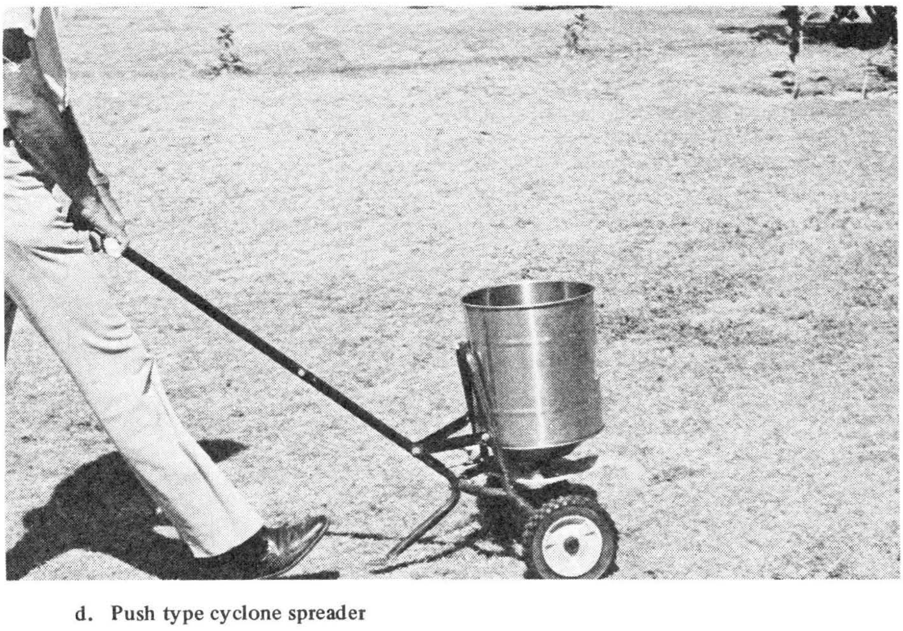
Hand application is the simplest and cheapest method. Its major disadvantage is the uneven application of the fertilizer material to the turf—resulting in unusual patterns, in one part of the area receiving more fertilizer than another, especially when first applying the material, and many times in burning of the turf.

Fig. 2. Types of equipment suitable for fertilizing small areas of turf.
a. Drop type spreader

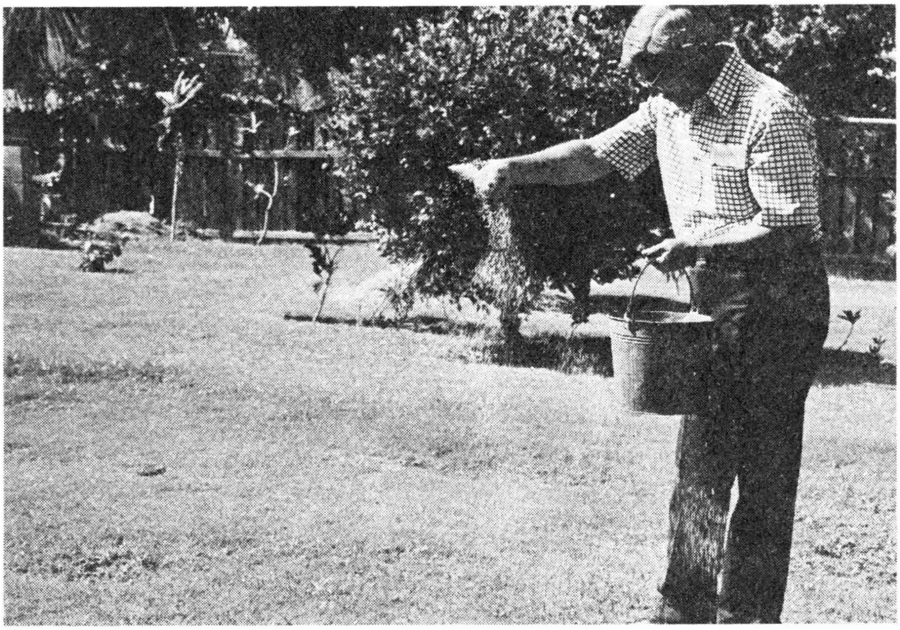


b. Liquid applicator

c. Hand-held cyclone spreader



d. Push type cyclone spreader



e. **Hand application**

Liquid application consists of applying a liquid fertilizer with a hose end applicator or a sprayer. The hose end applicator is most widely used. There is little danger of burning the turf with this method as the material is highly diluted. The equipment required is cheap and easily maintained and cared for. The major disadvantage is the relatively high cost of the nutrient in the fertilizer, which, with the very dilute solutions applied, necessitates more frequent application than is usual with dry materials.

Use of fertilizer spreaders provides a more convenient and uniform method of application. The major disadvantages are the relatively high cost of the equipment and the greater care and maintenance of the applicators. The applicators require calibration and must be used at a uniform pace to ensure uniform application of the fertilizer to the turf area.

The two types of fertilizer spreader most used are the drop type and the cyclone type. These may be push types or hand-held. There are also push type liquid applicators, but these have not become popular with homeowners.

Hand-held applicators are primarily the cyclone type. They are between the hand application method and push applicators in accuracy and unformity in spreading the fertilizer. They are also much cheaper than push type applicators.

Fertilizer Spreader Calibration

There are, generally, two types of fertilizer spreader most widely used for home lawns: the drop type and the rotary or cyclone type. Either must be calibrated prior to use. Below are two methods which have proven satisfactory for calibration of fertilizer spreaders.

Method 1. Select a smooth, hard, dry surface, such as a driveway or sidewalk, and measure a linear distance (say 25 feet). Partially fill the spreader with the fertilizer to be used. At a normal pace (the same pace you will use when fertilizing the lawn) and with the spreader half open, apply a strip of fertilizer the length of the measured distance. Measure the width of the fertilizer band (for drop type spreaders it is the width of the hopper) and multiply by the length of the distance covered to determine the number of square feet covered. Next, sweep up the fertilizer and weigh it. To determine the number of pounds of fertilizer applied per 1000 square feet, divide the area of the test strip into 1000 and multiply the answer by the weight in pounds of the fertilizer collected. If the amount is more or less than desired, adjust the setting on the fertilizer spreader and repeat the preceding steps until the proper rate is obtained. Record the setting for future use.

Example: A cyclone spreader which covers an eight-foot wide band is used to apply fertilizer to a test strip 25 feet in length. After weighing, it is found that 1.2 pounds (19.2 ounces) of ammonium sulfate was applied to the strip. How many pounds of ammonium sulfate per 1000 square feet would be applied at this setting?

Fertilizer band width = 8 feet

Length of test strip = 25 feet

Area of test strip = 8 X 25 = 200 square feet

$$\frac{1000}{200} \times 1.2 = 6 \text{ lb}/1000 \text{ square feet}$$

Method 2. A simpler method, but perhaps not as exact, is to determine the amount of fertilizer needed to cover the area. This amount is then weighed and placed into the spreader. Adjust the setting on the spreader low so that there will be more than enough fertilizer in the hopper to cover the lawn in one direction. Apply the remainder of the fertilizer at right angles to the first application. If the amount used in the first direction was significantly more or less than one-half the total amount, adjust the setting accordingly for the second direction. The objective of this method is to apply half the fertilizer in one direction and half at right angles to the first application. This is especially desirable from the standpoint of uniformity of distribution when drop type spreaders are used. Record the settings used. Fertilizer spreader settings are useful if the same materials are used repeatedly in a fertilizer program.

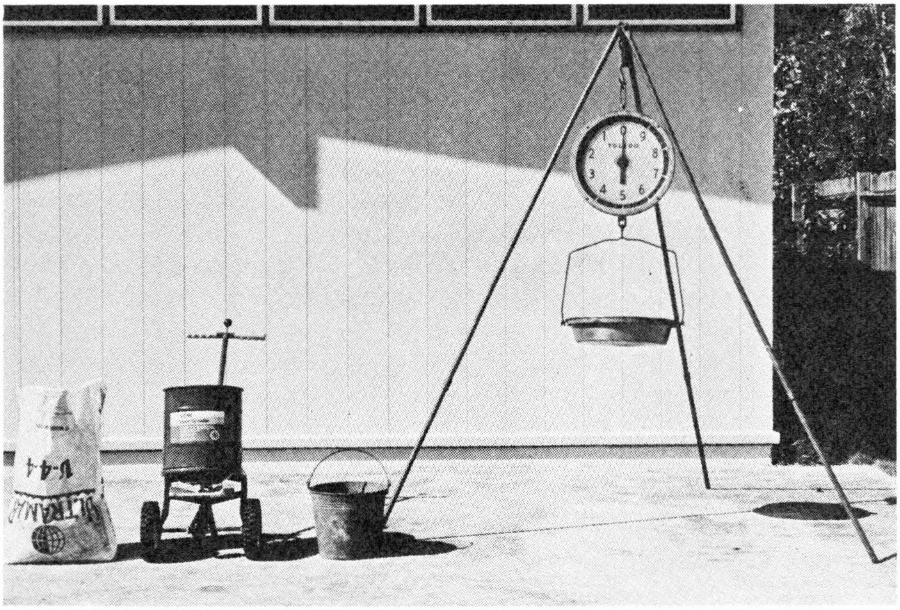
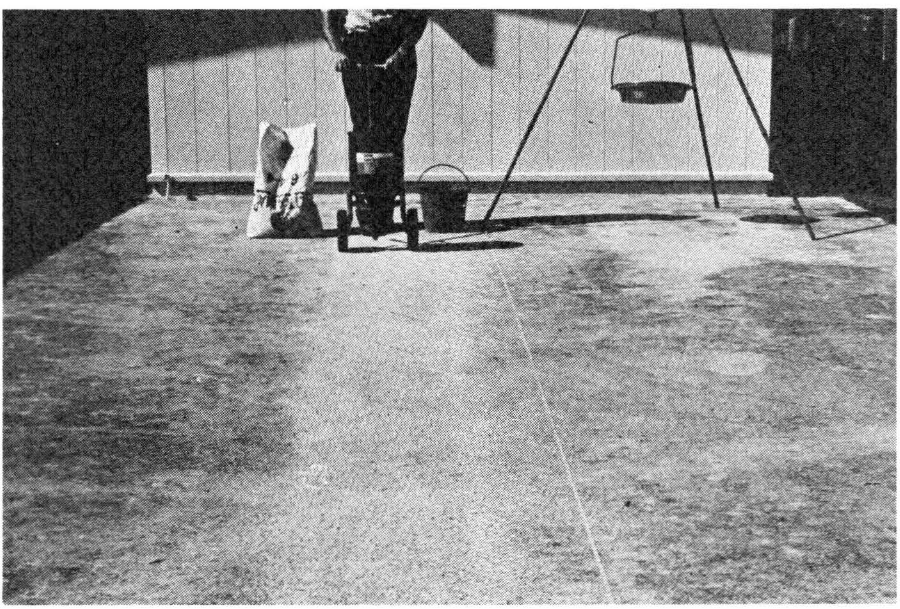


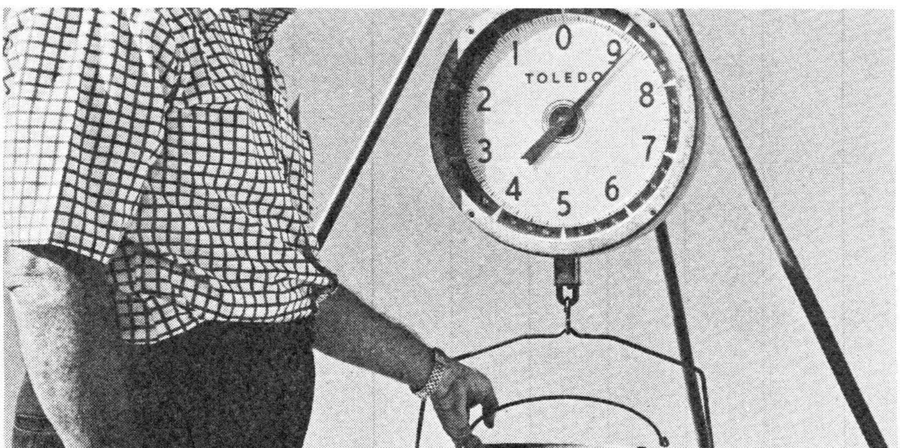
Fig. 3 Calibration of the fertilizer spreader.

a. the equipment needed, left to right: fertilizer, spreader, container, and scale



b. spread fertilizer over measured distance

c. sweep up and place fertilizer in container



d. weigh the material and calculate the rate of application

Fig. 4. Uneven growth and burning (at arrow) due to uneven distribution of fertilizer.

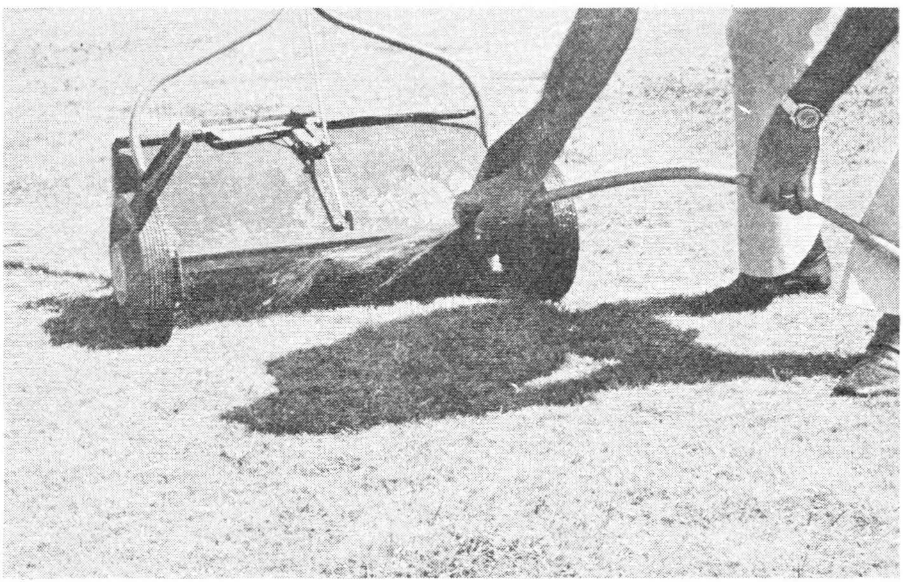


Fig. 5. Fertilizer spreaders should be cleaned thoroughly before putting away. Those with metal parts should be oiled. This prevents corrosion and malfunction of the spreader due to fertilizer residues.

Maintaining Fertilizer Spreaders

Fertilizers consist of salts that absorb moisture from the air. This causes caking of the fertilizer, rusting of metal, and "freezing" or clogging of the equipment. To prevent this, the fertilizer spreader should be thoroughly cleaned after each use. When dry, all metal parts should be lightly oiled to keep them in satisfactory condition. All equipment should be stored in a dry protected area to reduce the danger of corrosion. If these precautions are followed, the equipment will be easy to use and will provide accurate results for a long period of time.

For further information, consult your Country Agricultural Agent at one of the following county offices.

NOTE

The use of trade names is for the convenience of readers only and does not constitute an endorsement of these products by the University of Hawaii, the College of Tropical Agriculture and Human Resources, the Hawaii Cooperative Extension Service, and their employees.

Hawaii residents may order single copies of publications free of charge from county offices. Quantities of any one publication are sold at cost. Quotations will be furnished on written request to Agricultural Publications and Information Office, College of Tropical Agriculture and Human Resources, 2500 Dole Street, Krauss Hall Room 107, Honolulu, Hawaii 96822. Price per copy to bulk users, twenty cents plus postage.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U. S. Department of Agriculture. Noel P. Kefford, Director and Dean, Cooperative Extension Service, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, Honolulu, Hawaii 96822. An Equal Opportunity Employer providing programs and services to the citizens of Hawaii without regard to race, color, national origin or sex.
CIRCULAR 495–05/79 (Reprinted 03/91–2.5M)