BUYING FERTILIZERS FOR TURF

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Thousands of tons of fertilizers are applied annually to turf in the United States. Some turf culturists are familiar with the needs of turf and with the relative value of fertilizers. Many, however, have but vague notions of what to apply and how to buy advantageously, and are confused by the large number of grades of fertilizers on the market. Salesmen urge the use of certain brands said to be complete foods for grass. These may be good fertilizers but the prices often charged are not warranted by the value of the contents. The buyer usually pays well for a widely advertised name, whereas he may often buy at a great saving the equivalent amount of plant food in a standard grade of fertilizer without a fancy name.

Many of those who use fertilizers on turf do not understand the terms used in the trade. Consequently, they are likely to be confused by any discussion of fertilizers and easily deceived by statements concerning them. Although there are many complicated technical phases of fertilizers and their most effective utilization, the subject as it need concern the buyer for turf purposes is by no means as complicated and awe-inspiring as it is sometimes presented.

It is the purpose of this discussion to present the subject of selecting and buying fertilizers in as simple terms as possible in order that those who are responsible for the spending of the usually inadequate funds for turf fertilizers may use those funds to the best advantage. Throughout this discussion it is assumed that the principles of fertilizing turf as discussed

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in the article by Bengtson and Harrington on pages 142 to 154 of this issue are understood by the reader.

Analysis, Grade and Formula

In the trade, the amount of nitrogen present in mixed fertilizers is expressed in terms of percentage of elemental nitrogen (N), that of phosphorus in terms of percentage of phosphoric acid (P_2O_5) and that of potassium as percentage of potash (K_2O). The percentage composition of each mixture of fertilizer is determined by chemically analyzing the product. To protect the consumer, laws in 47 out of the 48 states provide that every bag of fertilizer must be marked with a statement which shows the minimum percentage of each of the principal nutrients contained in the bag. These percentages are now always given in the order: nitrogen, phosphoric acid and potash. This minimum analysis is known in the trade as the grade of the fertilizer. The actual analysis may show a higher percentage of the nutrients than that guaranteed on the bag.

A grade of 6-6-5, for instance contains not less than 6 percent nitrogen, 6 percent phosphoric acid and 5 percent potash. A 6-0-5 grade contains at least 6 percent nitrogen and 5 percent potash but no phosphoric acid, whereas a 6-6-0 grade contains 6 percent nitrogen and 6 percent phosphoric acid but no potash.

It is important that the buyer of fertilizers for turf understands the meaning of the grade and looks for it on the bags of each lot of fertilizer purchased. The grade not only helps him to calculate the quantity to be used but also enables him to figure the relative money value to him of different mixed fertilizers.

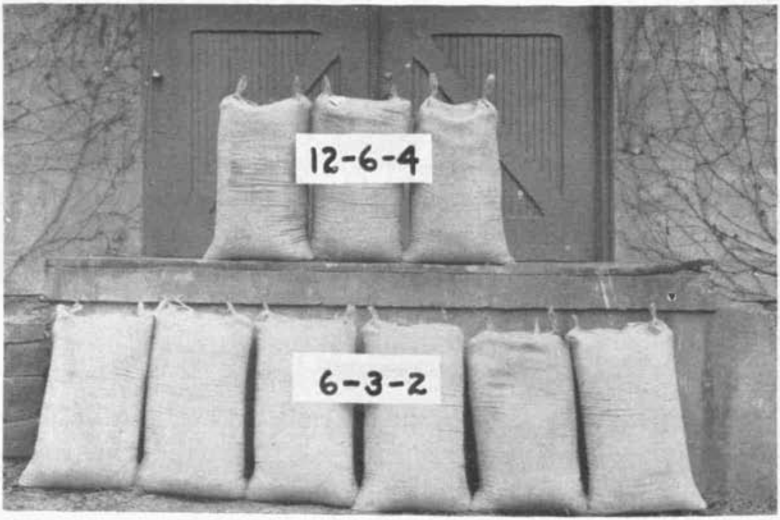
Mixed fertilizers are rated as high and low grade according to the number of units of plant food in the mixture. One percent of plant food in a ton of fertilizer is known as one unit. A 6-6-5 fertilizer contains 6 units of nitrogen, 6 of phosphoric acid and 5 of potash, or a total of 17 units. In general a fertilizer containing about 20 or more units of plant food is considered a high grade fertilizer.

The analysis on the bag gives the minimum percentage of each of the plant nutrients but it does not furnish information regarding the materials (carriers) which are used to carry these nutrients. This information is given in the formula which may or may not appear upon the bag. The formula gives the number of pounds of each carrier which has been used in making up the fertilizer.

Fertilizers for Turf

As described in articles in the December, 1939, issue of Turf Culture a 6-12-4 fertilizer has given about the same results as a 12-6-4 when the two were applied at rates giving the same quantities of nitrogen to each unit area. The same amount of nitrogen was applied with one-half as much of the 12-6-4 as the 6-12-4 fertilizer. While a 12-6-4 was used in the experiments a 6-3-2 might have been used. To simplify the comparison of these two fertilizers therefore, they may be considered in terms of the two grades 6-12-4 and 6-3-2. Both contain equal quantities of nitrogen but the 6-12-4 contains four times as much phosphoric acid and two times as much potash as the 6-3-2. Naturally a ton of 6-3-2 is exactly equivalent to one-half ton of a 12-6-4. The fact that the effect on the turf was about the same whether a 6-3-2 (12-6-4) or a 6-12-4 fertilizer was used indicated that at least on these soils small amounts of phosphoric acid and potash were as effective as large amounts.

Similar results might have been expected from the use of a 10-6-4, a 6-6-5 or many other grades commonly carried in



The three bags of 12-6-4, a high grade fertilizer, furnish as much plant food as the six bags of the low grade fertilizer, 6-3-2.

stock by fertilizer dealers had they been applied so as to give equivalent quantities of nitrogen.

These and numerous other experiments indicate that a mixed fertilizer for turf purposes should be high in nitrogen, need not contain more than one-half as much phosphoric acid as nitrogen and requires only a small percentage of potash. In many cases a fertilizer with no potash at all gives equally satisfactory results.

The user of mixed fertilizers in large lots will do well to study both analysis and price so as to determine the grade that will give the desired results at the lowest cost. The price of standard mixtures is largely determined by the nature of the carriers which were used for the different elements. Organic materials are usually more expensive than the inorganic. It has been calculated, for instance, that at present the cost of nitrogen in sulfate of ammonia is less than half that in the natural organic materials. This means that a mixed fertilizer in which the nitrogen comes from sulfate of ammonia should cost less than one in which the nitrogen comes from tankage, cottonseed meal, or some other natural organic material. The tendency of the fertilizer trade has been in the direction of greater economy. In 1910 statistics showed that 55 percent of the nitrogen in mixed fertilizers came from natural organics, while in 1936 only 15 percent came from these sources.

Cost of Fertilizers

Another factor which affects the cost of mixed commercial fertilizer is the labor involved in mixing the ingredients. The smaller the amount of mixture which is prepared, the greater is the proportionate expense of the mixing, since it costs little more to mix a large quantity than a small quantity. A specially prepared mixture may therefore cost more for each unit of plant food than a standard grade. If a standard grade high in nitrogen is available locally it will probably be more economical to use it than to have a special grade made. Unfortunately most of the standard grades offered are prepared for use with farm crops and are relatively too high in phosphoric acid and potash and too low in nitrogen for economic use on sports turf. For park areas and for many lawns where some white clover is not objectionable it may be depended upon for a part of the nitrogen and a fertilizer lower in nitrogen than that which is most satisfactory for sports turf may be used.

The actual cost of the ingredients for each unit of nitrogen, phosphoric acid and potash may be calculated. For example, in 1938, the prices per unit of plant food in the New York district were the following:

Nitrogen	$1.90 a unit
Available phosphoric acid	.70 a unit
Potash	.60 a unit

Such prices vary from year to year and place to place and therefore the actual values of these figures are of little use. Nevertheless the cost of nitrogen as compared with that of phosphoric acid and potash remains more or less constant and these relative costs are demonstrated in the figures cited. From these figures it can be seen that nitrogen is the expensive part of a fertilizer and that any mixture which is high in nitrogen will generally be more expensive than one low in nitrogen.

For example, two grades with which the Green Section has been experimenting, 12-6-4 and 6-12-4, each have 22 units of plant food. The first has 12 units of nitrogen, 6 of phosphoric acid and 4 of potash. Calculated on the basis of the 1938 cost figures given above for the New York district, the ingredients in a ton of this mixture would cost $29.40 as compared with $22.20, the cost of the ingredients in a ton of the 6-12-4 mixture.

In this latter mixture there is only half as much nitrogen. To apply 12 units of nitrogen it is necessary to use 2 tons of the 6-12-4 grade at a total cost of $44.40 as compared with 1 ton of the 12-6-4 grade at a cost of $29.40.

Figuring Comparative Costs

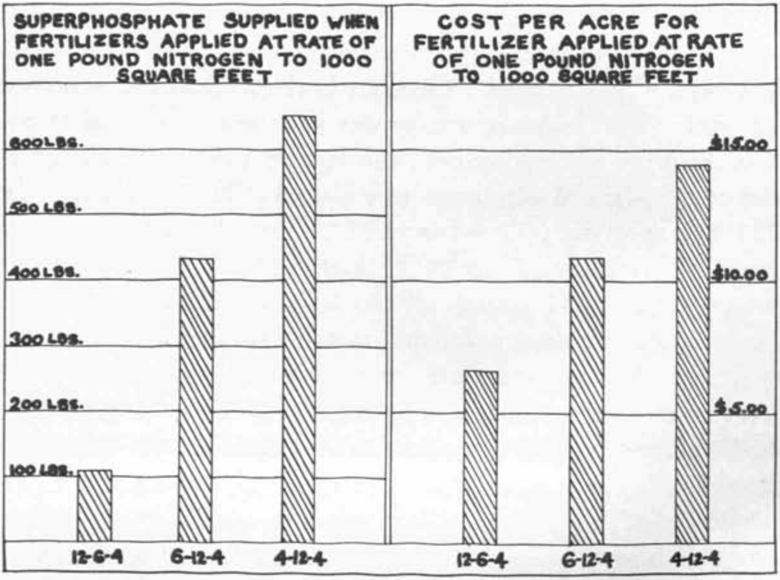
Perhaps the most satisfactory basis for comparing the cost of fertilizing turf with several different fertilizers is the cost per acre of applying nitrogen at the rate of 1 pound to 1,000 square feet. This should include not only the cost of the fertilizer itself but also the labor of distribution and the losses involved in the process of distribution due to the physical condition of the product.

To illustrate the comparison in cost of fertilizers to apply nitrogen at the above-mentioned rate, the two fertilizers 10-6-4 and 4-12-4 may be used. These are both standard grades offered in 1941. The prices of the grades vary with the locality but for purposes of comparison the lowest price of each grade delivered in the Washington area is used. The 10-6-4 sells for $33.22 a ton; the 4-12-4 for $26.87. To apply fertilizer to an acre at the rate of 1 pound of nitrogen to 1,000 square feet would require 435 pounds of the 10-6-4 and 1088 pounds of the 4-12-4. At these prices and rates of application the 10-6-4 will cost $7.29 an acre and the 4-12-4 will cost $14.58.

Moreover, everything else being equal, it would cost more to distribute the 1088 pounds of 4-12-4 than the 435 pounds of 10-6-4. In considering the costs of distribution the physical properties of the product should not be overlooked. A product which is lumpy cannot be distributed uniformly or efficiently and when handled in a distributor may cause mechanical difficulties, and dry powdered products when applied on windy days may be blown into areas where no fertilizer is required.

A similar comparison can be made between any two fertilizers. When differences in the percentages of nitrogen are pronounced, as in this case, the differences in cost for a unit area are more striking.

Generally speaking the high grade fertilizers which are high in nitrogen are the most economical to use. Freight charges, mixing and distributing costs as well as other expenses incidental to the use of fertilizers are just as great for a fertilizer containing a low percentage of plant food as for one with a high plant food content. Therefore, although the original cost of the ingredients in a high-grade fertilizer may be higher than



for a low grade, the later handling costs may make it advantageous to use the higher grade. This is recognized by the trade which is now encouraging more and more the use of high-grade fertilizers. Many of the higher grades tend to burn foliage when they come in direct contact with it. In ordinary agricultural practice this objection is not serious, since the fertilizer is usually applied to the soil before planting. On turf the fertilizer comes in direct contact with the leaves and the danger of burning must be recognized. Extra care must, therefore, be exercised in applying high grade fertilizers to turf.

Home-Mixing of Fertilizers

There are conditions under which it is advantageous for the consumer to mix his own fertilizer. This is particularly true when facilities for mixing the ingredients are at hand or when help is available which is not being used for other purposes. One of the chief advantages in the home-mixing of fertilizers is that any desired formula can be prepared. The expense of labor is no greater in mixing a fertilizer high in nitrogen than one low in nitrogen.

In calculating the cost of mixing any particular fertilizer at home, several items must be considered in addition to the cost of the ingredients. These include the labor of mixing, the filler when needed, in some cases a conditioner to prevent the mixture from caking, and bags if the fertilizer is to be stored.

The cost of the ingredients for mixing the 12-6-4 inorganic fertilizer according to formula A on page 165 has been calculated from prices in the Washington area in February, 1941. These figures are given only as an illustration since prices in other localities and at other seasons may be more or less. The price of sulfate of ammonia delivered is about $41.25 a ton; that of superphosphate $17.50 and that of muriate of potash, $36.00. Using these costs and the figures for formula A in the first column of the table on page 165 it will be found that the cost of the ingredients to mix 1 ton of 12-6-4 fertilizer is $32.39. This does not include the cost of the 67 pounds of filler, bags or cost of mixing. The price of a 12-6-4 fertilizer in the Washington market by those dealers who keep it in stock is about $37.50 a ton. The difference between this price and the cost of the ingredients is approximately $5.00 a ton, out of which must come the cost of labor, bags, and filler.

Whether home-mixing will pay must be left to individual judgment. Where a special grade is wanted and is not available locally it may pay to buy the materials and mix the desired grade at home. Much will depend on how large an extra charge the manufacturer will make for a special mixture of a few tons. In some cases such extra cost may be absorbed by the manufacturer; in other cases it may be enough to warrant home-mixing.

The important fact to be borne in mind is that a fertilizer high in nitrogen will require fewer pounds to apply a specified quantity of nitrogen to a given area of turf than one low in nitrogen. If, therefore, the grade available is low in nitrogen it may be profitable to make up or to have made up a grade high in nitrogen even at a considerably higher price a ton. When soils are known to be decidedly deficient in phosphorus or potash the above principle naturally must be modified until such time as these deficiencies are corrected.

The mixing itself is a comparatively simple matter. The materials weighed out should be spread in layers usually the most bulky first and then thoroughly mixed. This may be accomplished by a mechanical mixer or simply by shoveling over and over again. The mixture should then be screened so as to remove any lumps which remain, bagged and set aside. Where permanent employees must be kept busy, mixing fertilizers is a good job for days when outside work cannot be done. In that case all the labor expense of mixing is really saved.

Suggested Formulas

For the benefit of those who are interested in mixing their own fertilizers, several different formulas are suggested for the

Formula A. 12-6-4 Inorganic Fertilizer

Carrier	Total Pounds	Ingredients in Pounds N	P_2O_5	K_2O
Sulfate of ammonia (20% N)	1,200	240		
Superphosphate (20% P_2O_5)	600		120	
Muriate of potash (60% K_2O)	133			80
Filler	67			
Total	2,000	240	120	80

preparation of a 12-6-4 mixture. In experimental work at the Arlington Turf Garden and elsewhere fertilizers made up to this analysis have given satisfactory results with turf over a period of some 10 years or more. The essential difference between the three formulas is in the source of the nitrogen. Formula A is composed entirely of inorganic salts with some filler such as sand, or ground peat. Formula B derives about 20 percent of its nitrogen from activated sludge (Milorganite) the use of which obviates the necessity of using any filler. In Formula C several different organic sources of nitrogen and phosphorus are used. In this latter formula the nitrogen from activated sludge and from bonemeal is slowly available whereas that from urea is quickly available. Cottonseed meal, castor bean pomace or similar materials can be substituted for the activated sludge in Formulas B and C.

FORMULA B. 12-6-4 ORGANIC AND INORGANIC

Carrier	Total Pounds	Ingredients in Pounds N	P_2O_5	K_2O
Activated sludge (6% N + 2% P_2O_5)	825	50	16.5	
Sulfate of ammonia (20% N)	825	165		
Ammophos (11% N + 48% P_2O_5)	215	24	103.	
Muriate of potash (60% K_2O)	135			81
Total	2,000	239	119.5	81

FORMULA C. 12-6-4 ORGANIC FERTILIZER

Carrier	Total Pounds	Ingredients in Pounds N	P_2O_5	K_2O
Activated sludge (6% N + 2% P_2O_5)	1,080	65	22	
Steamed bone (2% N + 23% P_2O_5)	430	9	99	
Urea (46% N)	360	166		
Muriate of potash (60% K_2O)	130			78
Total	2,000	240	121	78

A mixture prepared according to Formula A should not stand long for it may cake.

METHOD OF CALCULATING OTHER FORMULAS

The above formulas are planned to give a fertilizer with an approximate analysis of 12-6-4. A formula for any desired fertilizer can be calculated by referring to a list of carriers and the quantities of each which must be used in a ton of fertilizer to give 1 percent of the nutrient concerned. Such a table is given on page 167. It will be noticed that some materials carry only nitrogen and some only phosphoric acid, whereas others contain appreciable quantities of both, and perhaps potash, as well.

In preparing mixed fertilizers from organic sources of nitrogen it should be remembered that the percentage of nitrogen and phosphoric acid in these materials is not uniform. Cottonseed meal may vary in nitrogen content from 3 to 7 percent, dried blood from 8 to 14 percent. When cottonseed meal is used as a source of nitrogen, every 672 pounds in a ton of fertilizer will add approximately 1 unit or 20 pounds of phosphoric acid. When bonemeal is used as a source of phosphoric acid a certain amount of nitrogen is also included. In raw bone-

QUANTITIES OF FERTILIZER INGREDIENTS EXPRESSED IN POUNDS TO BE USED TO GIVE DEFINITE PERCENTAGES OF NUTRIENTS IN A TON OF MIXTURE

Ingredient	1%	4%	6%	10%	12%
Carriers of Nitrogen (N)					
Nitrate of soda (15% N)	133	532	800	1,333	1,599
Sulfate of ammonia (20% N)	100	400	600	1,000	1,200
*Ammonium phosphate (11% N)	185	740	1,110	1,850	....
*Cottonseed meal (6% N)	333	1,333	2,000	....	....
*Raw ground bone (5% N)	400	1,600	....	....	....
*Steamed bone (2% N)	1,000	....	....	....	....
Dried blood (10% N)	200	800	1,200	2,000	....
*Activated sludge (6% N)	333	1,333	2,000	....	....
Urea (46% N)	435	174	261	435	522
Carriers of phosphoric acid (P_2O_5)					
Superphosphate (20% P_2O_5)	100	400	600	1,000	1,200
*Cottonseed meal (3% P_2O_5)	672	....	....	....	....
*Raw ground bone (23% P_2O_5)	87	348	522	869	1,043
*Steamed bone (23% P_2O_5)	87	348	522	869	1,043
*Activated sludge (2% P_2O_5)	1,000	....	....	....	....
*Ammonium phosphate (48% P_2O_5)	42	168	252	420	504
Carriers of potash (K_2O)					
Sulfate of potash (50% K_2O)	40	160	240	400	480
Muriate of potash (60% K_2O)	33	132	198	330	396

*Carries both nitrogen and phosphoric acid.

meal this may run as high as 6 percent. When bonemeal is used as a source of phosphoric acid, every 400 pounds in a ton of fertilizer may add a little more than 1 unit of nitrogen.

What Not to Mix

Certain substances which it may be desired to use on turf should not be mixed. The most striking case is that of hydrated or burnt lime and sulfate of ammonia. In the presence of water this mixture will cause a violent evolution of ammonia gas very toxic to grass.

When ground limestone is mixed with sulfate of ammonia, stable manure, cottonseed meal, bonemeal or activated sludge, small amounts of ammonia are gradually released, but not in sufficient quantity to be toxic to the grass. The chief danger in mixing these materials is the loss of fertility due to the gradual escape of nitrogen in the form of ammonia from the soil solution into the atmosphere. Dolomitic limestone, which is a calcium-magnesium limestone, can be used safely in mixed fertilizers to the extent of 200 or 300 pounds to the ton.

When lime, especially burnt or hydrated lime, is mixed with superphosphate the reaction causes a part of the phosphate to go into an insoluble form and reduces the value of the fertilizer. Lime mixed with bonemeal may cause a gradual loss of ammonia, as well as change a part of the phosphate into an insoluble form.

Calcium cyanamid mixed with superphosphate may give rise to toxic cyanide compounds. In fact, calcium cyanamid should always be applied alone and should never be mixed with any other fertilizer materials.

When it is desired to apply lime as well as the fertilizers