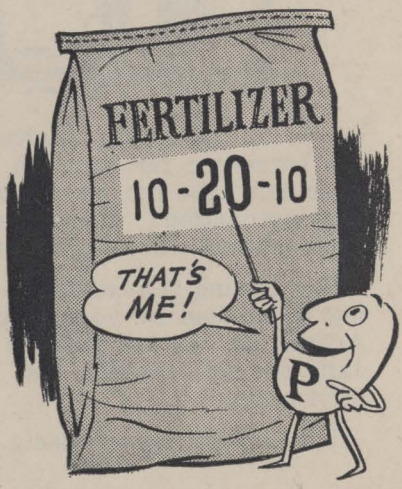
TEACHING RESEARCH SERVICE

UNIVERSITY OF IDAHO
College of Agriculture

FERTILIZER MATERIALS FOR IDAHO FARMERS

CHARLES G. PAINTER
G. ORIEN BAKER



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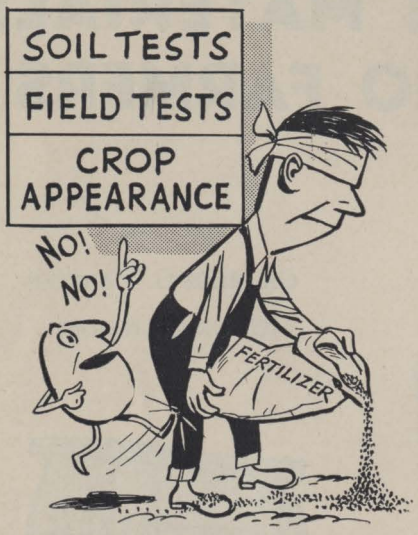

Don't Guess!

USE a soil test to determine the kind and rate of fertilizer you should apply. A small investment in a soil test may save you dollars by showing the correct fertilizer treatment.

A good soil test, used correctly, can tell a farmer many things. Is the soil too acid or too alkaline for growing certain crops? Do you need phosphorus, potash, or sulfur to balance soil fertility? Is the organic matter at a level that will give good soil structure for aeration and water penetration? Does your soil have too much salt or too much alkali for good crop production? These are some of the questions that a good soil test will help you answer.

Soil testing is available to any person in Idaho. Soil testing is handled by your University Agricultural Extension Agent. He can tell you the method of collecting and handling the soil samples, cost of analysis, and other detailed information.

Invest your money wisely in fertilizer.

Fertilizer Materials For Idaho Farmers

CHARLES G. PAINTER and G. ORIEN BAKER*

MANY new fertilizers have been put on the market in recent years. As a result, Idaho farmers have a wide choice of fertilizer materials to furnish plant nutrients needed for maximum crop production.

Knowing the characteristics of these materials will aid farmers in selecting the best fertilizer for their soils.

Fertilizers Supplying Nitrogen

More nitrogen is used in Idaho than any other plant nutrient. It is also the most expensive per pound of plant nutrient. Consequently, good judgment in selection of the carrier is very important in obtaining maximum returns on dollars invested.

Most nitrogen materials contain ammonium, ammonia, organic, or nitrate forms of nitrogen. Plants used only the ammonium and nitrate forms. Ammonia and organic forms of nitrogen are changed to the ammonium or nitrate forms before they are used by the plant.

AMMONIUM NITRATE — $NH_4 NO_3$

Commercial ammonium nitrate is a whitish, pelleted or granular material, containing 33.5 percent nitrogen. One-half the nitrogen is nitrate and the other half is in the ammonium form. Ammonium nitrate is usually prepared by changing ammonia to nitric acid and then neutralizing this acid with gaseous ammonia. The material is usually processed into shot-like pellets or granular fragments, an excellent material for spreading. It is entirely water-soluble and can be applied as a solution through irrigation water. This fertilizer has an acid effect on soils.

Natural ammonium nitrate absorbs water readily, but the material sold as fertilizer has had a conditioner added, so it will remain in good physical condition for many months when stored in waterproof bags. Under certain conditions this material is inflammable. Cautions on the use and storage of ammonium nitrate are printed on each container and should be heeded.

Ammonium nitrate flows freely through a spreader in dry weather, but when the air is moist it has a tendency to become sticky and feeds slowly. It is a good source of nitrogen.

* Soil Specialist, University of Idaho Agricultural Extension Service, Boise; and Soil Technologist, University of Idaho Agricultural Experiment Station, Moscow, respectively.

AMMONIUM SULFATE — $(NH_4)_2 SO_4$

This fertilizer contains about 21 percent nitrogen and 24 percent sulfur. It is made by mixing ammonia gas (NH_3) with sulfuric acid. Usually ammonia gas is passed through weak sulfuric acid and the sulfate of ammonia is crystallized out. After drying or granulation the fertilizer is ready for use. It carries the ammonia form of nitrogen and is adapted to areas where both nitrogen and sulfur are needed. It does not take up moisture during storage and has excellent physical qualities.

Ammonium sulfate is water-soluble and can be applied as a solution in irrigation water. It has an acid effect on soils.

It should not be mixed with superphosphate on the farm, as a chemical reaction takes place, resulting in a fertilizer of poor physical condition and poor spreading qualities.

ANHYDROUS AMMONIA — NH_3

Anhydrous ammonia is dry ammonia gas compressed into a liquid and held under pressure until used. Special caution should be taken when applying this material. High gas pressure and fume contact can cause severe burning and injury. The compressed ammonia contains 82 percent nitrogen, all in the ammonia (NH_3) form.

Most of this ammonia gas is produced by a synthetic process in which nitrogen from the air is combined with hydrogen. This hydrogen is usually a by-product of the gas and coke industry.

Anhydrous ammonia should be injected directly into the soil 4 to 6 inches deep. Special equipment for application must be purchased or rented. Custom application is available in most areas. Substantial losses may occur when ammonia is applied in irrigation water. This loss is more serious in alkaline water on alkaline soils.

Anhydrous ammonia temporarily increases the alkalinity, or pH, of the soil in the zone of solution-soil contact. After conversion to nitrate, this fertilizer leaves an acid effect on the soil. The fertilizer is a good source of nitrogen.

AQUA AMMONIA — $NH_4 OH + NH_3$

This fertilizer is a water solution containing the ammonium and ammonia forms of nitrogen. It is formed by passing ammonia through water, in which it is very soluble. Aqua ammonia usually contains 20 percent nitrogen and weighs 7.61 pounds per gallon. Water solutions of ammonia are unstable and rapidly lose ammonia when exposed to the atmosphere. Application methods follow the same principle used in anhydrous ammonia, except that the solution has to be pumped to the chisel points and usually is not injected as deeply in the soil.

Its effect on soil acidity is similar to anhydrous ammonia. Aqua ammonia is a good source of nitrogen. It is comparable in cost and value to anhydrous ammonia.

CALCIUM NITRATE — $Ca(NO_3)_2$

Commercial calcium nitrate has 15.5 percent nitrogen, all in the nitrate form, and about 19 percent soluble calcium. It is a white salt formed when limestone reacts with nitric acid. Calcium nitrate has an alkaline effect on soils and is well adapted to acid soils.

Calcium nitrate is granular and is completely water-soluble. It absorbs moisture when exposed to the air. Consequently, it is kept in air-tight bags. It should be spread on a dry day and the bags should not be opened until the time of spreading. Calcium nitrate costs more per pound of nitrogen than the more common nitrogen fertilizers.

CYANAMID — $CaCN_2$

This is a black material and contains about 21 percent nitrogen, 38 percent calcium, and 11 percent free carbon. Cyanamid is made by combining air, limestone, and coke under controlled temperature and pressure conditions. Cyanamid has an alkaline effect on soils and is highly soluble in water. Calcium cyanamid is marketed in both powdered and granular forms. Application through sprinklers is not recommended, due to its caustic properties.

The nitrogen in calcium cyanamid is in the form of cyanamid (CN_2), a synthetic non-protein organic nitrogen. When applied to the soil, it is converted rapidly into urea. After conversion to urea, it is further converted to nitrogen (ammonium and nitrate forms) by soil bacteria. In the breakdown stages cyanamid may be toxic to plants. Before seeding crops it is advisable to wait about 3 days for each 100 pounds of material applied per acre. Cyanamid should not be placed close to germinating seeds or plant roots.

This material is sometimes used as a soil sterilizer for killing molds and disease organisms. The degree of sterilization depends on the amount applied. Cyanamid is also used as a pre-emergence treatment for control of certain weeds and in defoliation of certain crops before harvesting.

UREA — $CO(NH_2)_2$

Fertilizer urea is a white, crystalline or pelletized material containing 45 percent nitrogen. The urea in this product is similar in chemical composition to that in animal urine. Called a synthetic non-protein nitrogen fertilizer, it is produced synthetically from ammonia and carbon dioxide under controlled temperature and pressure conditions. The material is completely soluble in water,

but the organic nitrogen must be converted to the ammonium and nitrate forms before it can be used by crops. Urea is rapidly converted into ammonium and nitrate forms of nitrogen when temperature and moisture conditions are ideal for bacterial activity. Urea should not be applied in large amounts close to germinating seeds or plant roots, as toxic effects may result.

Urea has an acid effect on soils. It is one of the better nitrogen fertilizers for foliar sprays and application in irrigation water.

AMMONIUM NITRATE-AMMONIA SOLUTION — $NH_4\,NO_3 + NH_3$

This nitrogen solution is made by passing aqua ammonia into a solution of ammonium nitrate. It contains 42 percent nitrogen and is applied as liquid material.

Since water solutions of ammonia are unstable, they should not be exposed to the atmosphere. Application should be 2 to 4 inches deep on alkaline soils. High losses would be expected if applied through irrigation water. They are similar in value to other aqua nitrogen solutions.

AMMONIUM NITRATE-UREA SOLUTIONS — $NH_4NO_3 + CO(NH_2)_2$

This nitrogen solution is made by mixing a solution of ammonium nitrate with urea. This produces a non-pressure liquid nitrogen fertilizer. It contains 32 percent nitrogen in the ammonium, nitrate, and urea forms. Its versatility in application such as in irrigation water, spraying, surface, and placement makes it a desirable carrier of nitrogen.

Fertilizers Supplying Phosphorus

In Idaho, phosphorus ranks second to nitrogen as a plant nutrient used. All of the phosphorus fertilizers guarantee a certain percentage of available P_2O_5,[1] which is made up of the water and citrate soluble phosphorus.

Plants use phosphorus in three forms: H_2PO_4, HPO_4, or PO_4. The availability of the phosphate to crops in Idaho depends a great deal on how much is water-soluble. Those carriers having a high percentage of water soluble P_2O_5 are recommended for Idaho soils. The percentage of water-soluble phosphate varies considerably with the carrier.

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[1] There is considerable discussion throughout the United States over changing the form of expressing fertilizer guarantees for phosphate and potash content. Instead of giving available P_2O_5 it would be given as available phosphorus (P) and instead of available K_2O it would be given as potassion (K). To change P_2O_5 to P, multiply by 0.44; and to change K_2O to K, multiply by 0.83. These changes will be given in parenthesis after the usual analysis.

DOUBLE SUPERPHOSPHATE (Triple or treble) — $Ca\ H_4\ (PO_4)_2$

This fertilizer has 42 to 47 percent available P_2O_5 (18 to 21 percent available P), and is highly water soluble. It contains 12 percent calcium and small amounts of sulfur.

Double superphosphate is made by treating ground rock phosphate with phosphoric acid. It differs from single superphosphate in having no gypsum, but has a higher percent of available P_2O_5. It is grayish and is usually in a granular form, making it very easy to spread. This material has no influence on soil acidity. It is an excellent source of available P_2O_5.

SINGLE SUPERPHOSPHATE — $Ca\ H_4\ (PO_4)_2$:$Ca\ SO_4$

This fertilizer has 19 to 21 percent available P_2O_5 (8 to 9 percent available P) and is highly water-soluble. Single superphosphate also contains about 10 percent sulfur and 19 percent calcium in the gypsum form. A ton of single superphosphate contains approximately 1000 pounds of gypsum. The material is formed by treating ground rock phosphate with sulfuric acid. It has no influence on soil acidity. It appears on the market in a gray, powdery to granular form.

Single superphosphate, when in the granular form, runs easily through most fertilizer spreaders. It is highly recommended where both phosphorus and sulfur are needed in plant nutrition.

PHOSPHORIC ACID — $H_3\ PO_4$

This is a syrupy, clear-to-greenish liquid having about 52 percent available P_2O_5 (23 percent available P). It is entirely water-soluble and has an acid effect on soils. It can be injected directly into the soil or applied in the irrigation water. Application through sprinklers is not recommended, due to its corrosive effect on the equipment. This material is very corrosive, so it has to be kept in steel drums, and is usually custom applied.

In preparation, ground rock phosphate is treated with excess sulfuric acid and the resulting free phosphoric acid separated by decantation and filtration. Another method involves the mixing of sand, coke, and rock phosphate and submitting them to high temperatures. This releases the elemental phosphorus which is oxidized and combined with water to give phosphoric acid.

It is an excellent source of available P_2O_5. High cost limits its use at the present time.

BONE MEAL—

Crushed bone was one of the first materials used as a source of plant-nutrient phosphorus. Bone meal is a by-product of the

packing industry. It comes on the market as raw or steamed bone meal. This material has a very low available P_2O_5 content and is very expensive.

BASIC SLAG

This phosphorus carrier is a by-product of the steel manufacturing industry. Available P_2O_5 ranges from 15 to 20 percent (6 to 9 percent available P) with very little being water-soluble. This material is sold as a finely ground, dark gray powder. In some areas it is used as a liming material, being about 50 percent as effective as ground limestone, and is extremely alkaline. Basic slag has more available P_2O_5 than rock phosphate, but less than the superphosphates.

CALCIUM METAPHOSPHATE — $Ca\ (PO_3)_2$

This fertilizer is made by treating ground rock phosphate with hot gaseous phosphorus, which forms liquid calcium metaphosphate. This liquid, on cooling, forms slag, which is ground and marketed as such. It contains about 63 percent available P_2O_5 (27 percent available P) which is not highly water-soluble.

ROCK PHOSPHATE — $Ca_3\ (PO_4)_2$:Ca F

This material is found in natural deposits in the western states of Idaho, Utah, Montana, and Wyoming. Other states have similar deposits. It varies in purity and is found in many forms.

Rock phosphate is finely ground and put on the market untreated. Rock phosphate contains 1 to 4 percent available P_2O_5 (trace to 2 percent available P) of which only a trace is water-soluble. The results of numerous experiments have shown that very little crop response can be expected from the use of rock phosphate on Idaho soils.

Fertilizers Supplying Both Nitrogen and Phosphorus

AMMONIUM PHOSPHATES

These materials contain both nitrogen and phosphorus. Ammonium phosphates are made by treating phosphoric acid with ammonia. The product consists principally of mono-ammonium phosphate ($NH_4\ H_2\ PO_4$), di-ammonium phosphate ($(NH_4)_2\ H\ PO_4$), or a mixture of these two salts.

The main carriers in Idaho are the 11-48-0, mono-ammonium phosphate, and the 21-53-0, di-ammonium phosphate. The 11-48-0 contains 11 percent nitrogen in the ammonium form and 48 percent available P_2O_5 (23 percent P). The 21-53-0 contains 21 percent nitrogen in the ammonium form and 53 percent available P_2O_5 (25 percent P). Both fertilizers are highly water-soluble and suitable for application as solutions. They are white to gray in color and are usually in granular or pellet form. They do not absorb moisture from the air, so will flow freely through any conventional fertilizer spreader.

They are excellent fertilizers when both nitrogen and phosphorous are needed. These fertilizers have an acid effect on soils.

AMMONIUM PHOSPHATE SULFATE

This fertilizer is a mixture of ammonium phosphate and ammonium sulfate. It is prepared by adding ammonia to a mixture of phosphoric and sulfuric acids, giving a 16-20-0 analysis. This material contains 16 percent nitrogen in the ammonium form, 20 percent available P_2O_5 (9 percent P), and about 14 percent sulfur in the sulfate form. Its properties are similar to the other ammonium phosphate fertilizers. It is also a good source of sulfur.

AMMONIATED SUPERPHOSPHATES

These materials are produced by adding ammonia to superphosphates, which gives a product containing ammonium phosphate, dicalcium phosphate, and ammonium sulfate. They contain 4 to 6 percent nitrogen, 16 to 48 percent available P_2O_5 (7 to 21 percent available P), 12 to 20 percent calcium, and 1 to 12 percent sulfur.

Since the available P_2O_5 is less water-soluble than many of the other P_2O_6 carriers, ammoniated superphosphates are not recommended on aklaline soils when other highly water-soluble carriers are available. In acid soils where calcium is low, their use is more desirable. Their effect on soils is slightly acid.

NITRIC PHOSPHATES — $Ca_2\ H\ PO_4 : NH_4\ NO_3$

These carriers are produced by treating phosphate rock with nitric acid plus phosphoric or sulfuric acid and ammonia gas. This gives a mixture of dicalcium phosphate and ammonium nitrate. They contain 12 to 17 percent nitrogen and 14 to 32 percent available P_2O_5 (6 to 14 percent available P). This fertilizer is relatively new and its effectiveness on Idaho soils has not been thoroughly tested. The P_2O_5 is not highly water-soluble.

Fertilizers Supplying Potassium

Very little potassium fertilizer is used in Idaho. There is little evidence of economical returns on dollars invested in this fertilizer. Possible benefits come from use on organic and very sandy soils.

All potassium fertilizers guarantee a certain percentage of water-soluble potash (K_2O).[2] Plants use potassium in the ionic form.

MURIATE OF POTASH (Potassium Chloride) — KCl

This fertilizer usually contains 60 percent water-soluble K_2O (50 percent K). It is produced by two processes—by extraction from the mineral sylvinite, mined at Carlsbad, New Mexico, or from brines in Searls Lake in California and the Salduro marshes in Utah. It is a white, crystalline salt, and readily available. Muriate of potash has no effect on soil acidity.

SULFATE OF POTASH (Potassium Sulphate) — K_2SO_4

This fertilizer contains 50 percent water-soluble K_2O (41 percent K) and about 24 percent sulfur as sulfate. It is made by treating muriate of potash with (1) sulfate of magnesia, (2) sulfate of potash-magnesia, (3) sodium sulfate, or (4) sulfuric acid. This product is a white, crystalline salt and readily available. Potassium sulphate has no effect on soil acidity.

It is an excellent fertilizer when both potassium and sulfur are needed for plant nutrition, but is more expensive than the muriate form.

Mixed Fertilizers

Mixed fertilizers supply two or more of the three primary plant nutrients—nitrogen, phosphorus, and potassium. They are made by combining certain amounts of the separate carriers of nutrients. State law requires that all containers show the source of individual nutrient carriers such as ammonium sulfate, single superphosphate, and muriate of potash, as well as a guarantee of analysis.

Use of mixed fertilizers is a convenient way of assuring a uniform application of various plant nutrients, when needed to give a balanced soil fertility. Also, the cost of applying a mixed fertilizer is less than applying the separate carriers individually.

Mixed fertilizers are recommended in Idaho only when (1)

[2] See footnote on page 6.

more than one nutrient is needed to balance the soil fertility, (2) the mixture contains the correct ratio of nutrients to give a balanced fertility, and (3) the cost of the nutrients in the fertilizer does not exceed approximately $10 to $15 per ton more than the nutrients would cost when applied as separate materials.

Fertilizers Supplying Sulfur and Calcium

Calcium and sulfur serve at least two functions in the soil. (1) They are used by plants in nutrition, and (2) they act as a soil conditioner in reclaiming unproductive alkali soils.

GYPSUM (Land Plaster) — $Ca\ SO_4 : 2H_2O$

Gypsum is a natural-occurring mineral. High grade gypsum contains 18 per cent sulfur and 23 percent calcium. Gypsum is recommended in certain areas of Idaho as a source of sulfur in plant nutrition. It is also recommended as a source of soluble calcium for reclaiming alkali soils. Gypsum has no effect on soil acidity.

LIME

Agricultural lime is used to include a great variety of materials such as ground limestone, hydrated lime, burnt lime and oyster shells. The material is ground so that 60 percent will pass through a 100-mesh sieve. Lime is used to supply calcium and to reduce soil acidity.

In Idaho, lime is not generally recommended for agricultural purposes. In northern Idaho, where some soils are extremely acid, lime is recommended on a trial basis.

SOIL SULFUR — S

This product is found in the elemental state in natural deposits. It is marketed in a pulverized form, varying in color from yellow or white to gray or black. The product contains 10 to 99 percent sulfur, depending on the source.

Elemental sulfur is not available to plants. It has to be converted to the soluble sulfate form (SO_4) by the soil microorganisms before it can be used by the plant. Consequently, it is not immediately available for plant use when applied to the soil.

In Idaho, sulfur is recommended primarily for reclaiming alkali soils. Its function is to lower the alkalinity and to make calcium soluble for replacement of sodium in such soils. Soluble calcium is obtained only when free calcium carbonate (lime) is present in the soil.

AMMONIUM SULFATE — $(NH_4)_2\ SO_4$

This fertilizer contains about 24 percent sulfur. *(See page 4.)*

SINGLE SUPERPHOSPHATE — $Ca\ H_4\ (PO_4)_2$: $Ca\ SO_4$

Single superphosphate contains about 10 percent sulfur and 19 percent calcium in the gypsum form. A ton of single superphosphate contains approximately 1000 pounds of gypsum. (*See page 7.*)

AMMONIUM PHOSPHATE SULPHATE

This fertilizer contains about 14 percent sulfur. *(See page 9.)*

Fertilizers Supplying Trace or Minor Elements

In Idaho, benefits may be obtained in local areas by applying zinc, iron, boron, and possibly molybdenum.

These are called trace or minor elements, primarily because small amounts are used by plants and small amounts correct deficiencies when they occur.

Most fertilizers contain a very small percentage of trace elements. The claims made for the benefit received from such small amounts have not been substantiated by field tests.

AGRICULTURAL BORAX

This fertilizer is the most common carrier of boron. It contains 11 percent boron. The small amounts required make it very difficult to spread uniformly so where sulfur is needed it is usually mixed with gypsum and applied as borated gypsum. It may also be mixed with other fertilizers.

BORATED GYPSUM

This fertilizer contains about 1 percent boron (10 percent borax equivalent), 17 percent sulfur, and 23 percent calcium. It is recommended in northern Idaho when both boron and sulfur are needed for plant nutrition.

CHELATES (Pronounced key'-lates)

Chelates are synthetic organic materials that have the ability to keep certain elements in an available form for plant use.

They carry iron or zinc or other minor elements. Some are adapted to alkaline and others to acid soils.

They have not been tested sufficiently in Idaho by research to

justify specific recommendations for control of chlorosis. Trials are recommended before general applications are made.

IRON AMMONIUM CITRATE

Iron ammonium citrate is a salt which is placed in gelatin capsules for application. These capsules are injected directly into holes bored into the tree trunk.

It is used for treating trees for correction of iron chlorosis.

FERROUS SULFATE — $Fe\ SO_4 : 7H_2O$

This material contains 20 percent iron. It is soluble in water and must be applied as a spray to the plant foliage to be effective under Idaho soil conditions. It is the product generally recommended for the improvement of iron chlorosis. (*See Idaho Circular No. 110.*)

ZINC SULFATE — $Zn\ SO_4 : 6H_2O$

Zinc sulfate contains 22 to 35 percent zinc. It is soluble in water and is applied as a spray to trees and shrubs. Soil applications have not been effective in Idaho on areas where zinc deficiencies have occurred. (*See Extension Circular No. 120.*)

SODIUM MOLYBDATE — $Na_2\ MO\ O_4 : 2H_2O$

This material contains about 39 percent molybdenum (Mo). It must be mixed with some other carrier or put in solution and used as a spray for even distribution. Molybdenum is recommended in certain areas of northern Idaho on a trial basis.

Organic Fertilizers

Dried blood, bone meal, meat meal, and other by-products of the packing industry contain some plant food. These are usually complete fertilizers with low percentages of nitrogen, phosphorous, and potassium. The cost per pound of nutrient is usually very high.

The nutrients in the above materials are not soluble in water and become available over an extended period of time. When nutrients become available, they are taken up into the plant in the same forms as discussed under inorganic carriers.

Activated sewage sludge comes under this classification. More of this product is available each year as cities build modern sewage disposal plants than can market treated sewage sludge as fertilizer.

Aids in Fertilizer Selection

The present Idaho state law requires that all fertilizers sold within the state shall have on each bag or container the following information:

1. The minimum percentage and source of nitrogen in available form.
2. The minimum percentage and source of available P_2O_5.
3. The mnimum percentage and source of potash (K_2O), soluble in distilled water.
4. The content of any other material from which a benefit is claimed.

The guaranteed analysis shown on all fertilizer containers is a statement of the nutrient content. Use this analysis for selecting fertilizers.

MIXED FERTILIZERS

Mixed fertilizers are labeled to show percent nitrogen (N), phosphorus (as P_2O_5), and potassium as (K_2O). (*See footnote on page 6.*)

For Example, if the analysis listed is 10-10-5, the first figure indicates 10 percent nitrogen, the second 10 percent P_2O_5, and the third 5 percent K_2O. Therefore, in this mixed carrier an 80-pound bag would contain 8 pounds of nitrogen, 8 pounds P_2O_5, and 4 pounds of K_2O, or a total of 20 pounds of the major plant nutrients. Every ton of this fertilizer would have 500 pounds of plant nutrients. The remaining 1500 pounds is usually composed of the other elements which must be combined with the nitrogen, phosphorus and potassium to produce a material that can be handled. The element nitrogen (N) is a gas and plants, except legume organisms, cannot use it. It has to be combined with other elements so it can be used by plants and so it can be handled. The element phosphorus (P) will burn when exposed to the air, and potassium (K) reacts vigorously when in contact with water. Consequently, they must be combined with other elements so they can be handled safely.

The analysis on the bag will also show the carriers of nitrogen, phosphorus and potassium used in making the mixed fertilizer.

For this 10-10-5 mixture, the carriers could be listed as:

Nitrogen—from ammonium sulphate
P_2O_5 —from superphosphate
K_2O —from muriate of potash

Knowledge of the separate carriers used in making this mixed fertilizer gives additional information as to availability of the

nutrients such as water-soluble P_2O_5, and whether the nitrogen is organic or inorganic.

SEPARATE MATERIALS

Separate materials sold as fertilizers are listed on the bag like this:

Ammonium sulfate
21 percent available nitrogen
24 percent sulfur

Urea
45 percent available nitrogen

Ammonium nitrate
33 percent available nitrogen

Single superphosphate
21 percent available P_2O_5

Muriate of potash
60 percent water-soluble K_2O (potash)

For separate carriers such as ammonium nitrate, there would be 33 pounds of plant nutrients per 100 pounds of fertilizer; or for every ton of fertilizer, there would be 660 pounds of desirable plant nutrients.

COST

What you pay for a pound of plant nutrient is very important when you select a nutrient carrier.

Separate nutrient carrires: For fertilizers carrying only one kind of plant nutrient, use this formula to determine the cost per pound:

$$\frac{\text{Cost per ton of fertilizer}}{\text{percent available nutrients} \times 2000} = \text{Cost per pound of available nutrients.}$$

Examples:

1. Ammonium sulfate (21 percent nitrogen)
   Cost — $72.00 per ton

   $$\frac{\$72.00}{420} = 17¢ \text{ per pound nitrogen}$$

2. Single superphosphate (20 percent available P_2O_5)
   Cost — $37.00 per ton

   $$\frac{\$37.00}{400} = 9.2¢ \text{ per pound available } P_2O_5$$

3. Muriate of potash (60 percent water-soluble K_2O)
Cost — $65.00 per ton

$$\frac{\$65.00}{1200} = 5.5¢ \text{ per pound potash } (K_2O)$$

Mixed nutrient carriers: For fertilizers carrying more than one kind of plant nutrient, the cost should be equivalent to the cost of the individual nutrients in the mixture plus a charge for mixing, sacking, and labeling of about $10.00 to $15.00 per ton.

Example: To estimate the value of a 10-10-5 mixed fertilizer:

10% nitrogen x 2000 pounds = 200 pounds nitrogen per ton
10% P_2O_5 x 2000 pounds = 200 pounds P_2O_5 per ton
5% K_2O x 2000 pounds = 100 pounds K_2O per ton

The cost per pound of nitrogen, phosphorus, and potash in single nutrient carriers varies between areas. Substitute local prices for the average costs used in this example:

Nitrogen cost — 15¢ per pound
P_2O_5 cost — 9¢ per pound
K_2O cost — 6¢ per pound

200 pounds nitrogen	x 15¢ per pound =	$30.00
200 pounds P_2O_5	x 9¢ per pound =	18.00
100 pounds K_2O	x 6¢ per pound =	6.00
	Nutrient value =	$54.00 per ton of fertilizer
	Mixing cost =	10.00 per ton of fertilizer
	Total cost per ton =	$64.00 per ton of fertilizer

This mixed fertilizer should sell for about $64.00 per ton to compare with the nutrient value of the single nutrient carriers.

All fertilizers should be compared as to the amount and cost of available plant nutrients carried in a ton of material.

Cooperative Extension Work in Agriculture and Home Economics, James E. Kraus, Director, University of Idaho College of Agriculture and United States Deparment of Agriculture Cooperating.
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