

NOVEMBER 1966

USGA GREEN SECTION RECORD



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by the United States Golf Association



GOLF COURSE PLANTINGS

The 18th at Southern Hills. Native oak trees on either side of the fairway frame the hole and the view of the clubhouse. A discussion of golf course plantings appears in this issue.

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Published by the United States Golf Association

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Planting the Golf Course

by Holman M. Griffin, Agronomist

Have you ever thought of a golf course as having character and ability to produce moods in the people who play it?

They do and can. However this subject has either been neglected or studied by only a few.

One of the most complete explorations of the subject is a thesis by Mr. Richard Morgan Phelps, a candidate for a Masters degree at Iowa State University.

Mr. Phelps advances the thought that "by carefully selecting and placing plant materials on any site, the designer may create moods, produce beautiful views and vistas, enclose spaces, enhance architecture and land formations, provide beauty, color, texture, fragrance, and scale, create illusion, provide privacy, and make man's environment more enjoyable in general."

A golf course is an area providing unlimited possibilities for the use of plant materials to create moods and otherwise enhance the enjoyment found in playing.

The following excerpt is taken from Mr. Phelps' thesis and is offered here as a guide to specific plant materials that may be used to satisfy the requirements of a golf course.

Greens

Trees that are to be placed near putting surfaces should possess characteristics that will allow turfgrass on the green to grow without interference. These characteristics include deep rooting, light or filtered shade, absence of litter, small volumes of leaves, strong branching, lack of insects and diseases, and unobtrusive coloration. Unfortunately no tree possesses all these characteristics.

As a result, trees with several of these characteristics are recommended. It must be emphasized that trees of many types are appropriate around greens, depending on their placement. Trees that are deep-rooting, strong, long-lived, and litter-free may cast dense shade or possess volumes of leaves. If these trees are placed so that their shadows are not cast upon the putting surface, they would be considered acceptable. Modern mulching equipment is able to handle the leaf problem easily. Many trees not mentioned in the following list may be used near greens, but they must be used with great care. The oaks (*Quercus* spp.) are of this type.

In general, shrubs are not recommended in the vicinity of greens. In special cases, they may be useful as protection for nearby tees, or to help prevent a ball from going out-of-bounds. Some golf course architects might consider them desirable as obstacles.

Trees may be of any height; however, high-branching varieties are preferred. The outer foliage line of the tree at maturity should be not closer than 15 feet from the edge of the green. Trees to be placed far behind the green will be considered under the listing "backgrounds."

Tees

Plant materials to be used in the vicinity of tees may possess characteristics that differ from those placed around greens. Trees may be lower branching, possess larger volumes of leaves, and be more colorful. Shrubs are often valuable around tees as a means of providing color and fragrance. Care must be taken, however, to insure

adequate air circulation, sunlight, and branching height for the tee area. Deep rooting trees should be specified to eliminate root problems. Many shallow-rooting trees may be used if the tee area is properly watered to encourage deeper rooting by the tree.

Trees placed near the tee should be placed closer to the edges at the rear of the tee and farther from the sides in front to allow ample clearance for a golf shot made from the rear. For the same reason, overhanging trees should not be used near the front of long tees.

Sunlight must reach all parts of the tee during a majority of the day to insure healthy turf. Trees and tall shrubs are valuable as shade providers if they are placed with care. Benches for resting may be placed in this shade while still allowing close proximity to the tee and full vision of the tee and fairway.

Fairways

Plant materials suited for fairways differ slightly from those used near greens and tees. Fairway turf requires adequate amounts of light and nutrients. As a result, trees should be rather open and deep-rooted; shallow-rooted trees rob grasses of water and nutrients. Shrubs should not be used on fairways. Litter should be kept to a minimum, although leaves and small twigs are not as objectionable in fairways as they are on greens. They may be easily mulched or removed by hoses, spray equipment, or rakes. Trees should be high-branching to avoid interference with a player's swing. Trees may possess interesting color such as flowers, foliage, fruit, or bark. They may also be picturesque or symmetrical in shape.

Trees placed on fairways should be used sparingly and set in strategic locations. Placement of any trees in a

fairway should be thoroughly and thoughtfully considered before they are specified. They have a definite place in the design of golf courses, but they must not be over-used.

Roughs

Trees and shrubs to be used in the rough may be of nearly any variety. Much will depend upon the type of golf facility, existing plant materials, and attitudes of local golfers. In general, municipal courses should use trees similar to those recommended for use on fairways. In addition, shrubs for use in the roughs should be avoided. Privately-owned courses open to the public where play is not as heavy, may specify either, or a combination of the two.

Plant materials in the roughs may be valued for their color, shape, bark, texture, specimen or massing use, and qualities as an obstacle. They should allow medium to high amounts of light to filter through to the turf and should be at least moderately free of insects and diseases, litter, and root problems. Some plant materials to be used out of the normal range of play will be mentioned under the subject: "Plants for Wildlife Areas." Other plants to be used in remote areas of the course should be native to the area or should provide material for specific uses such as lumber, specimens for arboretums, or nursery stock.

Table 1
Plant Materials Recommended for Greens, Tees, Fairways, and Roughs

Scientific name	Common Name	Use*
Acer nigrum	Black Maple	R
Acer rubrum	Red Maple	R
Acer saccharum	Sugar Maple	R
Albizzia julibrissin	Silktree Albizzia	G,T,F,R
Alnus spp.	Alders	R
Amelanchier spp.	Serviceberries	R
Betula lenta	Sweet Birch	R
Betula lutea	Yellow Birch	F,R
Betula nigra	River Birch	G,T,F,R
Betula papyrifera	Paper Birch	G,T,F,R
Betula populifolia	Gray Birch	G,T,F,R
Catalpa speciosa	Northern Catalpa	R

<i>Celtis laevigata</i>	Sugar Hackberry	F,R
<i>Celtis occidentalis</i>	Common Hackberry	F,R
<i>Cercidiphyllum japonicum</i>	Katsuratree	F,R
<i>Cercis canadensis</i>	Eastern Redbud	T,R
<i>Chionanthus virginicus</i>	White Fringetree	T,R
<i>Cladrastis lutea</i>	American Yellowwood	R
<i>Crataegus</i> spp.	Hawthorns	T,R
<i>Diospyrus virginiana</i>	Common Persimmon	R
<i>Elaeagnus angustifolia</i>	Russianolive	R
<i>Fraxinus</i> spp.	Ash	F,R
<i>Ginkgo biloba</i>	Ginkgo	G,T,F,R
<i>Gleditsia triacanthos</i>	Thornless, seedless	
inermis	Honeylocust	G,T,F,R
<i>Gymnocladus dioicus</i>	Kentucky Coffeetree	R
<i>Halesia carolina</i>	Carolina Silverbell	R
<i>Kalopanax pictus</i>	Castor Aralia	T,F,R
<i>Koeleruteria paniculata</i>	Panicked Goldenrain- Tree	G,T,F,R
<i>Lagerstroemia indica</i>	Common Crapemyrtle	R
<i>Larix decidua</i>	European Larch	G,T,F,R
<i>Larix laricina</i>	Eastern Larch	G,T,F,R
<i>Liquidamber styraciflua</i>	American Sweetgum	R
<i>Liriodendron tulipifera</i>	Tuliptree	F,R
<i>Malus</i> spp.	Crabapples	R
<i>Nyssa sylvatica</i>	Black Tupelo	G,T,F,R
<i>Ostrya virginiana</i>	American Hornbeam	T,R
<i>Oxydendrum arboreum</i>	Sourwood	R
<i>Paulownia tomentosa</i>	Royal Paulownia	R
<i>Phellodendron amurense</i>	Amur Corktree	F,R
<i>Phellodendron lavallei</i>	Lavalle Corktree	F,R
<i>Pinus banksiana</i>	Jack Pine	G,T,F,R
<i>Pinus flexilis</i>	Limber Pine	R
<i>Pinus nigra</i>	Austrian Pine	F,R
<i>Pinus palustris</i>	Longleaf Pine	G,T,F,R
<i>Pinus ponderosa</i>	Ponderosa Pine	R
<i>Pinus resinosa</i>	Red Pine	R
<i>Pinus rigida</i>	Pitch Pine	T,F,R
<i>Pinus strobus</i>	White Pine	R
<i>Pinus sylvestris</i>	Scotch Pine	T,F,R
<i>Pinus taeda</i>	Loblolly Pine	T,F,R
<i>Platanus acerifolia</i>	London Planetree	F,R
<i>Platanus occidentalis</i>	American Planetree	F,R
<i>Quercus borealis</i>	Northern Red Oak	F,R
<i>Quercus coccinea</i>	Scarlet Oak	F,R
<i>Quercus palustris</i>	Pin Oak	F,R
<i>Quercus velutina</i>	Black Oak	F,R
<i>Quercus</i> spp.	Oak	R
<i>Robinia pseudoacacia</i>	Black Locust	F,R
<i>Sassafras albidum</i>	Common Sassafras	R
<i>Sophora japonica</i>	Japanese Pagodatree	T,F,R
<i>Sorbus</i> spp.	Mountainash	R
<i>Syringa amurensis</i>	Amur Lilac	R
<i>Syringa amurensis japonica</i>	Japanese Tree Lilac	R
<i>Ulmus americana</i>	American Elm	T,F,R
<i>Ulmus carpinifolia</i> var.	Christine Buisman	
	Elm	T,F,R
<i>Ulmus glabra</i>	Scotch Elm	T,F,R
<i>Zelcova serrata</i>	Japanese Zelcova	F,R

*Green—G Tee—T Fairway—F Rough—R

Specimens

Almost any plant may be valued as a specimen in planting designs. However, trees and shrubs considered as desirable specimens usually possess an outstanding characteristic, such as beautiful flowers, seasonal color, special form, or special texture. Use of too many specimen plants tends to defeat their purpose and results in a mass of oddities instead of a unified composition of clumps and groupings. Occasional single specimens or small specimen clumps are desirable. The

current trend of making every tree or shrub on the golf course a specimen is illogical, regardless of mowing considerations. Some degree of esthetic feeling must be left on our modern courses.

Table 2
Trees Suited for Use as Specimens

Scientific name	Common name
<i>Abies</i> spp.	Fir
<i>Acer nigrum</i>	Black Maple
<i>Acer palmatum</i>	Japanese Maple
<i>Acer saccharum</i>	Sugar Maple
<i>Acer tataricum</i>	Tatarian Maple
<i>Aesculus</i> spp.	Buckeye; Horsechestnut
<i>Amelanchier</i> spp.	Serviceberry
<i>Betula</i> spp.	Birch
<i>Carya illinoensis</i>	Pecan
<i>Carya ovata</i>	Shagbark Hickory
<i>Cedrus</i> spp.	Cedar
<i>Cercidiphyllum japonicum</i>	Katsuratree
<i>Cercis canadensis</i>	Eastern Redbud
<i>Chamaecyparis</i> spp.	Falsecypress
<i>Chionanthus virginicus</i>	White Fringetree
<i>Cladrastis lutea</i>	American Yellowwood
<i>Cornus florida</i>	Florida Dogwood
<i>Cornus kousa</i>	Kousa Dogwood
<i>Crataegus</i> spp.	Hawthorn
<i>Fagus</i> spp.	Beech
<i>Ginkgo biloba</i>	Ginkgo
<i>Gymnocladus dioicus</i>	Kentucky Coffeetree
<i>Hamamelis virginiana</i>	Common Witchhazel
<i>Juniperus chinensis</i>	Pyramid Chinese Juniper
<i>Koeleruteria paniculata</i>	Panicked Goldenrain-Tree
<i>Larix</i> spp.	Larch
<i>Liquidamber styraciflua</i>	American Sweetgum
<i>Liriodendron tulipifera</i>	Tuliptree
<i>Magnolia</i> spp.	Magnolia
<i>Malus</i> spp.	Apple; Crabapple
<i>Nyssa sylvatica</i>	Black Tupelo
<i>Ostrya virginiana</i>	American Hophornbeam
<i>Oxydendrum arboreum</i>	Sourwood
<i>Phellodendron amurense</i>	Amur Corktree
<i>Phellodendron lavallei</i>	Lavalle Corktree
<i>Picea</i> spp.	Spruce
<i>Pinus</i> spp.	Pine
<i>Prunus</i> spp.	Apricot; Cherry; Chokecherry; Laurelcherry; Peach; Plum
<i>Quercus</i> spp.	Oak
<i>Salix</i> spp.	Willow
<i>Sciadopitys verticillata</i>	Umbrellapine
<i>Sophora japonica</i>	Japanese Pagodatree
<i>Syringa amurensis japonica</i>	Japanese Tree Lilac
<i>Taxodium</i> spp.	Baldcypress
<i>Taxus cuspidata commutata</i>	Japanese Yew
<i>Thuja</i> spp.	Arborvitae
<i>Tilia</i> spp.	Linden
<i>Toona sinensis</i>	Chinese Toona
<i>Tsuga</i> spp.	Hemlock
<i>Ulmus americana</i>	American Elm

Table 3
Shrubs Suited for Use as Specimens

Scientific name	Common name
<i>Caragana arborescens</i>	Siberian Peashrub
<i>Chaenomeles</i> spp.	Floweringquince
<i>Cotinus coggygria</i>	American Smoketree
<i>Euonymus alatus</i>	Winged Euonymus
<i>Euonymus americanus</i>	Brook Euonymus
<i>Euonymus atropurpureus</i>	Eastern Wahoo
<i>Euonymus europaeus</i>	European Euonymus

Exochorda spp.	Pearlbush
Halesia spp.	Silverbell
Hibiscus spp.	Hibiscus, Rosemallow
Hydrangea spp.	Hydrangea
Lonicera spp.	Honeysuckle
Prunus japonica	Chinese Bushcherry
Prunus triloba	Flowering Plum
Rhododendron spp.	Rhododendron; Acalea
Rhus spp.	Sumac
Viburnum spp.	Viburnum

Background

Many trees and shrubs possess characteristics that are valuable for background purposes. Plants of this type are often used behind greens, as a terminus of a view, for direction indicators, and as backgrounds for flowering specimens.

Trees and shrubs should be dense and heavy in appearance. Usually, their color is dark and ranges from dark green to purple-green or blue-green. Often they branch to the ground; however, this is not a steadfast requirement. Background plant materials may also possess color, texture, form, or fragrance characteristics of their own.

Table 4
Plant Materials for Background

Scientific name	Common name
Abies spp.	Fir
Acer spp.	Maple
Aesculus spp.	Buckeye; Horsechestnut
Alnus spp.	Alder
Cedrus spp.	Cedar
Chamaecyparis spp.	Falsecypress
Cornus florida	Flowering Dogwood
Crataegus spp.	Hawthorn
Diospyros virginiana	Common Persimmon
Fagus spp.	Beech
Ginkgo Biloba	Ginkgo
Hamamelis virginiana	Common Witchhazel
Ilex spp.	Holly
Juniperus spp.	Juniper
Liquidambar styraciflua	American Sweetgum
Nyssa sylvatica	Black Tupelo
Paulownia tomentosa	Royal Paulownia
Phellodendron spp.	Corktree
Picea spp.	Spruce
Pinus spp.	Pine
Pseudotsuga spp.	Douglasfir
Quercus spp.	Oak
Rhamnus spp.	Buckhorn
Rhus spp.	Sumac
Sophora japonica	Japanese Pagodatree
Staphylea trifolia	American Bladdernut
Syringa spp.	Lilac
Taxus spp.	Yew
Thuja occidentalis	Eastern Arborvitae
Tilia spp.	Linden
Viburnum spp.	Viburnum

Plants for wildlife areas

Certain plant materials possess

characteristics that are more favorable for wildlife. These plants may provide nesting areas, protection and food for many kinds of birds and animals. Many of our common plant materials provide seeds or fruits that wildlife require for survival, and these materials can easily be included in most plantings for golf courses.

Table 5
Plant Materials Valuable to Wildlife

Scientific name	Common name
Amelanchier spp.	Serviceberry
Aronia spp.	Chokeberry
Berberis spp.	Barberry
Betula lenta	Sweet Birch
Betula lutea	Yellow Birch
Betula nigra	River Birch
Betula populifolia	Gray Birch
Carya spp.	Hickory
Celastrus spp.	Bittersweet
Celtis spp.	Hackberry
Chionanthus spp.	Fringetree
Cornus spp.	Dogwood
Corylus americana	American Filbert
Cotoneaster spp.	Cotoneaster
Crataegus spp.	Hawthorn
Elaeagnus angustifolia	Russianolive
Euonymus spp.	Euonymus
Gaultheria procumbens	Checkerberry Wintergreen
Hippophae rhamnoides	Common Seabuckthorn
Ilex opaca	American Holly
Ilex verticillata	Common Winterberry
Juglans spp.	Walnut
Juniperus spp.	Juniper
Larix spp.	Larch
Lespedeza spp.	Lespedeza
Ligustrum spp.	Privet
Lindera spp.	Spicebush
Lonicera spp.	Honeysuckle
Malus spp.	Apple, Crabapple
Morus spp.	Mulberry
Myrica spp.	Bayberry; Waxmyrtle
Nyssa spp.	Tupelo
Parthenocissus spp.	Creeper
Picea spp.	Spruce
Pinus spp.	Pine
Prunus spp.	Apricot; Cherry; Chokecherry; Laurelecherry; Peach; Plum
Pyracantha spp.	Firethorn
Quercus spp.	Oak
Rhamnus spp.	Buckthorn
Rhus spp.	Sumac
Ribes spp.	Currant; Gooseberry
Rubus spp.	Blackberry; Dewberry; Raspberry
Sambucus spp.	Elder
Shepherdia spp.	Buffalobery
Sorbus spp.	Mountainash
Symphoricarpos spp.	Snowberry
Tamarix gallica	French Tamarisk
Tsuga spp.	Hemlock
Vaccinium spp.	Blueberry
Viburnum spp.	Viburnum
Vitis spp.	Grape

Screens and windbreaks

Plant materials that are suitable for windbreaks or screens should possess several important characteristics. They

must be dense and low branching. They may be fast or moderate in growth. They may have thorns in instances where they are needed as boundary screens or barriers. They must be able to withstand effects of wind and exposure. They may or may not be evergreen, depending upon their specific use. Evergreens are useful throughout the year, while deciduous materials are useful as windbreaks only during a portion of the year.

Table 6
Plant Materials for Screens and Windbreaks

Scientific name	Common name
<i>Acer campestre</i>	Hedge Maple
<i>Acer ginnala</i>	Amur Maple
<i>Acer negundo</i>	Boxelder
<i>Acer saccharinum</i>	Silver Maple
<i>Acer tataricum</i>	Tatarian Maple
<i>Ailanthus altissima</i>	Treeofheaven Ailanthus
<i>Berberis</i> spp.	Barberry
<i>Caragana</i> spp.	Peashrub
<i>Carpinus</i> spp.	Hornbeam
<i>Catalpa</i> spp.	Catalpa
<i>Chaenomeles japonica</i>	Floweringquince
<i>Cornus</i> spp.	Dogwood
<i>Cotoneaster</i> spp.	Cotoneaster
<i>Crataegus</i> spp.	Hawthorn
<i>Euonymus alatus</i>	Winged Euonymus
<i>Fagus</i> spp.	Beech
<i>Gleditsia triacanthos</i>	Common Honeylocust
<i>Hamamelis virginiana</i>	Common Witchhazel
<i>Hippophae rhamnoides</i>	Common Seabuckthorn
<i>Juniperus</i> spp.	Juniper
<i>Larix</i> spp.	Larch
<i>Ligustrum</i> spp.	Privet
<i>Lonicera</i> spp.	Honeysuckle
<i>Maclura pomifera</i>	Osageorange
<i>Mahonia aquifolium</i>	Oregongrape
<i>Morus</i> spp.	Mulberry
<i>Phellodendron amurense</i>	Amur Corktree
<i>Philadelphus</i> spp.	Mockorange
<i>Physocarpus opulifolius</i>	Common ninebark
<i>Picea</i> spp.	Spruce
<i>Pinus banksiana</i>	Jack Pine
<i>Pinus ponderosa</i>	Ponderosa Pine
<i>Pinus resinosa</i>	Red Pine
<i>Pinus strobus</i>	Eastern White Pine
<i>Pinus sylvestris</i>	Scotch Pine
<i>Platanus orientalis</i>	American Planetree
<i>Populus</i> spp.	Poplar
<i>Prunus spinosa</i>	Sloe; Blackthorn
<i>Ptelea trifoliata</i>	Common Hoptree
<i>Pyracantha</i> spp.	Firethorn
<i>Rhamnus</i> spp.	Buckthorn
<i>Robinia pseudoacacia</i>	Black Locust
<i>Rosa</i> spp.	Rose
<i>Salix</i> spp.	Willow
<i>Sambucus canadensis</i>	American Elder
<i>Staphylea trifolia</i>	American Bladdernut
<i>Thuja</i> spp.	Arborvitae
<i>Tsuga</i> spp.	Hemlock
<i>Viburnum</i> spp.	Viburnum

Undesirable Characteristics of Plants

Many unsuitable plant materials are used on golf courses. Such plants add

greatly to the yearly cost of maintenance. Most plants possess undesirable characteristics, such as litter, odor, soft wood, troublesome roots, quantities of leaves, or insect and disease. However, some are recommended when their desirable characteristics dominate their undesirable characteristics.

The following lists of plant materials should be regarded as indicators, since all plant materials have not been listed. Of the plants that are listed, many considered to be undesirable in one section of the country may be desirable in another. For example, Siberian elm (*Ulmus pumila*), boxelder (*Acer negundo*), Russianolive (*Elaeagnus angustifolia*), poplars (*Populus* spp.), and willows (*Salix* spp.) may be undesirable in the Northeast (region 1), while serving very well in the Northern plains (region 4).

Table 7
Undesirable Materials Due to Litter

Scientific name	Common name	Problem
<i>Acer negundo</i>	Boxelder	storm damage
<i>Acer rubrum</i>	Red Maple	storm damage
<i>Acer saccharinum</i>	Silver Maple	brittle, storm damage
<i>Aesculus</i> spp.	Buckeye; Horsechestnut	storm damage twigs, fruit
<i>Ailanthus altissima</i>	Treeofheaven	fruit, storm damage
<i>Betula papyrifera</i>	Paper Birch	storm damage
<i>Carya</i> spp.	Hickory	fruit
<i>Castanea dentata</i>	American Chestnut	fruit
<i>Catalpa</i> spp.	Catalpa	fruit (cones)
<i>Cedrus</i> spp.	Cedar	fruit
<i>Citrus</i> genera	Citrus	fruit
<i>Cladrastis lutea</i>	American Yellowwood	storm damage
<i>Diospyros virginiana</i>	Common Persimmon	storm damage
<i>Fagus</i> spp.	Beech	fruit
<i>Fraxinus</i> spp.	Ash	fruit, storm damage
<i>Ginkgo biloba</i> (female)	Ginkgo	fruit
<i>Gleditsia triacanthos</i>	Common Honeylocust	fruit pod
<i>Gymnocladus dioicus</i>	Kentucky Coffeetree	fruit pod, storm damage
<i>Juglans</i> spp.	Walnut	fruit
<i>Koeleruteria paniculata</i>	Panicled Goldenrain-Tree	storm damage
<i>Liquidamber styraciflua</i>	American Sweetgum	fruit
<i>Liriodendron tulipifera</i>	Tuliptree	storm damage
<i>Maclura pomifera</i>	Osageorange	fruit
<i>Malus</i> spp.	Apple; Crabapple	fruit
<i>Morus</i> spp.	Mulberry	weed tree, fruit

Picea spp.	Spruce	cones	Cercidiphyllum japonicum	Katsuratree	surface
Pinus spp.	Pine	cones	Cladrastis lutea	American Yellowwood	surface
Platanus spp.	Planetree	storm damage, fruit	Cornus alba sibirica	Siberian Dogwood	suckers
Populus spp.	Poplar	storm damage, seeds, twigs	Cornum amomum	Silky Dogwood	suckers
Prunus spp.	Apricot; Cherry; Chokecherry; Laurelherry; Peach; Plum	fruit	Cornum stolonifera	Redosier Dogwood	suckers
Pyrus spp.	Pear	fruit	Fagus spp.	Beech	surface
Quercus spp.	Oak	fruit	Fraxinus spp.	Ash	surface
Robinia pseudoacacia	Black Locust	storm damage, fruit pods	Hydrangea spp.	Hydrangea	suckers
Salix spp.	Willow	storm damage, twigs, seeds	Liriodendron tulipifera	Tuliptree	suckers
Sambucus spp.	Elder	storm damage	Maclura pomifera	Osageorange	surface
Schinus molle	California Peppertree	fruit	Morus alba	White Mulberry	surface
Sorbus spp.	Mountainash	fruit	Morus rubra	Red Mulberry	surface
Tilia americana	American Linden	storm damage	Ostrya virginiana	American Hophorn beam	surface
Ulmus spp.	Elm	fruit, twigs, storm damage,	Phellodendron amurense	Amur Corktree	surface
			Populus spp.	Poplar	surface
			Prunus americana	American Plum	suckers
			Prunus pensylvanica	Pin Cherry	suckers
			Prunus virginiana	Common Chokecherry	suckers
			Rhus spp.	Sumac	suckers
			Robinia pseudoacacia	Black Locust	shallow-suckers
			Salix spp.	Willow	shallow-suckers
			Sambucus canadensis	American Elder	suckers
			Sorbus spp.	Mountainash	shallow-suckers
			Staphylea trifolia	American Bladdernut	suckers
			Syringa vulgaris	Common Lilac	suckers
			Tsuga spp.	Hemlock	surface
			Ulmus spp.	Elm	surface
			Viburnum spp.	Viburnum	suckers
			Zanthoxylum spp.	Pricklyash	suckers
			Zelcova serrata	Japanese Zelcova	surface

Table 8
Undesirable Materials due to Dense Shade

Scientific name	Common name
Abies spp.	Fir
Acer ginnala	Amur Maple
Acer macrophyllum	Bigleaf Maple
Acer nigrum	Black Maple
Acer platanoides	Japanese Maple
Acer saccharum	Sugar Maple
Acer tataricum	Tatarian Maple
Aesculus hippocastanum	Common Horsechestnut
Asimina triloba	Common Pawpaw
Catalpa speciosa	Northern Catalpa
Cornus florida	Flowering Dogwood
Cornus mas	Corneliancherry Dogwood
Euonymus alatus	Winged Euonymus
Euonymus atropurpureus	Eastern Wahoo
Fagus spp.	Beech
Ilex spp.	Holly
Juniperus spp.	Juniper
Kalmia latifolia	Mountainlaurel
Ligustrum spp.	Privet
Magnolia spp.	Magnolia
Morus spp.	Mulberry
Paulownia tomentosa	Royal Paulownia
Picea spp.	Spruce
Pseudotsuga spp.	Douglasfir
Quercus alba	White Oak
Quercus bicolor	Swamp White Oak
Quercus borealis	Northern Red Oak
Quercus macrocarpa	Bur Oak
Quercus robur	English Oak
Rhododendron spp.	Rhododendron, Azalea
Taxus spp.	Yew
Thuja spp.	Arborvitae
Tilia spp.	Linden
Tsuga spp.	Hemlock
Viburnum spp.	Viburnum

Table 9
Undesirable Materials due to Roots

Scientific name	Common name	Problem
Acer negundo	Boxelder	suckers
Acer platanoides	Norway Maple	surface
Aesculus parvifolia	Bottlebrush Buckeye	suckers
Ailanthus altissima	Treeofheaven	
	Ailanthus	suckers
Alnus spp.	Alder	suckers
Amelanchier spp.	Serviceberry	surface
Asimina triloba	Common Pawpaw	surface
Carpinus spp.	Hornbeam	surface

Salix spp.	Willow	shallow-suckers
Sambucus canadensis	American Elder	suckers
Sorbus spp.	Mountainash	shallow-suckers
Staphylea trifolia	American Bladdernut	suckers
Syringa vulgaris	Common Lilac	suckers
Tsuga spp.	Hemlock	surface
Ulmus spp.	Elm	surface
Viburnum spp.	Viburnum	suckers
Zanthoxylum spp.	Pricklyash	suckers
Zelcova serrata	Japanese Zelcova	surface

Table 10
Undesirable Materials due to Susceptibility to Diseases and Insects

Scientific name	Common name
Abies balsamea	Balsam Fir
Acer negundo	Boxelder
Acer saccharinum	Silver Maple
Aesculus hippocastanum	Common Horsechestnut
Alnus japonica	Japanese Alder
Amelanchier spp.	Serviceberry
Betula spp.	Birch
Carya spp.	Hickory
Castanea spp.	Chestnut
Celtis spp.	Hackberry
Cornus alternifolia	Pagoda Dogwood
Crataegus spp.	Hawthorn
Cydonia oblonga	Common Quince
Euonymus spp.	Euonymus
Fraxinus spp.	Ash
Gleditsia japonica	Japanese Honeylocust
Halesia carolina	Carolina Silverbell
Ilex aquafolium	English Holly
Ilex opaca	American Holly
Juglans spp.	Walnut
Juniperus spp.	Juniper
Larix spp.	Larch
Malus spp.	Apple; Crabapple
Photinia spp.	Photinia
Platanus occidentalis	American Planetree
Populus spp.	Poplar
Prunus spp.	Apricot; Cherry; Laurelherry; Peach; Plum
Ptelea trifoliata	Common Hoptree
Pyrus spp.	Pear
Quercus borealis	Northern Red Oak
Rhamnus spp.	Suckthorn
Rhus spp.	Sumac
Robinia spp.	Locust
Salix spp.	Willow
Sorbus spp.	Mountainash
Syringa spp.	Lilac
Tilia spp.	Linden
Ulmus spp.	Elm

Golf Course Maintenance Equipment

by Lee Record, Agronomist

To meet the demands of present day golf course maintenance, the most modern and up-to-date equipment is needed. Maintenance equipment alone will not be the answer at every course; administration, programming, adequate budgets, manpower, responsibility and a host of other elements will be necessary.

The following suggested list may not be adequate at many golf courses, depending upon the degree of maintenance. This list should, however, be adequate for the majority of 18-hole courses.

Greens And Tees

- 6 to 8 putting green mowers
- 2 power aerators
- 1 vertical mower
- 1 power drag mat
- 1 power topdresser
- 1 power thatcher
- 1 power spiker
- 1 power sprayer (fungicides)
- 1 proportioner
- 2 rotary fertilizer spreaders
- 2 triplex mowers

Fairways And Roughs

- 2 to 7 gang hydraulic tractors and mowers
- 1 fairway aerator
- 1 fairway thatcher
- 1 fairway sweeper
- 1 power sprayer (herbicides)
- 1 rotary fertilizer spreader
- 1 5-gang mower (roughs)
- 1 3-gang roller

General Equipment

- 1 or 2 dump body golf tractors

- 2 general construction PTO tractors
- 1 jeep, pickup truck, etc.
- 1 dump truck (5 ton min.)
- 1 snow plow
- 1 front end loader and backhoe
- 1 power sod cutter
- 1 power saw
- 1 power stump cutter
- 1 power soil shredder
- 1 powered hand sweeper
- 2 powered leaf blowers
- 1 water ballast roller
- 6 rotary trimmer mowers
- 3 hand trimmer mowers
- 2 general purpose power reel mowers
- 2 or 3 gas powered runabouts

Miscellaneous Hand Equipment

(This list will go from A to Z.) axes, burners, crow bar, duster, cup cutter, wheelbarrow, ladder, sod edgers, sod lifters, shovels, rakes, funnels, spade, picks, forks, jacks, pruners, tree saws, traps (animal), pumps, gas cans, scales, pullers, hose, bamboo poles, soil testers, soil probe.

Tools For Repair Of:

All power equipment (trucks, tractors, mowers, etc.), plumbing, drains, electrical equipment, sewers, roadways, cement and concrete, water systems, painting and wood working repairs, etc.

Shop Equipment

Lapping machine, air compressor, steam cleaner, table saw, bench grinders, bed knife grinder, reel knife grinder, pipe threader, paint sprayer, welder, drill press, vises, arbor press, work benches.

Irrigation Equipment

Pumping station and number of heads will be determined by the superintendent at each individual course.

This suggested list has only touched a few of the many odds and ends and pieces of equipment needed. If we may have omitted the one piece of equipment which you feel is necessary, by all means add it to the list.

A maintenance building should meet the following requirements:

1. Superintendent's office (desk, file cabinets, adding machine, etc.)
2. Toilet facilities (showers, lockers, etc.)
3. Adequate heating and ventilation
4. Paint spraying room
5. Herbicide-fungicide, etc. storage room
6. Fertilizer storage area
7. Adequate storage area for all equipment
8. Adequate maintenance area.

Also in conjunction with the main maintenance building, an additional storage building is essential for the storing and mixing of topdressing material. Topdressing should be kept in a dry area so that it will be available

at any time of the season. A two-year supply should be stored at all times.

If we have the necessary equipment and maintenance building, how many men will be required to keep the equipment rolling for the necessary turf maintenance? We suggest the following personnel be considered for the average 18-hole golf course in the Northeast.

- 1 Superintendent (year round employment)
 - 1 Assistant Superintendent or Foreman (year round employment)
 - 1 Mechanic (year round employment)
 - 2 Laborers (year round employment)
 - 3 Laborers to be hired at the beginning of the outside maintenance program to be carried through until fall maintenance is completed.
 - 3 Laborers to be hired as summer help
-
- 11 men total

Regardless of the maintenance building and modern equipment, the work load cannot be carried out unless an adequate work force is available; a work force that can be depended on, day in and day out; men with responsibility to themselves, to the golf course they are working for and to the equipment they are handling.

Power Sprayers

by Albert Newberger, Agronomist

If one were to ask which piece of equipment is most vital to good golf course maintenance, a variety of answers might be expected. Certainly in this day of increased use of herbicides, insecticides, fungicides, and liquid fertilizers, power spray equipment must rank high on the list.

Treatment of turf, trees and shrubs on golf courses is becoming more and more necessary if we are to maintain high standards of quality in our plant

materials. Where chemicals are available in both dry and liquid formulations, it is often more economical to use the liquid.

However, many golf courses still have either no power spray equipment, or at best, highly inadequate equipment. Modern spray equipment is generally quite good, and it is not recommended that one build his own sprayer. However, it can be done if the material and know-how are available.

First, consider the major components of all power spray equipment. The primary component of any spray system is the pump. Pumps can be placed in two categories: positive displacement and non-positive displacement.

Positive displacement means that liquid is discharged as soon as the pump operates and continues as long as the pump operates. These pumps need no priming, but must have some means of relief when the discharge control valve is closed. These mechanisms will be discussed later. Examples of positive displacement pumps are the piston, gear, and some rotary pumps.

Non-positive displacement pumps can be operated without liquid discharge and are not necessarily self-priming. Examples of this type are the centrifugal and turbine pumps. The pumps mentioned above vary considerably in characteristics such as wear, cost, pressure, and speed of operation. Before purchasing or building a power sprayer, these characteristics should be investigated and given careful consideration.

Piston pumps are popular for all-purpose use because they can handle a wide variety of materials. When fitted with rubber or neoprene piston

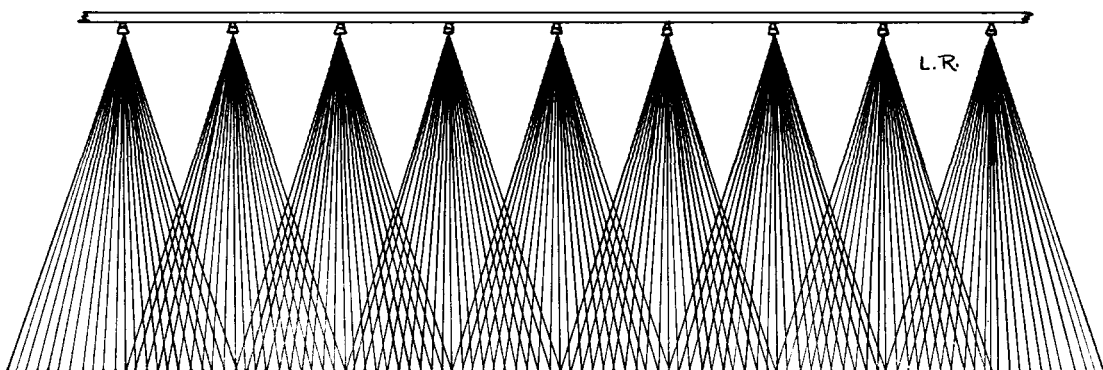
cups, these pumps are quite resistant to abrasion. For most golf course work, a pump capacity of 5-10 g.p.m. at 40-400 pounds per square inch is acceptable.

As mentioned, positive displacement pumps require a pressure regulator or bypass valve to relieve pressure and recycle liquid when the discharge control valve is closed. The pressure regulator also maintains constant pressure delivery to the boom or gun.

Located between the boom and the pump, the pressure regulator consists of a spring-loaded valve with adjustable tension. Whenever the pump pressure exceeds the spring tension, the valve opens allowing liquid to recycle into the tank, thus keeping pressure constant. This recycling aids in agitation, and in some cases is the sole source of agitation.

Adjustment of the spring tension regulates pressure at the boom or gun. In order to do this, the pump must maintain a pressure in excess of the desired pressure at the boom. In the case of non-positive displacement pumps, regulation of pressure is accomplished with a pressure reducing valve. This valve is also located between the pump and the boom, but no liquid is recycled in this case. Pressure on the input side of the valve may

A good spray pattern—a turf management must.



fluctuate, but output pressure is fairly constant.

An integral part of any sprayer is the pressure gauge. This should be located between the boom cut-off valve and the boom. It should be placed in such a position and be large enough so that the operator can read it clearly. The pressure gauge should be capable of reading pressure higher than the pressure used in normal operation. For general golf course spraying, a wide range of pressures, maximum 600 p.s.i., should be anticipated, especially if equipment also is to be used on crops other than turf.

Consideration of the type of tank to use in a power sprayer is very important. Size and material are of primary importance. For golf course use, tanks ranging from 200- to 400-gallon capacity are desirable, since most turf spraying is of rather high gallonage, 50-100 gallons per acre. When selecting a tank, its resistance to corrosion must be considered, since many chemicals are highly corrosive.

Because a power sprayer on a golf course is used to apply various types of chemicals, the tank should be of such material that it can be thoroughly washed out after use. Wooden tanks are resistant to corrosion, but they may tend to absorb highly volatile chemicals, thus limiting their use. In the case of both metal and wooden tanks, lining the interior with an inert material such as fiberglass or plastic may be desirable. Stainless steel and aluminum alloy tanks are commonly used today, but they are expensive.

The tank should have one large opening on top for filling, and at least one adequate drain on the bottom, to facilitate cleaning.

Because a large percentage of chemicals used in sprayers are either emulsions or wettable powders, some means

of sufficient agitation is necessary. The two most common methods of agitation are mechanical and hydraulic, the former generally considered to be better. Mechanical agitation is accomplished by paddles attached to a horizontal shaft in the lower part of the tank. The shaft is driven by the prime mover of the pump, either a gasoline engine or the tractor power take-off.

Hydraulic agitation is generally accomplished by forcing recycled liquid from the pump through holes in a pipe near the bottom of the tank or through an agitator nozzle. A large quantity of liquid must be recirculated in order to effect proper agitation.

Small bilge pumps can be used for agitation if mechanical or hydraulic agitation is impractical. Flat-bottom tanks generally require 30-40% more agitation than round-bottom tanks to keep material in suspension.

The pump suction line in the tank should be located near the bottom, but not so close that it will pick up sediment. A small well, 1 or 2 inches deep, beneath the tip of the suction line is preferable.

Strainers located at key points in the system alleviate clogging problems and facilitate more efficient operation. An easily removable 50- to 80-mesh strainer should be placed in the large filler opening at the top. This aids in mixing the spray material and the exclusion of large lumps. A strainer of similar size should be placed within the pump suction line.

A strainer of 100 mesh or smaller should be placed in the pump discharge line, and should be of sufficient area to do a thorough job of straining. Finally, the nozzles will contain screen of such size that it will block particles larger than the nozzle openings.

A quick-closing valve must be placed

in the boom supply line to allow for immediate cessation of spray flow. It is generally considered necessary to locate this valve as close to the boom as possible so a minimum of spray, still in the line, will drip out. By the use of spring-loaded nozzles, the necessity for placing the valve close to the boom is eliminated.

For golf course spraying a boom of 20-25 feet is preferable, and it can always be adapted to spraying a smaller swath by capping nozzles. Always recalibrate the sprayer after doing so!

The boom generally should be constructed of a strong pipe such as galvanized steel, black iron, or some alloys, and should be one inch in diameter or larger.

When the boom far exceeds the width of the tractor, it should be sectioned and hinged for easy folding. Sectioned booms require separate feeder lines, and this is generally desirable since it gives better control and more versatility in tight areas.

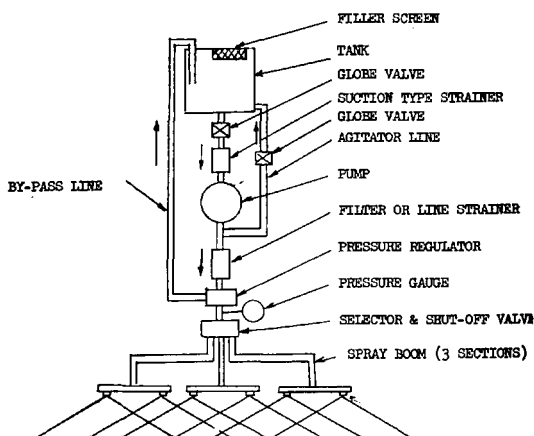
Sectioned booms should be held in the extended position by springs which allow them to give when they strike an object such as a tree or fence.

Front or rear mounting of the boom is primarily a matter of preference.

Nozzle attachment is preferable at the sides or the top of the boom to reduce settling of dirt particles and to reduce spray flow after closing of the cutoff valve. If spring-loaded nozzles are used and the boom is flushed out regularly, bottom attachment of nozzles is quite acceptable.

Nozzle spacing depends on the type of nozzles used, which in turn depends on the crop. Spacing of 18-22 inches using flat fan-shaped spray nozzles is desirable for most turf work. However the width of the spray delivered and the boom height govern the spacing.

It is generally desirable to keep the



Schematic diagram indicating the essential parts of a sprayer.

boom at a minimum height and pressure just great enough to produce the rate fan width, in order to minimize drift.

Consideration of the nozzles is extremely important! They are generally made of brass, plastic, stainless steel, or hardend stainless. The materials mentioned are given in order of increasing resistance to abrasion and also in order of increasing cost. Nozzles wear quite rapidly, especially when wettable powders are used frequently.

Selection of nozzles will depend on frequency of use and the material being used. However, when using *any* nozzle for application of wettable powders, frequent calibration is absolutely essential.

A hand spray gun or hand boom should be included in the spray system for golf course spraying.

Oil-resistant high pressure hose, 50-100 feet in length should be connected to the gun or hand boom. This hose is normally $\frac{3}{8}$ to $\frac{1}{2}$ inch in inner diameter. A reel with 100 foot capacity should be mounted on the tank so the hose can be rolled neatly and stored right on the rig.

Hand guns can be obtained which are adjustable from a fog to a far-reaching stream, and spray discs can be quickly changed for different types of spraying.

The mounting of a sprayer must be considered, especially if it is home-made. Most golf course sprayers are trailer-mounted riding on an axle with two wheels. Tandem wheel assemblies are also used in order to distribute weight more uniformly. Trailer-mounted sprayers allow for greater tank size which is desirable for general golf course spraying. However, rear and center tractor-mounted tanks may be used if necessary.

Homemade sprayer systems often use 55-gallon drums for the tank. These tractor-mounted tanks should be conveniently attachable and detachable. One of the greatest advantages of the tractor-mounted tank is that the boom can easily be placed in front of the tractor, thus allowing the operator to better observe the spray pattern.

Homemade systems may be mounted on an axle also, without too much difficulty. If the tank is such that its capacity is 400 gallons or more, over-size tires or tandem wheels should be used to prevent damage to soft turf.

The tank should be centered directly over, or slightly forward of the wheels to prevent too much pressure being exerted on the tractor drawbar as the amount of liquid in the tank changes.

Once you have either purchased or constructed your sprayer, the most important consideration is its proper use and care.

The following is a list of do's and don'ts:

Operating Precautions

1. Never use a pin, knife or other metal object to unplug a nozzle. Use compressed air, an old toothbrush or

brush with soft bristles. Never blow into a nozzle to clean it.

2. Never allow dirty water or debris to enter the tank.

3. Control spray drift by:

- (a) using the largest nozzle and the lowest pressure that will apply the spray material
- (b) keeping the boom as low as permissible
- (c) never spraying on a windy or even a breezy day.

4. Never operate a sprayer with any of the screens or filters removed. If the screen is constantly becoming plugged, replace it with a screen with the proper mesh and capacity.

5. Never fasten a P.T.O.-driven pump solidly to the tractor with a bar. Most sprayer pumps should be kept from rotating with the chain provided. Fastening the pump with a bar usually causes rapid pump bearing wear.

6. Never allow any sprayer pump to run without water, even for a short time. If no water is present, pump seals, bearings and other working parts may be severely damaged.

7. Never leave a tank with any spray material in it—even during noon hour. Wettable powders settle rapidly and are difficult to re-suspend.

8. Always pump at least 50 gallons of clean water through the sprayer at the end of the day or when changing from one spray material to another. Clean the nozzle tips and all screens at the same time. This will help to reduce the gummy deposits or the wettable powder accumulations in the sprayer. Leaving the tank full of clean water will help reduce flaking inside an unlined steel tank.

End-of-the Day Cleaning

Whenever wind or weather conditions force you *temporarily* to stop

spraying, clean the sprayer to prevent gum or powder deposits in the pressure regulator, selector valve, nozzle tips and on screens.

Follow these simple steps:

1. Rinse the inside and outside of the tank with plenty of clean water.
2. Half fill the tank with clean water and spray it out at low pressure. While the sprayer is operating, (a) run the bilge pump, (b) adjust the pressure regulator and the selector valve and (c) remove the plugs in the ends of the three boom sections. A small amount of liquid detergent added to the clean water will help clean the inside of the sprayer system.
3. Clean the nozzles, nozzle screens and suction screens with compressed air or a soft brush. Replace the screens and nozzles.
4. Leave the tank full of clean water if weather conditions permit.

Never clean a sprayer near susceptible plants or where the wash water could contaminate water supplies.

Storing the Sprayer

When you store your sprayer properly instead of just letting it sit in the fence corner, you add years to its useful life and put money into your pocket.

Here is a good procedure to follow.

1. Thoroughly clean the sprayer.
2. Completely lubricate all moving parts according to the manufacturer's recommendations.
3. Make a list of all faulty parts and order the new ones NOW—not next spring when you want to start spraying.
4. Fill the tank with water and add the recommended quantity and type of rust inhibitor or new light oil (see your instruction manual). Drain the tank. Leave all tank openings uncovered for better tank ventilation, but screen them to keep out dust and debris.
5. Clean all nozzle tips and screens with compressed air or a soft brush and kerosene. Store the tips and screens in a jar of new light oil or kerosene.
6. Take the weight off any tires.
7. Remove, clean and drain the pump. Fill it with the light oil or rust inhibitor recommended by the pump manufacturer. Seal all pump openings to keep out dust and dirt.

Make certain that no water is left in the pressure regulator, selector valve or the boom. These parts will be severely damaged if water freezes in them.

COMING EVENTS

November 30-December 2	Oklahoma Turfgrass Conference Oklahoma State University Stillwater, Oklahoma
December 1-2	Illinois Turfgrass Conference University of Illinois Urbana, Illinois
December 5-7	Texas Turfgrass Conference Texas A&M University College Station, Texas
December 8-9	Louisiana Turfgrass Conference University of Southwestern Louisiana Lafayette, Louisiana
January 11-13	Nebraska Turfgrass Conference Nebraska Center for Continuing Education Lincoln, Nebraska
January 24-25	Virginia Turfgrass Conference Hotel John Marshall Richmond, Virginia
January 27	United States Golf Association Green Section Conference New York, N. Y.

TURF TWISTERS

REMOVING BERMUDAGRASS

Question: Common bermudagrass exists in spots in our putting greens. We want to remove this sod and replace it with Tifgreen from our nursery. How much soil do we have to take out to insure against the bermuda coming back from the roots? (TENNESSEE)

Answer: Contrary to popular belief, bermuda is not able to regenerate growth from its severed "roots." The regrowth comes from the underground fleshy stems called rhizomes. In closely cut bermudagrass, these rhizomes are rarely found below 2 inches.

In many cases sod is removed to a sufficient depth to take out all the growing points, but the *area* removed is too small. The growing points of underground stems frequently grow underground for a considerable distance beyond the edge of the visible top growth. If these are cut off and left in the ground, the bermudagrass will become reestablished in a relatively short time.

PROBLEM WITH ALGAE

Question: Algae has been quite a problem on our greens. It starts as a green scum in thin areas and then becomes black and crusty. (OKLAHOMA)

Answer: Algae is almost always present in areas where turf is thin and where water remains on the soil surface. Thick turf areas, and areas where water drains off or infiltrates readily, rarely are affected by algae.

A common treatment is a light dusting of hydrated lime. About 2 or 3 pounds per 1,000 square feet is enough. This appears to dry the surface somewhat. Perhaps the very sudden change in pH just at the surface layer where the algae is growing is enough to stop its growth.

Another treatment that is giving good results is an application of zineb. This product is primarily a fungicide, but it appears to be a very effective algicide as well.