# A SHORT SHORT-COURSE IN GREENKEEPING

HIGH rating placed by attending greenkeepers on the papers presented at the annual Lawn Day of Massachusetts State college suggested that GOLFDOM present available outlines of these papers as prepared by the authorities who read them.

In the following notes of the authors, greenkeepers will find considerable material for study and discussion.

## SOIL WATER AND THE GRASS PLANT

By HOWARD B. SPRAGUE

The supply of soil water is indispensible to growing grass. Living green plants are 70 to 95% water, and this content must be maintained. Water is used to manufacture new cells and tissues in roots, stems and leaves, and all of the soil nutrients enter the plant dissolved in water. In addition, it has been estimated that 20 to 40 gal. of water are given off by the leaves of grass on each 1,000 sq. ft. of lawn surface during a single hot day. The most important point to note is that every drop of this water must be absorbed by the plants' roots from the soil.

The principal supply of water is rainfall. This is supplemented by artificial watering in dry periods. The effectiveness of rainfall is determined by the rapidity with which it falls, the ability of the soil to absorb it, and the evaporating power of the air. Gentle rains are more effective than sudden downpours, and gentle slopes permit greater penetration than steep slopes. The drying power of the air normally increases from April until it reaches a peak in July, and thereafter it falls steadily with the season. May, June, July and August are all months when evaporation normally is high in comparison to rainfall, in contrast with September and October which permit the restoration of soil moisture exhausted in summer.

Only a portion of the soil moisture is available for use by plants. The thin films of water held tightly by the soil particles are not used by grass roots. Thus, plants wilt when there is still moisture in the soil because it is held so strongly that the grass roots cannot absorb it. Only the water in the capillary spaces between the soil granules is useful to plants. After a heavy rain, or watering, some free water is present in soils, but this quickly drains away in good soils. The maximum water holding capacity of soils is the amount of total water which the soil contains after the superfluous water has drained off. To illustrate, a certain sandy soil may have a water capacity of 17 lbs. per 100 lbs. of soil. Since 4.5 lbs. will be unavailable to plants in this soil, the potential supply for use by plants is 12.5 lbs.

The water holding capacity of soils varies tremendously with texture, structure, and organic matter content. A rich silt loam may easily hold twice as much available water as a light sandy loam. In general, heavier soils are capable of storing more water than light soils. Also, soils which are in good structure or tilth will store much more water than soils of the same texture which are badly puddled or compacted and have but little pore-space. Soils that are rich in organic matter are more likely to be in good tilth, and the organic matter itself has at least 10 times the water holding power of soil particles.

The depth of the root system determines the use which grass roots are able to make of the soil. Poorly drained soils force plants to develop shallow root systems. On well drained soils, the height of cut and system of fertilization influence the root development. The ability of grass to endure drought is determined by the water supplying power of the soil and the depth to which plants can use soil moisture.

## AVAILABILITY AND LIFE OF FERTILIZERS

By L. S. DICKINSON

The availability rating of a fertilizer is a comparison with a standard whose nitrogen, phosphorus, or potash, as the case may be, is wholly useful to the plant use within a reasonable time after the fertilizer is applied. For example: In nitrate of soda all of the guaranteed nitrogen is immediately available for plant use when dissolved in water (soil water); cottonseed meal has an availability rating of 70 which means that only 70% of the

| Material | Availability of Nitrogen | Period of influence in number of days after application | | |
|---|---|---|---|---|
| | | Start | Peak | End |
| Ammonia | 90 | 3 | 6-9 | 16 |
| Ammo-Phos | 90 | 5 | 8-12 | 18 |
| Bone Meal (steamed) | 25 | 20 | 30-35 | 45 |
| Castor bean pomace | 70 | 9 | 25-28 | 42 |
| Cottonseed meal | 70 | 7 | 18-22 | 35 |
| Calcium Cyanamid | 90 | 10 | 14-18 | 25 |
| Dried blood | 80 | 5 | 8-10 | 22 |
| Fish (ground) | 70 | 7 | 12-16 | 30 |
| Guano | 70 | 8 | 14-18 | 30 |
| Garbage tankage | 30 | 22 | 30-35 | 42 |
| Hoofard Horn meal | 60 | 18 | 30-35 | 50 |
| Manures, dried | 60 | 12 | 17-22 | 35 |
| Milorganite | 80 | 5 | 12-15 | 40 |
| Nitrates | 100 | 1 | 4-8 | 15 |
| Poultry Manure | 70 | 5 | 10-14 | 25 |
| Soybean meal | 70 | 20 | 28-32 | 40 |
| Tankage, High grade | 70 | 10 | 14-18 | 40 |
| Tankage, Low grade | 30 | 20 | 30-35 | 45 |
| Urea | 90 | 8 | 12-15 | 25 |

guaranteed available nitrogen can be made ready for plant use within a reasonable time. The remainder of 30% is not lost, but made available in small quantities over a considerable period of time.

Obviously there are many factors that control the availability and duration of the effectiveness of fertilizers when applied to the soil, more especially so in the case of top-dressing as is usually practiced in turf culture. The above table is arranged with the assumption that each fertilizer is used under similar soil conditions.

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## WEED PROBLEM OF TURF

By HOWARD B. SPRAGUE

Weeds are plants growing where they are not planted. They are frequently more aggressive than turf plants. According to length of life, weeds are:

**Annuals,** which complete growth in one year and produce seed abundantly. Examples: Crab grass, goose grass, foxtail grass, knotweed, chickweed, panic grass.

**Biennials,** which require two seasons to complete growth; the first being used to manufacture and store food for the production of flowers with the formation of seeds in the second. Examples: Common thistle, wild carrot.

**Perennials,** which live more than two seasons; usually begin forming seed by the second season. The most troublesome perennials have creeping, rooting stems which contain stored food and send up new shoots. Examples: Dandelions, plantain, poison ivy, field sorrel.

**Sources of Weed Seed:**

a. Carried by wind, drainage water, and animals, including man.
b. Introduced in fresh or partly-rotted manure.
c. Added in top-soil used for topdressings, or carelessly managed compost piles.
d. Present in seeding mixtures, particularly cheap seed.
e. Produced by weeds in turf, in spite of close mowing.

**Control of Weeds:**

a. Remove sources of weed seeds; bake or steam topdressing to kill weed seeds, or purchase topdressing that carries no weed seed.
b. Maintain turf in vigorous condition to prevent weeds from obtaining a foothold. Proper liming, fertilization, mowing, watering and rolling are very effective.
c. Close mowing kills many types of weeds; prevention of seed formation in the fairways and the rough by mowing also aids.
d. Use of chemicals, as sprays, or in topdressing (such as lead arsenate).

**Some Troublesome Turf Weeds:**

**Crab Grass**—Warm season annual, spreads by seed. Hand weed greens in June and July. Use lead arsenate in topdressings and keep turf vigorous, particularly in early spring and summer. Timely fertilization and careful watering are very effective on lawns.

**Chickweed**—Dust plants with ammonium sulphate or ammo-phos, water thoroughly as soon as weeds turn brown, remove dead plants, and reseed.

**White Clover**—Stimulated by potash and phosphorus fertilizers. Undesirable only on fine turf. Largely controlled by careful nitrogen fertilization of the grass, and the use of aggressive strains of grass. It may be controlled temporarily by burning, as for chickweed.

**Silver Crab Grass** (Goose grass)—Warm season annual, spreads by seed only. Hand weeding in June and July. Same treatment as for crab grass.

**Poa Annua**—Very difficult to control. Keep soil moderately dry and well drained, and maintain vigor of the turf by proper treatment. Use lead arsenate in topdressing. Hand weeding is the only method practicable for complete control and this is very expensive. Add new seed of desirable grasses in August or September, to compete with seedlings of Poa Annua.

**Foxtail Grass**—Warm season annual, spreads by seed. Hand weed fine turf in June and July. Prevent seed formation on lawns and fairways by close mowing wherever seed heads are formed. Follow same treatment as that recommended for crab grass.

**Stink Grass**—Same as for crab grass.

**Yarrow**—Perennials spreading by root stocks. When closely mowed, sometimes makes fine turf. To control, remove all turf and soil to a depth of 3 inches, fill in with clean soil, and sod or replant. Complete sterilization of soil with chlorate weed killers is also effective.

**Plantain**—Perennials without creeping stems. Hand weed or poison each individual plant with sulphuric acid or kerosene. If very abundant try spraying with iron sulphate solution (2 lbs. per gal.) after bruising leaves with suitable implement.

**Dandelion**—Same as for plantain. Spray with iron sulphate solution after mowing and bruising leaves with some suitable implement.

**Poison Ivy**—Perennial with creeping stems. Poison with sulphuric acid or spray with calcium chlorate, or grub out roots and rootstocks. Caution: Calcium chlorate applied as spray may destroy all other vegetation in the same area. However, the soil is not permanently poisoned and may be reseeded after several heavy rains. Fine spray applied to leaves only, or dust applied to leaves only, may be used to kill plants without injury to neighboring vegetation, if used with care.

**Lawn Pennyworth**—If deep rooted, same treatment as for Yarrow. If shallow rooted, dust with fertilizer as for chickweed.

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### *WHAT HAPPENS INSIDE A GRASS BLADE*

By E. KLAUCKE

The main difference between the nutritional processes of plants and animals is that plants manufacture their own foods from raw materials, whereas animals cannot. All living cells, whether plant or animal, require starch and sugars (carbohydrates), proteins and fats.

It is in the grass blade that photosynthesis, the process of starch and sugar manufacture, takes place. This process consists essentially of the following: carbon dioxide and water are synthesized to sugar and starch under the influence of the green coloring matter of the leaf (chlorophyl) and light. Oxygen is given off as a waste product.

Although photosynthesis is the most important blade function, the synthesis of fats takes place largely in the leaves as does a considerable quantity of the proteins utilized by the plant cells.

Transpiration or the loss of water vapor from the plant through the numerous small "pores" of the leaf is another very important blade function. The amount of water vapor passing from the leaves by transpiration is extremely large.

All living cells respire or breathe all the time. Thus, respiration is another process going on in the grass blade. Oxygen is taken into the cells and carbon dioxide and water are given off as waste products — the very reverse, it will be noticed, from photosynthesis. Photosynthesis and respiration go on simultaneously during the daytime, but only respiration goes on at night.

Certain conclusions are to be drawn from the above:

Mowing, particularly the close clipping of putting green areas, tampers in no small degree with the natural processes of a grass plant.

Dust collecting on the surface of leaves clogs the "pores" on the leaf surface, thus reducing photosynthesis.

Because turf grass is kept under unnatural conditions, the turfman should supply raw materials in the form of fertilizers according to a definite program to fit the requirements of his grass. Whenever, possible, the clippings should be left on the area to decay.

The grass should be cut less often and the height of cut of the mower should be raised during very dry periods in the summer.

The grass should not be clipped late in the fall in order that the blades may make as much reserve food material as possible for the following early spring growth.

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### *ARTIFICIAL WATERING OF TURF GRASSES*

By L. S. DICKINSON

I. Artificial watering should be considered only as a supplement to a deficiency in normal rainfall.

Unless water supply contains an excessive amount of any element, artificial watering affects soil similarly to rainfall, i. e.:

1. Makes plant food available; 2. Washes out plant food; 3. Increases acidity of the soil; 4. Puddles clay soils; 5. Starts erosion; 6. Accumulates in low areas; 7. Runs off to slopes, etc.

II. Three periods in development of turf grasses:

1. Seed and seedling. Water requirement high.
2. Development or root training. Placing of water supply important.
3. Mature stage. Both placing and amount of water important.

III. Considering mature turf:

Why water? 60% for color effect, 40% for health of grass.

When is water needed? Not until after wilting has started and soil supply of capillary water exhausted as determined by examination of soil.

IV. Fundamental factors determining methods of applying water:

Is the soil condition practically uniform in all ways?

If yes, large coverage sprinklers permissible.

If no, small coverage sprinklers desirable.

V. Quantity of water desirable and rate:

Enough to wet to a depth of 4 to 6 in.

Apply as rapidly as soil will absorb the water.

Ohio State College Experiments show during 3 summer months 1½ times normal rainfall ample amount.

At Amherst that means 18.16 in. or a 75 ft. diameter range sprinkler throwing 15 g.p.m. on 4,000 sq. ft. must operate a total of 50 hours during the season. This amount is probably excessive for New England.

VI. Late spring and early fall watering sometimes needed.

VII. Incorrect watering has cumulative bad influences which may not become prominent for three or more years.

Kentucky bluegrass becomes very thin from excessive watering.

VIII. Conclusion: Artificial watering of fine turf grasses is very beneficial if correctly done; otherwise, it may be very harmful.

More water requires more fertilizer and more frequent clipping, resulting in costs that are constant and seldom considered when planning a water system.

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### *CHANGING THE SOIL STRUCTURE*

By HOWARD B. SPRAGUE

Desirable soil structure is highly essential on turfed areas, from the standpoint of drainage and aeration, and of water-holding capacity. Soils naturally differ greatly in soil structure and subsequent treatments are responsible for further changes. Three vital factors affecting soil structure are the texture, lime content, and humus supply.

The natural differences in soil structure may be indicated by the water-holding capacity of 12 soils of three geographic provinces in New Jersey. These soils ranged from a capacity of 594 gal. of available water for a sandy soil to a depth of 6 2/3 in. over a surface of 1,000 sq. ft., to 1787 gal. for a silt loam soil. Not only did these soils differ in capacity to store water, but they also differed greatly in their ability to permit ready entrance of rainfall. Thus, Merrimac sandy loam allowed water to enter 7 times as rapidly as Wethersfield gravelly loam, under equal conditions. Obviously, the Wethersfield soil is a very inefficient soil, even though it has equal water holding capacity, as a result of its failure to absorb rainfall readily.

The structure of soils may be considerably changed by treatment. In general, continuous cultivation has greatly exhausted the humus supply of our soils, and caused a breakdown in their granular structure. In many cases, lime has also been lost extensively and this has still further deflocculated the soil. Grass will gradually restore soil structure, to the depth of root penetration, provided the proper treatment is given. Improper management may be responsible for still further deterioration in structure even though the area is continuously in sod.

In a series of tests conducted at New Jersey on the same soil type, the continuous use of acid-forming fertilizers without the use of lime has had the following effect: (1) increased soil acidity and broken down soil granules, (2) caused a tremendous accumulation of roots, producing a sod-bound condition, (3) greatly reduced the capacity of the soil to permit entrance of water, and (4) seriously injured the turf in spite of continued watering.

By contrast, the use of a properly balanced fertilizer together with lime has produced a sod that is durable, strongly drought resistant, and capable of sturdy growth in both cool and warm weather.

Discing or spiking is a great aid in renovating soils with poor structure. It speeds up the penetration of lime applications and hastens the entrance of water. Without such treatment lime may lie stranded on the matted surface layer of grass crowns for a considerable period (several months or years) before actually reaching the soil and exerting a beneficial effect. Lime applied in late summer or early fall will be more effective than spring applications, since autumn rainfall is more likely to be favorable for washing the lime into the soil. Lime is slow in its action and at least 1 or 2 years will be required to exert a significant effect, when applied as a topdressing on established sod.

Organic matter additions are effective in changing soil structure only when incorporated in the soil itself. Topdressings of organic matter on established sod will not penetrate the soil to improve its structure or water-holding capacity. When incorporated with soil, organic matter is extremely effective in improving the structure of all classes of soil.