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On-Site Mixing – Barely Second Best

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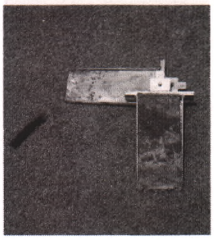

Cover Photo:
On-site mixing — barely second best.

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Sand – The Building Block

by **CHARLES B. WHITE**
Director, Southeastern Region, USGA Green Section

SAND IS ONE of the most common naturally occurring resources at our disposal today. It is used by turfgrass managers in all sorts of manners, from making concrete to filling bunkers, to mixing with other materials for topdressing and putting green construction. Sand holds tremendous benefits for the golf course superintendent, and yet, how little we know about it!

To begin with, the term sand is very vague. These individual rock or mineral fragments found in soils are characterized by their particle sizes, ranging from 2.00 mm to 0.5 mm. Sand grains usually consist chiefly of quartz, but they may be of any composition. If the particle size ranges listed above are divided into one another, one will see a 40-fold increase in sand particle diameter. Although this is a significant difference in particle size, any particle within this range is classified as a sand. This is important in understanding behavior differences within sands. To the soil scientist, any soil that contains 85 percent or more of sand and not more than 10 percent of clay is texturally classified as a sand. Thus, we can see that there are all kinds of sands. No wonder the confusion.

Keep in mind that turfgrass roots are not grown *in*, but *between* the soil particles. By necessity, however, our discussion of sand will center on particle size and distribution, silt and clay content, infiltration rates, bulk density, and the interrelationships between them. In other words, while our primary interest may be in pore spaces, we must understand the particles that surround them if we are to make any progress!

Sand is the ideal medium to resist compaction on the golf course. It also provides excellent internal drainage, and, when it is properly blended with other materials in proper proportions, it forms an exceptional growing medium that retains adequate amounts of nutrients and water. Sand has indeed evolved today as a primary constituent of turfgrass management practices.

RESISTANCE TO compaction is the major factor when formulating a good root zone soil mixture for golf tees and greens, because these areas receive continuous concentrated traffic. For good turf, every means possible must be used to resist soil compaction and poor drainage. Sand solves the problem. Its physical characteristics remain constant within the soil profile. When the right sand is mixed with a compatible source of organic matter and/or small amounts of topsoil, a high-quality growth medium is produced that maintains its physical characteristics indefinitely.

Accompanying this resistance to compaction are the excellent drainage characteristics needed on golf courses. Poor drainage creates long shutdown periods during rainy seasons, decreasing revenues significantly. Good internal drainage is not only important in putting greens and tees, but also in bunkers and throughout fairways as well. The use of a proper sand in conjunction with proper construction techniques can alleviate such drainage problems.

Turfgrasses, as other plants, grow best when soil moisture approximates field capacity. Properly blended soils for turfgrass growth, which can be formulated by a physical soil laboratory, are designed to provide adequate soil moisture levels. Unfortunately, the soil moisture levels optimal for growth are also optimal for compaction. Therefore, an interaction is seen again between soil and nutrient/moisture retention. Properly blended soil components maintain proper degrees of soil moisture that, in turn, maintains proper soil nutrition levels. This does not, however, eliminate the need for frequent and thorough soil testing to determine nutritional and soil pH levels.

PARTICLE SIZE determines the number of particles in a gram of soil. A good example of differences in number of particles per gram based on particle size is illustrated in *Table 1*. Both sands have the same percentage of medium sand. The sand on the left, however, has the second-highest percentage of sand particles in the coarse

TABLE 1
PARTICLE SIZE DISTRIBUTIONS

Sand	% by wt	Particles/g	% by wt	Particles/g
Very Coarse	10	9	5	4
Coarse	25	180	15	108
Medium	45	2,560	45	2,560
Fine	15	6,900	25	11,500
Very Fine	5	36,000	10	72,200
		45,649		86,372

TABLE 2
PARTICLE SIZE ANALOGY

VERY COARSE SAND	8 FT. DIA. BEACHBALL
COURSE SAND	4 FT. DIA. BEACHBALL
MEDIUM SAND	MEDICINE BALL
FINE SAND	BASKETBALL
VERY FINE SAND	SOFTBALL
SILT	POKER CHIPS
CLAY	OATMEAL

and very coarse range compared to the sand on the right, having the same percentages of particles in the fine and very fine category. Consequently, the ratio of coarse to fine is simply reversed from sand 1 to sand 2. Notice that in switching the percentages from coarse to fine, with medium sand constant, the number of particles per gram is approximately doubled. This has tremendous impact on the physical behavior of these two sands. The sand on the right has more particles and a lower infiltration rate, giving it greater nutrient and moisture retention, as well as making it more susceptible to compaction.

Table 2 shows a good analogy for determining particle sizes of the various soil separates. If clay were in relation to oatmeal flakes, then coarse sand would have the same relation as eight-foot-diameter balls. Now imagine these seven soil separates combined in a large swimming pool. The finer flakes will filter down through the larger particles. If these various components are mixed at improper ratios, a tremendous settling occurs that causes development of a layer of material that is impermeable to water and very susceptible to compaction. The same is true in the soil profile when an improper sand is used under putting green situations. Foot traffic, aerifications, watering, and equipment traffic cause migration of fine particles, creating an impermeable barrier below the soil surface.

Figure 1.

Figure 2.

ATTEMPTS TO improve soil conditions are often made by rototilling sand into the soil. Unfortunately, soil physics does not always permit the addition of small amounts of sand to improve the overall soil profile. On the contrary, large amounts of sand must be added to a heavier soil before soil porosity and compaction resistance improvements are experienced. Small amounts of additional sand create hardpans within the soil as the small particles filter into the larger pores, creating a soil interface. This is the principle behind cement setting up, and this same phenomenon can occur in a heavy soil when small amounts of sand have been incorporated.

Next, consider water movement through a soil profile and its relation to the perched water table system of the Green Section Specifications. As water moves vertically through the soil profile, it also moves laterally at about the same rate. However, once the water uniformly infiltrates the 10 to 12 inches down to the coarse sand layer, it does not move into or through this textural barrier. A law of soil physics, i.e., surface tension, is at work. The water backs up and will not move into the coarse sand until saturation occurs immediately above it in the upper soil mix. Only then, when the weight of the water above the coarse sand layer becomes great enough to overcome the tension force, will it move into and through the sand layer.

Theoretically, after field capacity is reached in the upper soil mixture, any water added beyond this point will drain into the coarse sand and on into the gravel-drain system. This principle allows the perched water table to maintain the desired moisture levels in the growing medium, yet not maintain saturated conditions in the soil profile.

Figure 3.

Figure 4.

The soil profile will, of course, be wetter at the lower extremities than at the higher, so therefore a uniform 12 inches of mix is necessary to maintain a uniform moisture content throughout the green. Final contours of a putting green must first be established in the subgrade, keeping the various construction layers constant and giving uniform conditions in the low as well as high areas.

THE PRINCIPLE that water will not readily move from soil of one texture into a soil of entirely different texture affects surface drainage functions as well. Remember, a larger-particle medium must be exposed to free water to allow water penetration from surrounding areas. Tile drains, French drains, or slit trenches use this principle in draining areas such as greens, low areas in tees and fairways, and underground drainage systems for bunkers. If installed with a thick sod cover, these drains will be of little or no use. Placing sod over tile drains prevents contact with free water, prohibiting lateral water movement into them.

A properly constructed drainage system may be installed with or without tile, but most important, the trench bottom must maintain a definite 1½ to 2 percent slope from the trench high point to the exhaust area. Gravel is used in the trench bottom and around the tile. The gravel may be overlayed with sand at a depth according to location. In greens, this depth must be enough for cup changing, and in tees and fairways it must accommodate aeration. However, in roughs or out-of-play areas, the sand cover may be only 1-2 inches, or even absent, providing maximum surface exposure for the gravel. Again, proper sand particle size selection prevents migration into the gravel and possible drainage system blockage.

Figures 1 and 2 illustrate the results of improperly and properly constructed drains installed in turfgrass areas. *Figure 1* shows a drainage system having a much too coarse sand, producing hydrophobic conditions. *Figure 2*, however, shows a properly constructed drain system having a proper sand medium over gravel, thus producing good drainage and the best-quality turf on the entire putting surface. Upon examination of the two soil profiles, the rooting depth will be as much as three times greater above the drain than in the adjacent poorly drained soil. Both drainage systems handle surface and subsurface drainage well, but a properly selected sand mixture prevents drought conditions above the drainage system itself, consequently preventing an eyesore on the putting green.

Figure 5.

FINDING THE right sand for a putting green or a soil mix is not as easy as it may first seem. As we have learned, sand is not just sand! There are tremendous differences within the sand classifications — indeed, within sand sources themselves. A laboratory mechanical and physical analysis is essential if you are to determine the actual behavior and benefits of a sand before actual use. The USGA Green Section laboratory (telephone Agri-Systems, 713-846-6543) can save a tremendous amount of money and time by eliminating the guesswork in sand, soil, and organic matter component determinations and ratios. After all, the desired soil characteristics of drainage, moisture/nutrient retention, and resistance to compaction are better determined by a laboratory than by guess and by gosh. The first step to better soils, therefore, is through the soil testing lab.

The next controversial step encountered is frequently between the practice of on-site vs. off-site mixing of the soil components. In reality, if one is interested in a uniform soil mix, there is no controversy at all. Off-site mixing is the key to producing a well-blended and uniform growing medium. On-site mixing is barely second best!

Figure 3 shows only one way, but it is a most effective way to achieve a consistent soil blend. A very thorough job is accomplished by blending materials in this manner. Contrast this with the problem facing the golf course superintendent in *Figure 4*. A sand with a high infiltration rate was used in this putting green construction, with sphagnum peat rototilled into the upper soil profile. The result was a mix in which turfgrass establishment and proper maintenance was nearly impossible. Attempting to mix a heavier material (such as sand) uniformly with a lighter material (such as peat) with a rototiller is virtually impossible. Even where this type of mechanical mixing is done in different directions and with many replications, pockets of sand and concentrations of organic matter are unavoidable. The final product is less than one should accept.

SAND IS ALSO vitally important in the make-up of topdressing materials and for bunker use.

Topdressing has always been one of the most important practices in putting green management. It is a factor in maintaining smoothness, uniformity, and relief from compaction, and it improves internal characteristics in the soil profile as well. Topdressings reduce thatch accumulation. Light, frequent topdressings improve putting green quality and speed.

In a number of cases, sandy topdressings have been used to improve the original upper soil profile. Such efforts are in vain, however, unless the sandy material has the proper physical characteristics. Of equal importance is the incorporation of the sandy material into the original soil profile through aerification. Topdressing the surface alone is not sufficient, as layering will result. This has caused serious problems in the past. However, incorporating the sand into the open aeration holes by dragging or matting develops good rooting. It also prevents development of a soil layer. *Figure 5* is a good example of proper sand/soil incorporation.

Choosing the proper bunker sand is often neglected when considering bunker management and playability. Important qualities for bunker sand include a firm surface, lack of fried-egg lies, proper drainage, resistance to compaction and movement from water or wind. If the proper sand is used, excellent playing conditions result. On the other hand, if improper sand is selected, bunker maintenance costs are going to increase.

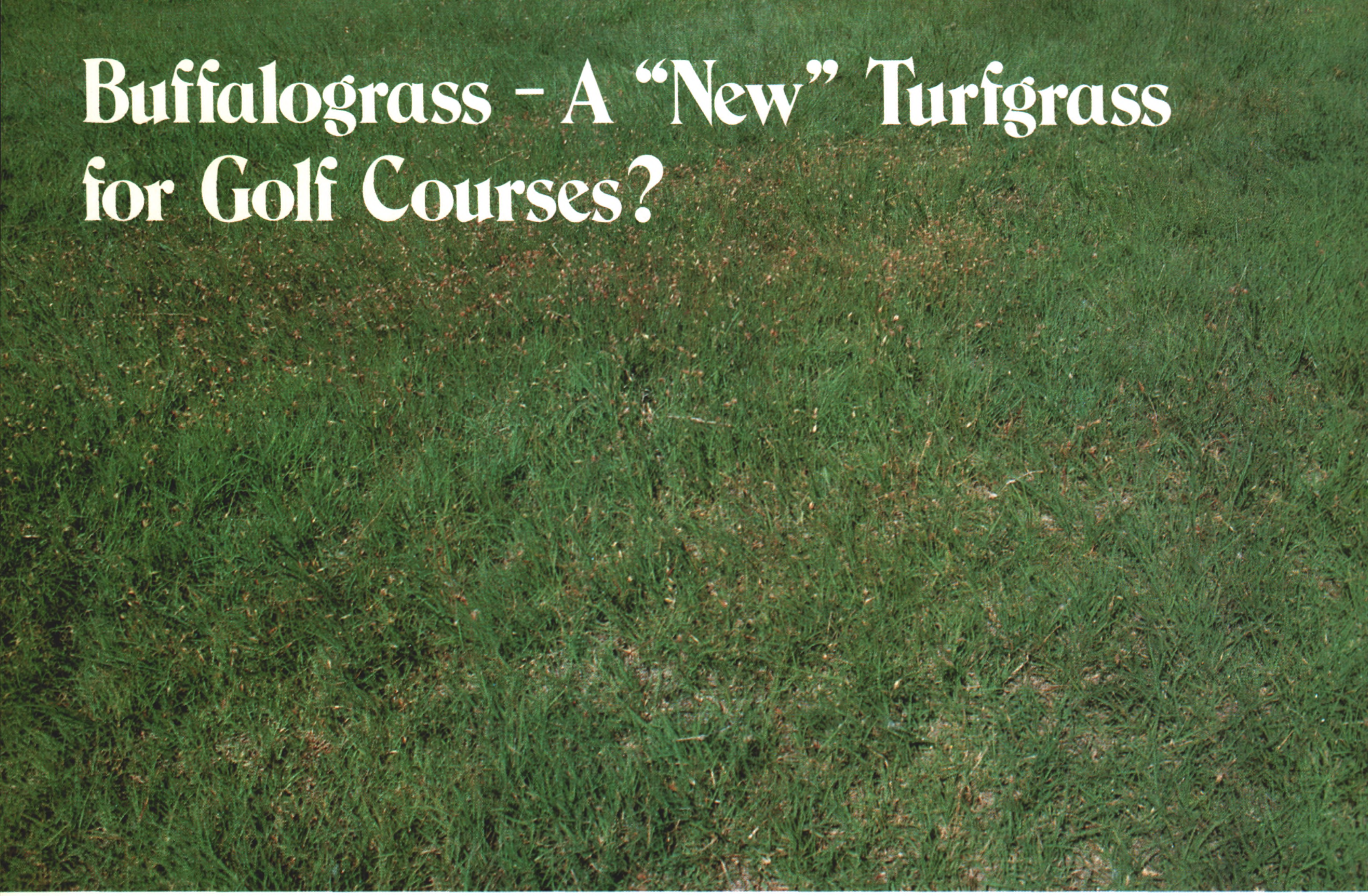
Oftentimes, the major consideration for a bunker sand is color. Although color is a poor judging point for sand quality for most golf course purposes, it is of major importance when it comes to bunker use. *Figure 6* reflects the problems an improper sand creates in bunkers. This sand has a very white color and provides good playing conditions but is very fine and has tremendous wind movement problems. This creates another problem for the golf course crew and increases the overall budget.

IN CLOSING, reconsider two earlier statements: Sand is not just sand, and turfgrass roots grow between, not in, the soil particles. We have seen what the right and wrong sands can do to golf course turfgrass management operations. With what seem to be insignificant changes in the proportions of sand particle sizes, organic matter, and soil components, we find significant differences in the way a soil mix reacts. We have seen the detrimental effects of hydrophobic sands and how and why some sand mixes and topdressings have received an undeserved bad reputation. We have tried to point out the value of a laboratory physical soil analysis — not only for construction, but for topdressings and bunkers as well. If a high-sand mixture is of good quality, then a physical analysis will quickly show its attributes. If the mixture does not have the necessary physical properties, a physical analysis can point this out before high expenditures and bad results develop.

A well-constructed putting green is expensive, but the proper use of a scientifically formulated sand mixture is not an expense — it is an investment for the future. *Sand is the building block.*

Figure 6.

Buffalograss – A "New" Turfgrass for Golf Courses?



by **DOROTHY FALKENBERG BORLAND**, Research Assistant,
and **JACK D. BUTLER**, Professor, Colorado State University

CUTTING golf course operation costs has been the topic of many past articles in the GREEN SECTION RECORD. Superintendents and architects are constantly looking for ways to effectively reduce maintenance, especially water needs. Current practices are altered more and more to where maintenance is somewhere between an optimum and a minimal or critical level. Thus, in certain areas of the United States, different grasses, used in earlier times when maintenance standards were not nearly as high, are being used once again.

Buffalograss [*Buchloë dactyloides* (Nutt.) Englem.] is a grass native to the Great Plains. It shows potential for expanded use on golf courses. In 1933, David A. Savage wrote an article for the USGA Green Section on sodding buffalograss for fairways because seed was not available (8). Now, almost 50 years later, buffalograss is being re-examined as a potential turfgrass for home lawns and golf course purposes. This grass serves a valued role on unwatered fairways and roughs, especially on older courses in the High Plains. Two golf facilities of special interest are the Collindale Golf Course, Ft. Collins, Colorado, (Neil Johnson, Superintendent) where research on buffalograss maintenance is done, and at the nearly completed Battlement Mesa Golf Course, near Parachute, Colorado, (Dave Johnson, Superintendent) where buffalograss is being used widely to greatly reduce water needs.

Buffalograss is a long-lived, drought-resistant, perennial grass that spreads rapidly under good growing conditions by stolons and creates a dense sod. It is a warm-season grass that will go dormant with heat and drought stress as well as at the first frost. It is also three to four weeks slower to green up in the spring than cool-season grasses, such as Kentucky bluegrass and fine fescue. Seldom does this grass grow taller than 10 inches, including extended male flowers. Under most conditions, foliage height is two to three inches.

Buffalograss is known for its drought resistance and hardiness to high temperatures. It does well on heavy soils. Although this grass is commonly found on poor, heavy clay soils, it will also grow on good, well-drained soils. It does not do well on soils high in sand, however (9). It is found naturally in semi-arid areas that receive 12-25 inches of precipitation per year. Deep and infrequent supplemental irrigations benefit buffalograss turf. Improper irrigation encourages broadleaf weeds and invasive grasses.

THE FERTILITY requirements and mowing tolerances of buffalograss turf have not been well researched. Buffalograss does respond to light applications of nitrogen, but overfertilization can encourage weeds. This grass can be maintained with little or no mowing; however, mowing can be used regularly throughout the season to give a more manicured appearance. A mowing height of between 1.5 and 2 inches can remove the male flowers and clean up the turf (1).

Tolerance to traffic is of concern on golf courses, and observations indicate that buffalograss will tolerate cart traffic quite well. As a range grass, buffalograss can tolerate a high degree of trampling and the associated close clipping of grazing (often to 0.5 inches) (9). Fraser and Anderson (2) found that Texoka buffalograss tolerated a moderate level of continual traffic and a regular mowing program very well. Nevertheless, if buffalograss is severely worn, regrowth may be slow or nonexistant, because regrowth occurs only from stolons.

Buffalograss is rarely troubled by insects or disease if not over-irrigated or over-fertilized. However, it can serve as a host for many types of insects and common turf diseases.

Once established, it can produce a tough sod that has few weed problems. Weeds can be a problem, however, until almost complete cover is achieved. Several chemicals have been tested on buffalograss, but potential turf injury and lack of labeling is of concern. 2,4-D [(2,4-dichlorophenoxy) acetic acid] is often used for weed control in buffalograss, but it may cause leaf burn and stunting of seedlings and mature plants, especially if plants are stressed at time of application (4, 7, 9). Pre-emergent herbicides such a propazine, siduron, and simazine seem to have little, if any, damaging effects when applied at seeding, when applications are at label rates (5, 6). Successful weed control with no damage to dormant buffalograss turf has been reported using high rates of Trimec®, Roundup®, and Weedone Super D® (6).

With the recent surge of interest in dry-land landscapes, more detailed knowledge was needed about buffalograss. Since most of the work done previously was concerned with dry-land range needs, research to test various untried establishment and maintenance practices on buffalograss for turf purposes was instigated at Colorado State University. Practices studied included seeding date and rate and effect of preplant and maintenance fertilization. A comprehensive thesis on buffalograss and other dry-land grasses is available (1), and it would be useful for those considering planting buffalograss turf.

TWO AREAS OF importance in establishment of turf, either for a home lawn or a golf course, are optimum seeding date and seeding rate. Only rarely are turf professionals able to seed at the optimum time; however, seeding at the best time can provide great return. Buffalograss can, in most of its areas of adaptation, be seeded anytime from mid-May until the end of August. In these studies best germination and subsequent cover was achieved by seeding in May. Early fall (September or later) is not advisable unless *UNTREATED* seed is used and germination is expressly planned for the following spring. By the second year, there was no appreciable difference between test plots seeded in May and July.

Seed cost is another important consideration. Buffalograss seed is expensive (wholesale cost in 1982 is $8.00 per pound) due to the difficulty in harvesting the burs that are found close to the ground. Also, the pretreatment that is necessary to ensure a high percentage of germination adds to the cost. The burs contain two to five seeds, with an average of two seeds per bur. A pound contains about 50,000 burs.

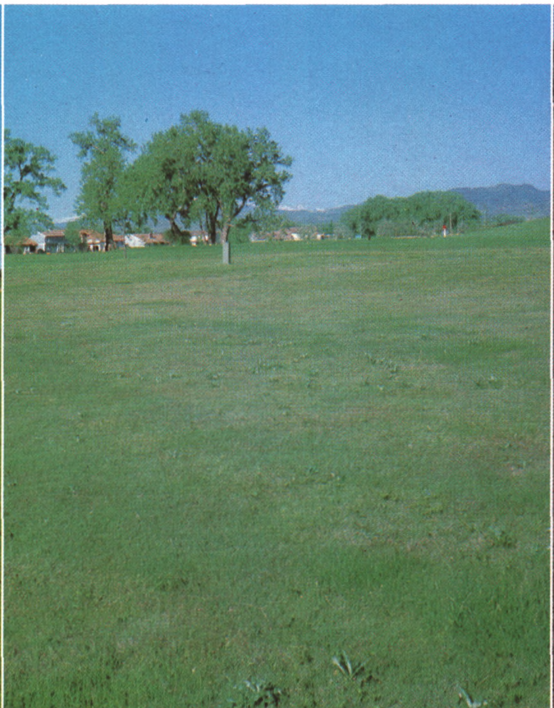
Recommended seeding rates for buffalograss for turf are high, as much as 7 lbs./1,000 ft.^{2} (7). When comparing five different broadcast seeding rates, adequate cover was achieved in one dry season with no supplemental water (beyond germination and initial establishment) using 3.9 lbs./1,000 ft.^{2}. With no irrigation beyond initial establishment, 2.3 lbs./1,000 ft.^{2} produced adequate cover within two growing seasons. Lower rates might be used and adequate cover achieved in one season if a regular irrigation schedule is planned or summer rains occur fairly regularly. After establishment, the frequency of irrigation can be adjusted for weather conditions and quality and rate of cover desired.

Color, density, and quality ratings comparing various seeding rates to a

At Ft. Collins, Colorado, unwatered buffalograss roughs:

After heavy spring rains in May.

In June.



In August.

good-quality buffalograss turf were made during the seeding year and the second season. During the seeding year, color was better in the plots with sparser stands than with those seeded at higher rates. Color differences were not visible during the second season, when color was acceptable throughout. Heavier seeding rates (2.3, 3.9, and 5.5 lbs./1,000 ft.^{2}) produced better cover, and the lowest seeding rates (0.4 and 0.8 lbs./1,000 ft.^{2}) produced unacceptable cover. The trend was similar during the second season. Quality was based on both color and density.

THE USE OF preplant fertilizers for establishment of high-quality turf is a common practice. Preplant fertilizer benefits on buffalograss were examined. There were no significant differences in growth rate or appearance with fertilization despite low soil nutrient levels at planting.

As a range grass, fertilization is often considered unnecessary for established buffalograss. However, a study at Collindale Golf Course showed that established buffalograss without irrigation, except to water fertilizer in, responds favorably to nitrogen fertilization. Nitrogen at a rate of 0.5 lb. N/1,000 ft.^{2} applied monthly during the growing season increased turf quality, color, and density greatly. Applications only in July or at a heavier rate (2 lbs./1,000 ft.^{2}) as a dormant, because of drought, treatment in August also improved overall turf quality. A residual effect from fertilizer application was noted the second spring.

In the U.S.A., there is a "new" grass for golf course use. Buffalograss can provide a suitable turf for golf purposes even when it is dormant and dry. Although buffalograss is native to the Great Plains, undoubtedly it will perform satisfactorily in several other areas. It withstands many of the climatic extremes common in the semi-arid High Plains, and it responds well to proper mowing, watering and fertilization. More research needs to be done to establish its environmental tolerance and to determine its disease and insect susceptibility, as well as to find its optimum irrigation. But here is a grass with potentials yet untapped. No doubt, as our resources become more and more limited, the use of this grass will be greatly extended.

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Established buffalograss can withstand heavy traffic, even when dormant. The green grass is Kentucky bluegrass.

Gabions being used as a headwall.

Gabions - Their Applications on the Golf Course

by JOHN DREW
Superintendent, Winters Run Golf Club, Maryland

EROSION IS a basic part of nature, and indications are that the forces that tear down and build up are not tired yet. One of these forces that we in the golf course business have to deal with is that of water and resultant erosion. Creek, pond, stream, or wave erosion affect almost all of us at some time.

Erosion caused by running water can be extremely devastating. These problems become magnified in areas of increasing population. Water runoff increases each time houses, roads, and parking lots are built. Runoff causes quiet little brooks to become raging torrents and placid creeks to act like bulldozers as they tear away the soil. We who are within the influence of streams and rivers tend to become concerned when the rain starts coming down hard.

Our golf course, like so many others, contains some land that is not suitable for housing or farming. Forty-eight of 180 acres are in a flood plain. Winters Run, a major stream, meanders through the course, giving it character, beauty, floods, erosion, and silt. The last named items caused us to look for protection from water damage early in the club's history. It is interesting to note that from 1972 through 1979 we experienced at least five "100-year floods." Floods of this magnitude, statistically speaking, are only supposed to happen once every 100 years. Unfortunately, Winters Run does not understand such definitions and will probably flood a few more times in our lives.

Many ideas have been proposed to prevent creek bank erosion. Vegetation, logs, rip-rap, railroad ties, concrete, and steel sheet piling have been used with varying degrees of success and/or failure. In our case, we decided that rip-rap would protect our eroding creek banks most effectively and at minimal cost. After finding local stone (at no cost), we spent $5,000 to haul and place it along 300 feet of bank. The next "100-year storm" scattered most of our work down the stream, leaving just a few of the very largest rocks in place.

First gabions on the upper course (summer).

Re-evaluation showed us that our banks would best be protected through the use of gabions.

Gabions may be traced back to Roman times, when they were used primarily in warfare. The term gabion means "a large basket, sometimes wickerwork . . . or iron, filled with earth or stones to create a battlement or sunk in water to form a bar or dike . . . ." Modern gabions fit this definition perfectly except that they are rarely used in war. Today's gabions come in a variety of sizes, and all are made of either heavily galvanized or PVC-coated wire. The basic size used in this country is 3 feet high by 3 feet wide by either 6, 9, or 12 feet long. Variations include baskets that are 1½ feet high, all other dimensions similar, and mattresses which are 1 foot thick by 6½ feet wide by either 8, 10, or 12 feet long. Galvanized wire is recommended for all applications except where the baskets will be exposed to salt water or water with a pH considerably different from 7.

THE GABION principle, where applied to water control and not warfare, embodies two things which make it unique and thus quite advantageous — flexibility and porosity. Because the gabion baskets are filled with 4″ to 7″ stone and laced shut, they are capable of bending, should the need arise. Also, since they are filled with rather large stone, the voids are numerous. These allow water to pass through, but not with great speed or force.

In the majority of cases, hydrostatic pressure is the downfall of stream bank protection systems. How many times have we seen walls made of rigid material, such as railroad ties or concrete, falling over into the very stream they were built to protect against? This is not a case of the force of the stream pushing the wall down, but rather that of water buildup behind the wall pushing it into the stream. It can be embarrassing to build a mighty defense against one force only to have it succumb to another.

Because of the voids between the stones, gabions do not allow any hydrostatic pressure buildup. In the case of our stream, it tends to flood quickly and then rapidly drop back to normal levels. This leaves the banks in a supersaturated condition. In other words, there is a lot of water left in the soil of the stream banks. It wants to hurry back to join the stream itself and will stop at nothing to get there. Gabions allow this drainage to occur rapidly and so prevent any pressure buildup. Additionally, the porosity of the structures keeps them from being subjected to heaving or other frost damage.

In protecting stream banks, two things should be considered. The slumping of earth from the sides of the banks into the water must be stopped. Also, the scouring action of the water along the base of the banks must be arrested. In many cases this scouring action does most of the damage.

Gabion mattresses, usually 12 to 18 inches thick, are used with great success as both a base for upper courses and as a scouring protector. Because of their great flexibility, these mattresses bend if water erodes the underlying soil. When they do this they interrupt the erosion process. Mattresses may also be used on sloping banks and as linings for stream bottoms.

The 3 foot by 3 foot by 6, 9, or 12 foot long baskets are used on top of the previously mentioned mattress. They both protect the bank from water and the upper courses may be used as retaining walls.

GABIONS ARE shipped assembled but folded up. In the field they must be unfolded, and the corners and individual cells are laced together using wire provided. After being built, they are moved into position and wired to any adjacent baskets. This wiring creates a monolithic type of structure out of individual blocks. When this step is completed, the basket is filled with 4-inch to 7-inch stones. These may be placed by hand or carefully loaded by machine. The more hand work done in placing stone within the basket the neater the overall job will be. When the basket is filled, the lid is folded down and wired shut. Gabion construction progresses in a similar manner to concrete block work. The difference between the two is that, with gabions, the completed blocks are as large as four cubic yards and weigh as much as six tons apiece.

Because of the simplicity of assembly, these structures do not require the expertise of outside labor. Once the decision has been made to use gabions and the design work is finished, normal golf course crews should have no trouble doing a fine job. In many instances the work can be carried out in stages. The job can be started during a slack work time, then finished later on. In our case, we usually can do the mattress work in July and August when cool-season grasses are not growing much and when it is pleasant to be in the creek — then come back and complete the upper courses after the usual fall work is done.

Although in this article we have concentrated on stream bank protection, keep in mind that gabions may also be used as retaining walls, dams (weirs), channel linings, and on gradually sloping banks. They can be used to arrest wave erosion on seashores and to prevent bank deterioration in ponds due to burrowing animals or the like.

We have successfully used these structures as outfall basins for storm drains, abutments for bridges, and head walls for culverts, as well as the normal applications. Currently we are thinking of putting a gabion retaining wall on a steep slope to create a terrace that will support a needed golf cart path. Before starting that, we have to get back in the creek and install some 600 feet of gabion mattress in order to protect a fairway that is eroding yearly, due to scouring at the base of the bank.

GABION COSTS will vary depending on distance from a manufacturing and distribution point and the price of large stone delivered to the job site. Our costs do not usually exceed $100 per cubic yard for installed gabions. In most cases this includes any excavation and backfill. We normally use our own backhoe-loader for preparing, lodging baskets, and backfilling. Limited access, great distance from supplies, and lack of equipment will all tend to raise the cost.

In summary, if you have any of the problems outlined here, or anything approaching them, take the time to investigate gabions. Gabions are useful for river training, flood control, and earth control. Consider that they can be constructed with existing labor, can be worked on in stages (and added to years later if need be), cause no hydrostatic pressure problems, are yielding and will bend instead of break, are versatile, and they look quite handsome when finished.

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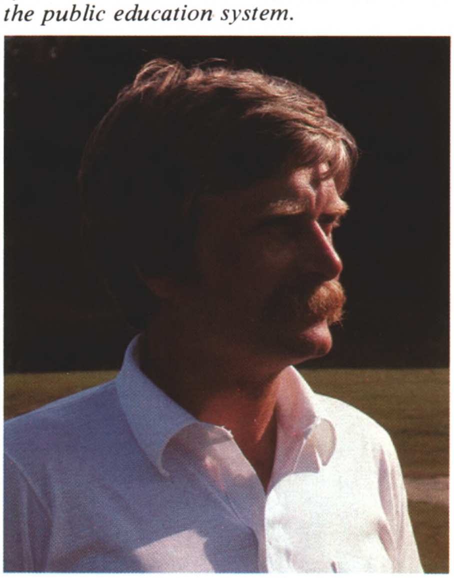

Overseeding Bentgrass Greens – Is It Worth It?

by **BRIAN SILVA**
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"I TRIED THAT a couple of years ago and didn't see any results." Unfortunately, that's often the response to a suggestion for annually overseeding bentgrass to bentgrass greens. But remember, "one summer a seeding does not make." On closer examination, the long-term possibilities for green improvement and eventual success should not be even slightly overlooked.

There are many advantages to overseeding greens. Improved color, putting speed, shot-holding capability, as well as rapid recovery from injury are among the leading ones. Add to these the factors of increased uniformity and consistency of putting surfaces and a formidable, favorable argument begins to take shape.

Putting greens that have become a patchwork quilt of different bentgrasses and *Poa annua* varieties pose an unusual problem for the golf course superintendent. The various grasses and types respond differently to basic management practices, such as fertilization, topdressing, vertical mowing, and even pesticide applications. A variable response to environmental factors such as temperature is also noted. An annual overseeding program would encourage the development of greater uniformity with regard to the grass species and variety which predominates on a putting surface.

We often ask the impossible of greens originally planted to bentgrass. In many instances, these greens receive no additional desirable seed after they become established. This is the case even though annual bluegrass consistently produces vast quantities of new seed each season. Expecting the existing bentgrasses to compete solely on a vegetative basis with annual bluegrass may be expecting far too much. A vigorous annual bentgrass overseeding program can play an integral role in a maintenance scheme designed to favor the growth and development of bent and at the expense of *Poa annua* encroachment.

While many superintendents appreciate the advantages associated with annual overseeding, many of them hesitate to introduce still another variety into their putting greens. This is especially true on greens originally planted to velvet bentgrass or vegetative creeping bentgrasses such as Arlington and Congressional. However, close examination of greens originally planted to these specific grasses often reveals a less-than-claimed degree of purity. For example, many velvet bent greens often contain as much creeping bentgrass and annual bluegrass as they do velvet bent. Additionally, many greens planted vegetatively to two or more strains of creeping bentgrass have suffered separation and take on the patchwork appearance mentioned earlier. An overseeding program would provide a blending of grasses and greater uniformity of putting surfaces. Just as importantly, proper maintenance practices will yield more consistent and predictable results.

By now you are probably ready to jump on the bandwagon and wave the banner for annual bentgrass overseeding. Right? Wait a minute! Certain questions and techniques first merit your attention.

ONE OF THE keys to good germination from any seeding program is the development of proper seed to soil contact. On a new green, or on a project where complete renovation is in order, the development of excellent seed-to-soil contact is achieved with relative ease. However, when overseeding is carried out on an area of actively growing turf, the seed-to-soil contact becomes more difficult.

Any one of a number of techniques, or a combination of them, will work. If you are dead serious about a bentgrass overseeding program, consider first the use of a small, power-driven slicer-seeding machine that places the seed slightly below the putting surface. Special thin colters are available that barely disturb the surface. Very successful results have been obtained with this technique.

Soil cultivation, i.e., aerification, is another frequently used practice in gaining seed/soil contact. The soil cores should be removed and a drop seeder used for the sowing. Follow this with a moderate topdressing of desirable quality and then slowly mat or drag the material into the open aeration holes. *Slow* dragging is far preferable to the racetrack technique, and it doesn't disturb the original putting surface as much.

Depending on the time you have available and the prevailing weather conditions, you may wish to carry out a moderate vertical mowing program immediately after removing the soil cores as mentioned above. The vertical mowing should be carried out to a depth which will bring a small amount of previously applied topdressing or soil material to the surface of the greens. After removal of the thatch debris and/or soil material brought to the surface, the holes resulting from aerification and the slight grooves caused by vertical mowing will allow an infinite number of seeds to make good soil contact.

Spiking or slicing greens with mechanical disk spikes will also produce a good seedbed for overseeding. It will require at least three or four passes over the putting green — more if possible — before actual seeding is accomplished.

Remember, overseeding is taking place on actively growing turf. This allows less than optimal conditions for germination and the growth and development of new seedlings. An intensive soil cultivation program, combining aerification, vertical mowing, and spiking will prepare a better seedbed and reduce the level of competition imposed by actively growing turf. The relatively moderate topdressing which follows overseeding will permit acceptable putting conditions. Once the seed is in the ground, very light syringings for two or three weeks throughout each day will aid in higher germination percentages.

AS TO THE seed itself, one of the improved creeping bentgrass varieties is recommended. Penneagle or Penncross would represent a good choice, because they have an aggressive growth rate, which allows them to germinate and develop under less than ideal seedbed conditions. Once established, their aggressive nature will offer an increased level of competition against the ever-present annual bluegrass.

Much has been made of the tendency for such aggressively growing grasses to thatch and become puffy under putting green conditions. However, contemporary putting green maintenance practices, including light and frequent topdressing, light vertical mowing, and judicious use of nitrogen, will keep thatch accumulation in check.

Obviously, seedling mortality will be high. While the chances of overseeding success increase with the intensity of seedbed preparation, relatively high seeding rates should be used. Additionally, if you wish to shorten the time for higher bentgrass populations, overseed twice annually. Minimum seeding rates of two pounds per 1,000 square feet for the grasses suggested above are recommended. On a golf course with average-size greens, this seeding rate means an expenditure in excess of $1,000 per seeding per year. Just for a minute, though, consider the expense involved in maintaining greens through the summer stress period that are comprised mainly of annual bluegrass. The extra syringing and fungicide treatments add up quickly, and substantially. Better yet, imagine the cost in actual dollars and inconvenience associated with a set of greens that come through a winter in poor shape after annual bluegrass has exhibited its all too famous susceptibility to winter injury.

The timing of overseeding is critically important. While spring and fall might be the accepted times for propagating turf on a new site by seeding, they are not the best times for overseeding existing turf. Cool soil temperatures in the spring and fall, plus extreme competition on the part of annual bluegrass, render these periods inappropriate for overseeding. Carried out in the summertime, however, before the prime germination period for *Poa annua*, overseeding can give bentgrass seedlings an increased level of competitive ability. Soil temperatures at this time will also allow excellent germination, while diligent irrigation and fungicide treatments can improve seedling survival.

THE IDEAS behind overseeding sound great. Conditions of surface uniformity and consistency on greens can be improved. Greater competition on behalf of the desirable grasses can be gained against the encroachment of annual bluegrass. However, these results will never be realized by a one-shot effort.

A sound overseeding program must be carried out on a continuing and annual basis. Frequently we are asked how long the program should last. Is three years enough? Is five years too long? The best answer seems to be to initiate and continue an annual overseeding program as long as it is necessary to keep bentgrass in the dominant role. This may well take many, many years, but then in agriculture, only crop *failure* comes about overnight.

And you can count on one more fact. The results gained from overseeding will not be immediate. Three or four years may be required before you even see a hint of progress. However, if you persevere, you will improve bentgrass populations and uniformity throughout your putting surfaces. Without annual overseeding, your present putting surfaces will, at best, remain static. The more desirable grasses will be competing on a vegetative basis and, generally speaking, this is a losing proposition. Expect annual bluegrass encroachment. In many cases, the initiation of overseeding will challenge a distorted equilibrium that has developed over the years and favors annual bluegrass populations. It will take time to shift this equilibrium, but a shift will surely take place through overseeding and altered maintenance practices.

If you are attracted by greens dominated by creeping bentgrasses, an annual overseeding program deserves your further investigation.

One of the best ways to overseed bentgrass into a "bentgrass" green.

TURF TWISTERS

"STOP" IN THE SUMMER — "GO" IN THE FALL

Question: I have been using preemergence herbicides on our bermudagrass tees to control silver crabgrass, or goosegrass, through the summer. Now I want to overseed the same tees (and collars) for the winter. Will I be successful? Has the preemergence material dissipated by now? Will it harm my overseeding? (Virginia)

Answer: Yes. Hard to say. Maybe. But regardless of these answers, there is a possible way to cancel out the lingering effectiveness of the preemergence herbicide. A week or two before overseeding, apply activated charcoal to the herbicide-treated areas. The suggested rate is two to three pounds per 1,000 square feet.

A ONE-POINT-FIVE

Question: In my area, sand and gravel companies sell their products by the ton. In the Green Section Specifications, you list sand and gravel needs by the cubic yard. What's the correct conversion factor? (California)

Answer: In days of old, sand and gravel were sold by volume. These days, most trucking companies base their charges on weight and not volume. A standard figure of 1.5 is generally used for converting yards of sand or gravel to tons. For example, if recommendations call for 10 cubic yards of sand, simply multiply by 1.5 to find the approximate tons of sand required (in this case, 15 tons). Oh yes, also be wary of "wet loads."

ANTI-FREEZE CALL

Question: Is potash helpful in the fall for improving bermadagrass winter hardiness? (South Carolina)

Answer: Potash is extremely important for improving winter hardiness of bermudagrass. When potash is applied and taken up by the bermudagrass plant, the freezing point of all fluids is depressed and water is driven out of the cells. Thus, potash acts as an anti-freeze. About four weeks before the first expected frost, apply potash at 1 to 1½ pounds per 1,000 square feet to improve winter hardiness.