Topdressing greens

By Ernest L. Kallander, Stony Brook Golf Course, Southboro, Mass.

Since my articles on the effect of sand and sand mixtures were published in this magazine 1979 and 1980 showing the uselessness of high quality sand to promote permeability, for the average green, I have had other misgivings when sand is the sole component.

Having refrained from the use of 100% sand after our greens were built thirteen years ago, and having many compliments on their quality, I decided to test the effect of the various other materials combined with sand. At first, we simply used the same material left over from which the green's top soil was constructed, viz: 67 percent sand, 24 percent clay loam and 9 percent peat. This was the mixture selected after tests made on our materials at Agri-Systems of Texas by Marvin H. Ferguson, employing their newly-designed percolations tests. I did not accept their recommendations completely because by actual growing tests made here (Southboro) I found that I would be watering and fertilizing much too often in order to keep the plants alive. I think we struck a fortunate balance because while the initial permeability was but 1 to 1.5 inches per hour, it has climbed to about 4 inches per hour now.

How? I think it is due to the agglomoration of the fine particles. I don't know exactly what has promoted this phenomenon but I suspect these factors: use of minimum fertilizer (last year only 3 lbs. N per 1,000 sq. ft.), practically no insecticides, sparing use of fungicides and the application of moderate amounts of gypsum ($CaSO_4$). I have appended some notes to explain the effect of gypsum. Also, we have a moderate amount of earthworms and blackbirds aplenty. Their drill holes don't bother anyone. We have never had to aerate but resort, once a year, to dethatch which I suspect is more a ritual than a necessity.

Experimental

After using up the original top soil, we tried using sand but couldn't get it to feed through our spreader without drying it up with terragreen. It took about 20 percent to make the sand flow well enough. But the mixing paid off in other ways. It permitted us to incorporate wood ashes, with their valuable potash and almost colloidal silica, etc., to correct pH with limestone, and to promote agglomeration with gypsum. You'd think that we'd ruin permeability with all this junk? Wrong. Agglomeration took care of all the fine particles. How did I know? Not only did the percolation improve but when I took samples of the soil I could easily distinguish the pellets, about the size of BB shot. When dried, though quite hard, you could crush them between your fingers into powder. Don't they get crushed by foot traffic? I find no evidence of this. Besides, they are buried by a resilient layer of turf.

What else is lacking in the use of straight sand? To anyone who has had to grow crops, the answer is obvious. You need clay or some clay-like material to supplement the humus that you are trying to dilute:

1. To firm up the turf to increase fastness of roll;
2. Promote breakdown of the dead and dying roots and stems which, in the live plant, consists of about 65 percent cellulose and 35 percent lignin. The cellulose will get chewed up by action of bacteria, etc. to promote hydrolysis into its original components, carbon dioxide and water. The lignins will be left behind— also called humus;
3. And, most importantly, maintain the ability of the built-up layer to nourish the grass without increased use of water and fertilizer; a factor that I will show is sadly lacking in a straight sand top dressing.

So, looking toward the future, with continued use of top dressing, what kind of composition will we have ten or so years from now? To answer this question, I set up some experiments to be described. They are based on the very good assumption that we will end up having a (a) large amount of top dressing with respect to humus, (3 to 1) or (b) moderate amount, or (c) a small amount, (1 to 3). This gives us a nine fold spread of one component with respect to the others. Shown on table 1.

Tests for percolation on these compositions, shown on Plate 1 and Table 3, reveal the expected result: the more the mineral (sand plus modifier, if any), the lower the percolation, but that even at 50 percent concentration, the lowest formulas (4, 5, 6) are plenty high.

As for resistance to compaction, each series is close to the others. If greater precision is required, as in the case of Vermiculite, you can use more top dressing to obtain more resistance. See Plate 2.

As for their ability to hold

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TABLE 1. Compositions and C.E.C. Values (x100)

Soil no.		1	2	3	4	5	6	7	8	9	10	11	12
H.Q. Sand	Vol.	33	50	67									
	grams	195	390	585									
	CEC	0	0	0									
BM Sand	Vol.				25	38	50	25	38	50	25	38	50
	grams				145	290	435	145	290	435	145	290	435
	CEC				0	0	0	0	0	0	0	0	0
Peat Moss	Vol.	67	50	33	67	50	33	67	50	33	67	50	33
	grams	36	24	12	36	24	12	36	24	12	36	24	12
	CEC	40	26	13	40	26	13	40	26	13	40	26	13
Clay	Vol				8	12	17						
	grams				50	100	150						
	CEC				30	60	90						
Vermiculite	Vol							8	12	17			
	grams							4	8	12			
	CEC							6	12	18			
Terragreen	Vol										8	12	17
	grams										16	33	50
	CEC										9.6	19.8	30
Gr. Limestone	grams	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Gypsum	grams	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total CEC	values.	40.0	26.0	13.0	70.0	86.0	103	46.0	38.0	31.0	49.6	45.8	43.0

nutrients, they were evaluated from two standpoints.

1. Their *immediate potential* , as indicated in Table 1, which shows that the use of clay to replace 25 percent of the sand is best, followed by calcined clay (Terragreen) and then Vermiculite. Even the latter possesses nearly twice the capacity of straight sand.

2. Their *capacity for retention of nutrients* as shown by Table 2. Note that the use of 25 percent clay has doubled the retentive power for NH_4. NO_3 was not improved nor could it be expected to, as pointed out to me by Mr. Niclows, Suburban Experiment Station, Waltham. All other nutrients, however, are correspondingly better.

What is new about these ideas? Nothing. Every greenkeeper around here has been top dressing with loam. I'd rather that most would have selected a loam high in sand, intuitively. The only change I'd propose is to eliminate the loam because it contains humus that you don't need; it is that which you are trying to reduce. Furthermore, the literature is full of data on the virtues of clay and this is an attempt to utilize it precisely, without its drawbacks. It is only recently that the agglomerated clay, in the form of Vermiculite and calcined, has become available. For what reason? Because of the necessity of providing its absorbent power in a form easy to use and without the need for careful adjustment inherent in raw clay.

Description of materials

1. HQ (high quality) Sand (recommended by U.S.G.A.), having a particle size largely in the range of 0.1 millimeter to 1.0 millimeter. Supplied from Slatersville, R.I., 9/79, called No. 50 at $13.75 delivered. Has precolation rate of about 50.
2. B.M. (brick mortar) sand, having a particle size of .075 millimeter to 1.0 millimeter, and about 7 percent smaller than .075 supplied locally for about $4.00, 9/79, with a percolation of about 50.
3. Clay, mined locally, almost white, and has been used to make common brick. Has a percolation value of 0.6 and 44 percent is through 200 mesh.
4. Vermiculite No. 4 supplied by W. R. Grace (their smallest size available).

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PLATE 1.— Percolation

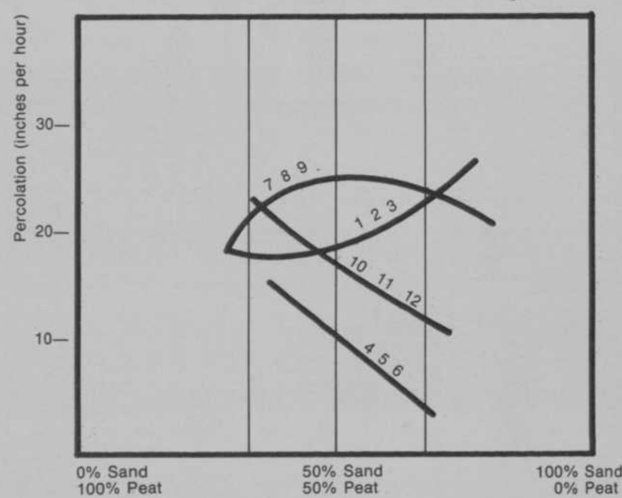

Table 3. Percolation Results
Compositions described in Table 1

Sample No.	Inches per hour 1st	2nd	Avg
1	18.0	15.4	16.7
2	18.2	14.7	16.5
3	23.7	24.0	23.8
4	16.6	11.5	14.0
5	8.3	10.2	9.2
6	3.6	2.7	3.2
7	18.0	10.8	14.4
8	27.5	24.0	25.7
9	19.6	18.2	18.9
10	22.2	19.9	21.0
11	19.7	11.4	15.5
12	10.6	5.9	8.2
GS*	3.4	3.2	3.3
GS	3.0		

* Sampled from New Green Reconstructed in lab.

PLATE 2.— Indentation

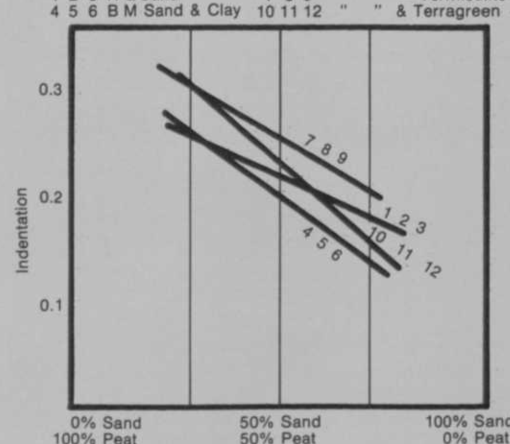

Table 2. Nutrient Analysis of Leached Soils

No.	NH_4	NO_2	P	K	Ca	Mg	Zn	Al	pH
2	6	10	0.77	25.7	144	15.4	2.1	2.1	5.5
5	12	10	2.04	36.4	158	17.3	5.1	6.1	5.6
8	18	10	1.81	38.3	199	31.6	11.8	3.8	5.7
11	24	10	2.75	58.8	342	32.7	4.4	3.4	5.5
NG	10	6	2.90	25.6	136	16.1	4.4	15.9	6.3
Jiffy	48	10	9.70	69.6	523	272	3.7	1.85	6.5
Rec. Levels									
High	24	75	25	200	1600	150	70	200	6.5
Low	6	10	2	50	300	20	3	40	6.5

NH_4 added initially to the extent of about 60 p.p.m. in a balanced fertilizer.

The above figures furnished by Soil Analysis Lab, Suburban Field Station, Waltham, MA.

5. Terragreen, calcined montmorillinite clay supplied by Oil-Dri Corp. A similar material is made by I.M.C. called Turface (to be investigated).
6. Ground Limestone having 34 percent CaO, 1.5 percent MgO.
7. Gypsum, hydrated $CaSO_4$ by U.S. Gypsum, finely ground.
8. Peat Moss, labeled Mr. Peat and supplied by Agway, dried and sifted through ¼ inch screen and then ground to about 1/8 inch.

Nutrient analysis of leached soil

The samples prepared in our procedure and leached as in Set 2 with 23.6 inches of water, were analyzed by our Cooperative Extension Service in Waltham, Mass.

Examination of their results, shown in Table 2, reveal an increasing amount of NH_4 in going from sample 2 (no addition to the sand), to No. 5, in which 25 percent of the sand has been replaced by clay, and further to No. 8, using Vermiculite, and finally to No. 11, using Terragreen (calcined clay). A similar effect is shown for K (potassium), for Ca (calcium) and Mg (magnesium).

It appears clear, therefore, that these additions possess valuable powers for retaining nutrients; powers that are utterly lacking in sand.

It will be remarked that in all specimens the NO_3 content is low, which is to be expected since there is little, if any, cation content which is necessary in order to absorb anions such as NO_3. There is an abundance of anion content to absorb cations such as NH_4, K, Ca, Mg., etc.

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Effect of gypsum and alum

The effect of gypsum and alum to cause coagulation, or agglomeration of clay particles can be demonstrated visually, and quickly, as follows. I took three portions of clay, dispersed each in a glass of water. To glass No. 2, I added a pinch of gypsum ($CaSO_4$) and to No. 3, a pinch of alum ($Al_2(SO_4)_3$). After about one minute, No. 1, untreated, was still very cloudy whereas No. 2 and No. 3 were fairly clear and a noticeable precipitate had formed. The precipitates were weighed and No. 2 and No. 3 were twice the weight of No. 1.

Each sample was contained in the same cylinder used for percolation test, viz: A depth of 5 in. times an area of 5 in. gives a total volume of 25 cu. in. They were saturated with water and allowed to drain for 3 days. All tests were performed at room temperature.

Each was placed on a solid support and subjected to initial compaction by allowing a 4-lb. weight to drop 6 in. three times over the entire area (5 sq. in.), resulting in an expenditure of energy 3 times 6/12 times 4 equals 6 ft. lbs.

They were then subjected to the compression test by measuring the depth of penetration of a cylinder (rounded at the edges) 3/4 in. diameter, area 0.44 sq. in. and weighted 6 lbs. The resulting pressure was then 6/44 equals 13.5 lbs. per sq. in. (a man's bed pressure would be about 10 lbs. per sq. in.) The duration of pressure was 30 seconds. Results are shown on Plate 2.

Inspection of Plate 2 shows that, as expected, resistance to compaction is increased by mineral content. It indicates, further, that a composition of sand containing some clay increases resistance more rapidly, i.e., less is required to achieve the same resistance, resulting in a large saving in cost of top dressing and with better qualities otherwise, as discussed elsewhere in this report. The use of Terragreen does not appear to affect compaction more than straight sand, whereas Vermiculite has less affect. However, as shown on Plate 2, all may be equated with each other depending on how much top dressing you decide to use.

The skilled greenskeeper will adjust his top dressing to adjust for the level of softness he wants. He will not use too much, else his greens will not "hold" when at a normal water

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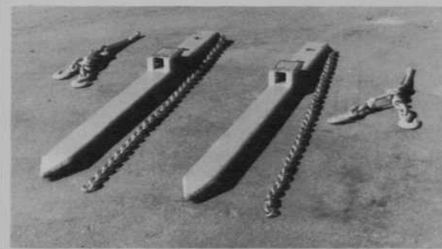

content. Nor will he use too little else his "fastness" of ball roll will be too slow.

Growth tests on leached compositions

Procedure

Samples of soils, Nos. 2, 5, 8, and 11 described in Table 1, in which the ratio of peat moss to granular material was 1 to 1 (by volume) were treated as follows:

Set 1

Placed in pots 3 x 3 x 2, saturated with water and allowed to drain one day, then treated with a solution of fertilizer analysing 23-19-17. The amount was calculated to be the equivalent of 6 lbs. N per 1,000 sq. ft. It figured to be 0.4 gms. of fertilizer per pot containing 18 cu. in. of soil. This was dissolved in about 1/4 cup. Successive portions of 1/4 cups of water was added to leach out the fertilizer to the extent that 4.8 inches of water had been applied. Each pot was then seeded with Seaside Bent grass 1/14/81 and examined 1/20/81, 6 days later to find all seeds had germinated. The growth observed is as follows:

		2	5	8	11	N.G.*	J.**
2/15	relative amounts of clippings	6	6	5	6	7	8
2/23	condition	5	6	7	8	8	9
2/26	"	5	6	7	8	7	9

*new greens soil
**Jiffy Potting Soil
rated 1 = low, 9 = high

Set 2

Another set of pots was made up, similarly fertilized and subjected to leaching to the extent of 23.6 inches. By 1/23/81, all had germinated and by 1/26/81 were growing well except N.G., which appeared weaker and finally succumbed. I suspect the fungicide Dexon was insufficiently buffered by the low peat content.

Calculation of fertilizer content

per Clark W. Nicklow, Suburban Experiment Station, Waltham

"The application of 1,000 lbs. NH_4NO_3 per acre is equivalent to 112 p.p.m. (parts per million) of soil".

I deduce from this that 1 acre, 44,000 sq. ft., 6-in. deep contains about 20,000 cu. ft., which, at 100 lbs. per cu. ft. would contain about 2,000,000 lbs.

Since NH_4NO_3 is 22.5 percent NH_4, the amount of NH_4 in 2,000,000 lbs. would be 225/2,000,000 or about 112 p.p.m. lbs. per million of soil.

The ration of p.p.p. to lbs./acre is 1:2. Therefore, if we have an analysis of 24 p.p.m., equivalent to 48 lbs./acre.

Commentary:

I am puzzlied that no one has published any procedure similar to mine and I regret this situation because when I talk about percolation tests, I feel like I am talking in a vacuum. I adapted it to determine permeability directly on turf and this procedure can also be carried out with very ordinary materials. The rather messy calculations could be simplified by means of charts. **GB**