SOIL FERTILITY

R. H. Tucker

The application of commercial fertilizers is only one part of a complete, well-rounded program for Colorado soils. It would be uneconomic and nearly impossible to try and supply through commercial fertilizers all, or even a major part, of the principal plant food elements removed on a high-yielding farm if all the products were sold off the farm. However, if rotation of crops is practiced, and the feed crops produced on these farms are fed, crop residues and manure saved and used, then it is possible and economic to supply additional plant foods by the use of commercial fertilizers.

Soils low in organic matter, high in alkali salts, or otherwise poor, do not respond to and cannot be corrected by the use of commercially applied plant foods. Hence the greatest use of commercial fertilizers has been and will continue to be made by the better farmers and on the better soils.

While the use of commercial fertilizer, in Colorado can be materially increased, their use will increase faster and their value will be materially greater if a sound soil-management program is practiced. This program involves crop rotation, including the growing of a legume, the use of occasional high-residue crops and green manures, the incorporation of crop residues and the saving and use of manure.

THE FERTILIZER BUSINESS IN COLORADO

Robert Gardner

Approximately 12 million tons of fertilizer were sold in the United States in 1945. It is estimated that about 20 percent of the 1945 crop resulted directly from the use of commercial fertilizers. In contrast to the United States as a whole, Colorado used only between 10 and 20 thousand tons. It is impossible to predict the future size of the fertilizer business in Colorado, but it can be expected to approach more nearly the average for the other states.

The use of commercial fertilizers is so new in Colorado that there is considerable confusion in the state regarding the kinds and amounts of the various fertilizer constituents to use, and the price which should be paid for these constituents. The soils of this state differ in many respects from the soils of the states where fertilizers are extensively used, yet it is believed that much of the experience of the other states will apply to Colorado. The size of the business will be determined by the profitable response obtained by the farmers.

The experience of the other states indicates that the principal fertilizer need has been for nitrogen, phosphoric acid and potash. These three ingredients constitute the main bulk of the fertilizer business. It can be expected that this
will be true of Colorado. The ratio of the three constituents vary greatly in different localities and for different crops. On the average phosphoric acid constitutes about half of the fertilizer with nitrogen and potash making up the other half in about equal amounts. Areas like California and some of the southern states, where vegetables and citrus fruits predominate, use more nitrogen than any other constituent. On farms where legumes are produced and livestock feeding is practiced there is much less need for nitrogen fertilizers. It is expected that the greatest need in Colorado will be for phosphoric acid, with a smaller need for nitrogen and potash.

Minor elements, including sulphur, iron, boron, copper, manganese, and zinc, are essential to crop production, but they are required in smaller quantities and do not become deficient so quickly or frequently. The volume of the business in minor elements therefore can be expected to be relatively small.

In addition to plant nutrients, mineral materials known as soil amendments are sometimes needed to control the soil reaction or improve the physical condition of the soil. These include calcium and magnesium carbonates, which are classed as liming materials, and sulphur and gypsum, which are used to counteract high alkalinity. The soils of Colorado are predominately alkaline and seldom need lime. Sulphur and gypsum have a place on highly alkaline soils but are of little value on most mildly alkaline soils. When these materials are needed they are required in such large quantities that the price must be low to make their use economical.

To help the user purchase fertilizer goods intelligently and economically, it is the responsibility of the dealer to label the packages accurately and completely. Since all fertilizers look very much alike, the only guides which the consumer has in making his purchase are the price and the analysis furnished by the dealer. It is therefore necessary to have the percentages of the constituents in a form available to plants listed on the packages. The practice of listing constituents which are present in quantities too small to be of value is misleading to the purchaser and should be discouraged.

THE PRICE AND RELATIVE VALUE OF FERTILIZERS

Dale S. Romine

The retail price of a fertilizer is generally the sum of four charges.

First: the price of the plant nutrients contained.

Second: the transportation charges.

Third: the profits and selling charges of the manufacturers, dealers, and salesmen. (It is interesting to note that the prices of fertilizers during the past few years have not advanced as much as the prices of farm products or other things which farmers buy.)

Fourth: the cost of maintaining and operating the fertilizer factory and the mixing plant and other incidental items.

The last three items may be grouped together and called "general expense," which constitutes a more or less fixed charge against each ton. This basic fixed cost is the average cost of manufacturing, bags, transportation, sales, and all
other incidentals independent of the plant-nutrient content. The basic cost will vary from year to year and will also vary with the different sections of the country for any given year. The general-expense item amounts to a large percentage of the total price, particularly of the low-analysis fertilizers, and the basic price would be charged for any mixture handled in the usual way even if it contained no plant nutrients and consisted entirely of filler.

A source of generally unnecessary expense to the user of fertilizer is the purchase of low-analysis mixtures. It can be readily seen that the same amount of plant nutrients will be contained in either 1 ton of 4-16-4 or two tons of 2-8-2-, but the consumer would have to pay the general expense charges on 2 tons if he purchased the 2-8-2, and on only 1 ton if he chooses the 4-16-4. This, of course, would make the plant nutrients in the 2-8-2- mixture much more expensive, even though it cost considerably less per ton. Therefore, it is more economical for a farmer to buy the higher grades of fertilizer, making sure that they contain plant nutrients in proper proportion to meet his needs.

Since fertilizers are sold with a guaranteed analysis printed on the bag or the label, it is possible by observing certain fundamental principles to estimate the relative value of any commercial fertilizer, soil amendment, or agricultural mineral. The estimated relative value, based on the price of the plant nutrients contained, is used for comparing values of fertilizers of different grades, and it should not be confused with the selling price. Selling price can not be accurately estimated because of the many factors, some of them variable, which are included in it.

A fertilizer grade is conventionally expressed in the order N-P\textsubscript{2}O\textsubscript{5}-K\textsubscript{2}O. (N) represents the total nitrogen reported as elemental nitrogen. (P\textsubscript{2}O\textsubscript{5}) represents the available phosphorus reported as available phosphoric acid and (K\textsubscript{2}O) represents the available potassium reported as water soluble potash. It should be emphasized that only the available forms of any of the plant nutrients should be used in estimating the relative value of any fertilizer, soil amendment, or agricultural mineral. It should be further emphasized that if the amounts of the plant nutrients, or essential elements, are not stated in percentage on the bag or the label such nutrients can not honestly be used in estimating their relative value, for the reason that only a trace would satisfy the guaranteed analysis.

Fertilizers are designated by formulas, 20-0-0, 11-48-0, 4-12-4 etc. The first figure refers to percent nitrogen (N). The second figure refers to percent available phosphoric acid (P\textsubscript{2}O\textsubscript{5}), and the third figure to percent water soluble potash (K\textsubscript{2}O). If calculated on a ton basis, the fertilizer trade finds it convenient to figure in terms of "units" instead of percentages of 100 pounds. A "unit" is 20 pounds of any nutrient or 1% on the basis of a ton. Ammonium sulphate, 20-0-0, means 20 units of total nitrogen to the ton. A 4-12-4 mixed fertilizer contains 20% or 20 units of total nutrients—or in popular terms 400 pounds of "plant nutrients".

In stating the cost of fertilizer elements carried by any material, it is customary in the trade to do so on the basis of a unit of total nitrogen, available phosphoric acid, or water soluble potash. Following are sample calculations to illustrate how relative values may be estimated.

As a basis for computing unit values the price per ton of common concentrated sources is generally used. With ammonium sulphate (20-0-0) at $50.00 per ton; treble superphosphate (0-43-0) at $55.00 per ton and potassium sulphate (0-0-51)
at $59.00 per ton respectively, nitrogen will cost $2.00 per unit, available phos-
phoric acid $1.28 per unit and water soluble potash $1.16 per unit. Using these
unit costs a fertilizer having a guaranteed analysis of 4% total nitrogen, 12%
available phosphoric acid and 4% water soluble potash that is a (4–12–4) grade
fertilizer has a relative value of $28.00 per ton. A fertilizer analyzing 10–18–5
has a relative value of $48.84 per ton.

These values seem high when compared to $2.76 per ton, which under most
Colorado soil conditions, is the actual relative value of an "agricultural mineral"
having a guaranteed analysis of 33.00% calcium carbonate (CaCO$_3$), 14.00% iron
oxide (Fe$_2$O$_3$), .12.00% magnesium carbonate (MgCO$_3$), 6.00% sulphur (S), and 20.00%
silica (SiO$_2$). Soil amendments are not frequently needed in Colorado soils and
therefore have a low relative value. For example; in estimating the relative value
of the above agricultural mineral it should be pointed out that most of the agricul-
tural soils in Colorado contain large amounts of calcium and magnesium, therefore
these elements should not be considered in the evaluation.

In Colorado where the soils contain natural lime the Fe$_2$O$_3$ is not available
to plants and therefore should be discounted in the evaluation. Silica is inert and
is not considered a plant nutrient. Even if the guaranteed analysis lists all
elements contained they cannot all be considered in the estimation of relative value
unless the amounts contained are specifically stated for each element listed.
In the evaluation of an "Agricultural Mineral" for most Colorado soils, the only
material that can be justifiably considered is sulphur. Four units of sulphur at
46¢ per unit gives a relative value of $2.76 per ton. With calcium carbonate at 14¢
per unit and magnesium carbonate at 16¢ per unit, this material may have a relative
value of $9.30 per ton in an area where lime is needed, and it would be classed as
a low-grade liming material. It should be pointed out that these relative value
figures do not include the so-called "general expense" items.

COMMERCIAL FERTILIZER TESTS ON FRUITS AND VEGETABLES

A. H. Binkley

Not any blanket fertilizer recommendations can be given that will cover all
the variable soil conditions that exist in the production of Colorado crops. It is
recommended that growers first build up the organic matter content of their soils
and use commercial fertilizers in supplement to such a program. Before making a
general orchard or crop application of a commercial fertilizer, run a few test
plots first to see if it will pay. Each orchard and each crop grown is a different
problem. The results of commercial fertilizer tests on peaches, sour cherries,
apples, potatoes, onions, and pod peas over a period of several years, carried in
various parts of the state, indicate certain response trends. On tree fruits,
nitrogen fertilizer applications have shown increased yields of fruit. Ammonium
sulphate nitrogen fertilizer was used at the rate of 2½ pounds to 5 pounds per tree,
depending on the age of the tree. The results of testing out various commercial
fertilizer materials on tree fruits are available in bulletins Nos. 471, 458, and
Miscellaneous Publication No. 254.

On potatoes in Northern Colorado, the nitrogen, phosphate 6–30–0 fertilizer
combination has shown beneficial responses in the late district when applied at the
rate of 200 pounds per acre. In the early sandy soil district straight ammonium
sulphate nitrogen fertilizer is applied. In the results of 5 years, fertilizer
tests in the San Luis Valley, the general trend favors a high-phosphate complete
mixture, such as a 10–18–5 ratio, applied at the 200 pounds rate per acre. Fertilizer
tests on types and rates of application are carried in other districts on potatoes
but have not been carried long enough to show trends.
On onions, five years results in the Arkansas Valley indicate a nitrogen phosphate combination such as 6-30-0 and 10-20-0 as being more satisfactory than a single element application or no application.

Pod pea trials in the San Luis Valley under root rot soil conditions, show beneficial responses from straight phosphate fertilizer applications, as measured by stand counts and yields. There appears to be some value in a phosphate and potassium combination in reducing root rot damage under certain soil conditions.

The use of minor elements, copper, iron, zinc, manganese, and boron is still in the exploratory stage. Tests on the San Luis Valley Substation on rocky, gravelly soils, indicate that a combination of copper, iron, and manganese applied at the rate of 25 pounds of each element per acre will be beneficial to yield and quality of potatoes under those soil conditions. Two year tests in various parts of the state with minor elements applied singly and in various combinations have not shown significant responses in yields so far.