TECHNIQUES OF FERTILIZER INTRODUCTION: A CASE STUDY OF INVERTED RATIO FERTILIZERS

by

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INTRODUCTION

This paper is concerned with some of the marketing aspects of the most dynamic sector in agriculture; that of fertilizer. Growth and change, of and within the fertilizer industry during the last decade has been phenomenal. This has been exhibited in many ways.

In 1959 the volume of fertilizer consumed in the U.S. was 25,312,672 tons. By 1965 the volume had increased to 34,532,215 tons, an average annual growth rate of 5.3%. Likewise, during the same period use of fertilizer in Kansas surged from 290,657 to 833,786 tons,[1] an annual growth rate of 19.2%.

This broad view of increased fertilizer usage masks many changes that have occurred within the industry. The percentage of plant nutrients in Kansas fertilizer has increased from 40.1% in 1959 to 47.3% in 1965. The average analysis of nitrogen, phosphorus and potash, respectively, changed from 21.0 - 17.0 - 2.2 to 30.3 - 14.7 - 2.3 during this period.[2] Furthermore, there was a large change in the sources of the three nutrients.

Another area of rapid change has been the types of grades of fertilizer on the market. Twelve of the 36 grades marketed in 1958 are no longer sold. Fifteen of the 44 grades sold in 1965 had been introduced since 1958.[3] Almost as many grades have been discontinued or introduced since 1958 as were on the market in 1958.

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[1] U.S., Department of Agriculture, Agricultural Statistics, (Washington: U.S. Government Printing Office), 1961, p. 491; 1967, p. 582.

[2] Ibid

[3] Kansas State Board of Agriculture, Tonnage of Commercial Fertilizer Reported By Manufacturers, (Topeka: Semi-annually, 1958-1967).

The Tennessee Valley Authority has had a role in making the fertilizer industry a dynamic one. It is authorized by Congress to operate the National Fertilizer Development Center at Muscle Shoals, Alabama. Here, through research and development work, TVA develops new products, processes and distribution practices. TVA's objective is to introduce these developments to consumers and private industry. Once market development has been carried out TVA turns the manufacture and distribution of the new product over to private industry via royalty-free, non-exclusive licenses.[4] Thus business is left to private enterprise, research and development to TVA, and the fertilizer consumer enjoys a more effective, lower cost product.

Ammonium phosphate nitrate (APN) represents a process of production and a product developed by TVA. TVA's ammonium phosphate nitrate had an analysis of 30-10-0; nitrogen, phosphate and potash, respectively; and was the first "inverted" ratio fertilizer on the Kansas market. The designation "inverted" ratio signifies that the fertilizer has more nitrogen than phosphate and/or potash. 30-10-0 has three times as much nitrogen as the other two nutrients combined.

Introducing a new product into such a dynamic industry might appear to be a simple task. In an effort to find a more rapid and economical introduction method, TVA used a special technique in the introduction of 30-10-0. This technique, which we will examine closely, was to allow no more than one retail dealer in each county or trade area during the initial introduction period. Complementing this technique was an aggressive educational program.

The technique by which TVA's 30-10-0 was introduced into the market is

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[4]Tennessee Valley Authority, Facts About TVA Operations, (Knoxville, Tennessee: Tennessee Valley Authority, 1964), p. 24.

the subject of this paper. More generally we will be concerned with the whole process of product development, introduction and market development, and the final transfer of production and distribution to private enterprise.

Objectives

The objectives of the study will be first to examine and describe the various techniques and processes used in the introduction of 30-10-0. The second objective will be to determine the effects of TVA's introduction of 30-10-0 on: 1) the distribution and sales of 30-10-0 in particular, 2) the consumption of inverted ratios and all other fertilizers, and 3) on the production of 30-10-0 by private enterprise. Finally, we will evaluate the performance of the introduction process and its various techniques, make comparisons with other introduction processes and suggest possible improvements.

Procedures

Much of the basic data came from the U.S. and Kansas Departments of Agriculture as well as various University publications. Much information of a more specific nature was obtained from TVA.

To study specific aspects in general and for various regions, two questionnaires were sent; one to participating dealers and the other to fertilizer blenders. Sixty-one percent of the 70 dealers and 48% of the 225 fertilizer blenders responded to the questionnaires. In both cases some of the questionnaires were followed up with interviews, the purpose being to check the accuracy of the questionnaires and to probe for more details.

Several contacts were made with the distributors who participated in the introduction program. The facilities and various TVA personnel at the National Fertilizer Development Center in Alabama were visited in order to gain a broader perspective of the fertilizer industry.

THE INTRODUCTION PROCESS

There are problems common to the marketing of any new product. Before marketing can begin, research and development are necessary to create a new product. However, just having a new product is not sufficient. It must be something the public needs or wants or can be educated to want. Ideally, market analysis should bear this out before any effort has been expended to create the product.

Next comes the question of how the new product should be marketed. Will the existing or traditional marketing channels be most effective in enabling widespread distribution? What kind of advertising and information dissemination will attract and educate the consumer most effectively? Finally, how is the firm to cope with competing products or competing firms until the product makes a place for itself in the market?

These questions pertain to the marketing of any new product. The following description is of the approach TVA used to introduce a specific product, 30-10-0, into the Kansas fertilizer market.

By 1958 TVA had developed and tested a new fertilizer they considered appropriate to the agronomic needs of many farmers. While 30-10-0 was somewhat unconventional it had certain direct and indirect economic advantages. The solution to overcoming the unconventional nature of the product was to educate potential consumers.

TVA decided to carry out its initial introduction program in Kansas through a single wholesale distributor. Together they decided on the "one-dealer-per-county" technique for introduction. With no more than one retail

dealer in each county a wide distribution could be obtained without requiring great quantities of the product.

In some counties more than one dealer was established. The primary constraint was that their trade territories did not overlap. The rationale for allowing this monopolistic situation will be pursued further.

Since there was only one wholesale distributor, that distributor was in a monopolistic position relative to all of the retail dealers throughout the state. Thus it was possible for him to sell 30-10-0 at a price allowing him a higher than normal profit margin. The distributor's agreement with TVA allowed just that - providing the distributor performed certain extra services.

Because their trade territories did not overlap, this same monopolistic situation (with conditions) applies to the dealer-farmer relationship.

The conditions imposed on these two monopolistic situations by TVA concern educational and demonstrational activities which were intended to speed up acceptance of the new product and market development.

To further analyze the relationships between TVA, distributor, dealers, and farmers it is necessary to briefly mention some of the conditions in the agreements and the activities for which they provide.[5]

The wholesale distributor was to inform his dealers of the program and to offer TVA 30-10-0 to those who agreed to cooperate. A written agreement was the basis for implementing the program.[6]

In turn, the dealer was to inform the farmer of the availability of

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[5]These are set forth in detail in the "Distributors Demonstration Program For TVA Fertilizers in Kansas", (Snyder Chemical Co. and TVA).

[6]See copy of agreement in appendix, p. 40.

TVA 30-10-0 and to offer it to him with the understanding that it was to be used for educational and demonstrational purposes. Methods of using 30-10-0 were to be in accordance with the recommendations of Kansas State University.[7] Further, the dealer was to provide the farmer with information concerning the TVA 30-10-0 introduction program and KSU's recommendations for its use - purpose and conditions of program, crops, time, rates, placement, etc..

The dealer was to seek the assistance of the local county agent in conducting at least one field demonstration. Encouragement for soil testing was to be given farmers. The dealer was to seek any further advice or assistance from the Agricultural Extension Service. Finally, the dealer was to keep records as to amounts, purchasers and intended uses of all TVA 30-10-0 sold.[8]

Each cooperating farmer could purchase a maximum of 10 tons of TVA 30-10-0. Each user was to apply according to KSU's recommendations and was to leave a check strip for observational and demonstrational purposes. The user also agreed to report on storage, drilling and handling qualities, and response obtained from TVA 30-10-0, if requested.[9]

The wholesale distributor and the retail dealers were responsible for the administration of the program. TVA did coordinate efforts with KSU in furnishing the distributor with experimental and test-demonstration results and other informational materials.

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[7]"Distributors Demonstration Program For TVA Fertilizers in Kansas", (Unpublished Handbook by Snyder Chemical Co., Inc. and TVA), p. 2.

[8]Ibid., p. 4.

[9]Ibid., p. 2.

Since the successful introduction of a new product relies primarily on changing ideas of dealers and consumers, it can be called an educational process. The introduction of TVA's 30-10-0 included educational techniques common to marketing in general and some that are not usually utilized in fertilizer marketing.

Advertising of 30-10-0 was incorporated into the general advertising of both that of the distributor and of the dealer. Probably more effective, however, was the passing of information by word of mouth from the dealers to their farmer friends. This "personal" advertising was followed up by informational backstopping with bulletins, pamphlets and other material supplied by the dealers. This was the first step toward widespread acceptance of 30-10-0.

The first users of TVA's 30-10-0 it will be remembered, were required to leave check strips so that they themselves and others might observe the results. When these check strips were used in farm tours and the results were made available in farm meetings, the process of changing dealer and farmer attitudes was well on the way. As more farmers began to rely on their neighbor's results and on their own soil samples, the benefits of increased fertilizer usage were rapidly realized. This, then, was the second step in the introductory educational and demonstrational program.

Perhaps another area of motivation for usage of TVA's 30-10-0 will come to mind as one remembers the monopolistic situation existing between distributor and dealers and between dealers and farmers. TVA reduced the price at the manufacturers level. This preferential treatment during the introduction program had a theoretical justification. The increased profit margins were to allow for the increases in initial marketing costs due to the extra educational techniques mentioned above. This preferential price

treatment was only to occur during the introductory program.

Finally, in keeping with TVA's national, long-run objectives, the role of TVA in manufacture and distribution of 30-10-0 was to diminish. After the 30-10-0 grade was deemed a success and it was recognized that a market existed, TVA assisted private firms in taking over its manufacture. This TVA did by supplying technical assistance as well as the royalty-free, non-exclusive licenses allowing use of TVA's patented processes and products. The fertilizer blending industry also received assistance from TVA in the form of assistance in setting up bulk handling systems and guides for formulation of blends.

The above has been a general description of the introduction program for TVA 30-10-0, as it was meant to be. An evaluation of the program will be examined in chapter IV.

EFFECTS OF TVA'S INTRODUCTION OF 30-10-0

Before we evaluate the introduction process let us examine the direct, and as closely as possible, the indirect effects of 30-10-0's conception and debut on the market.

To put our study of 30-10-0 into a better perspective let us examine some data relating to it and the fertilizer industry in general. We will use data covering the seven fiscal year period, 1958-1965.

We will divide up 30-10-0's introduction period into two parts. The initial stage began in the fall of 1958 (fiscal year 1959) and continued through fiscal years 1960 and 61. During this time TVA worked with only one wholesale distributor. The number of counties, number of dealers and volume of TVA 30-10-0 increased during the initial stage of introduction.

During the latter stage of introduction (fiscal years 1962-65) various changes occurred. In 1962, a second distributor began participating in the TVA program. It was this year also that the number of participating retail dealers and volume of TVA 30-10-0 was commercially manufactured within the state. After 1962, other manufacturers and distributors entered the market. The increase in volume and kinds of inverted ratios (29-14-0 and 30-15-0) brought about a corresponding decrease in TVA 30-10-0 used in the introduction program.

The volumes of TVA and commercial 30-10-0 are plotted in figure 1.[10] The period has been extended to include fiscal years 1966 and 1967.

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[10] Respective sources of data are TVA and Kansas State Board of Agriculture. This data may be found in the appendix, Table 3, p. 40.

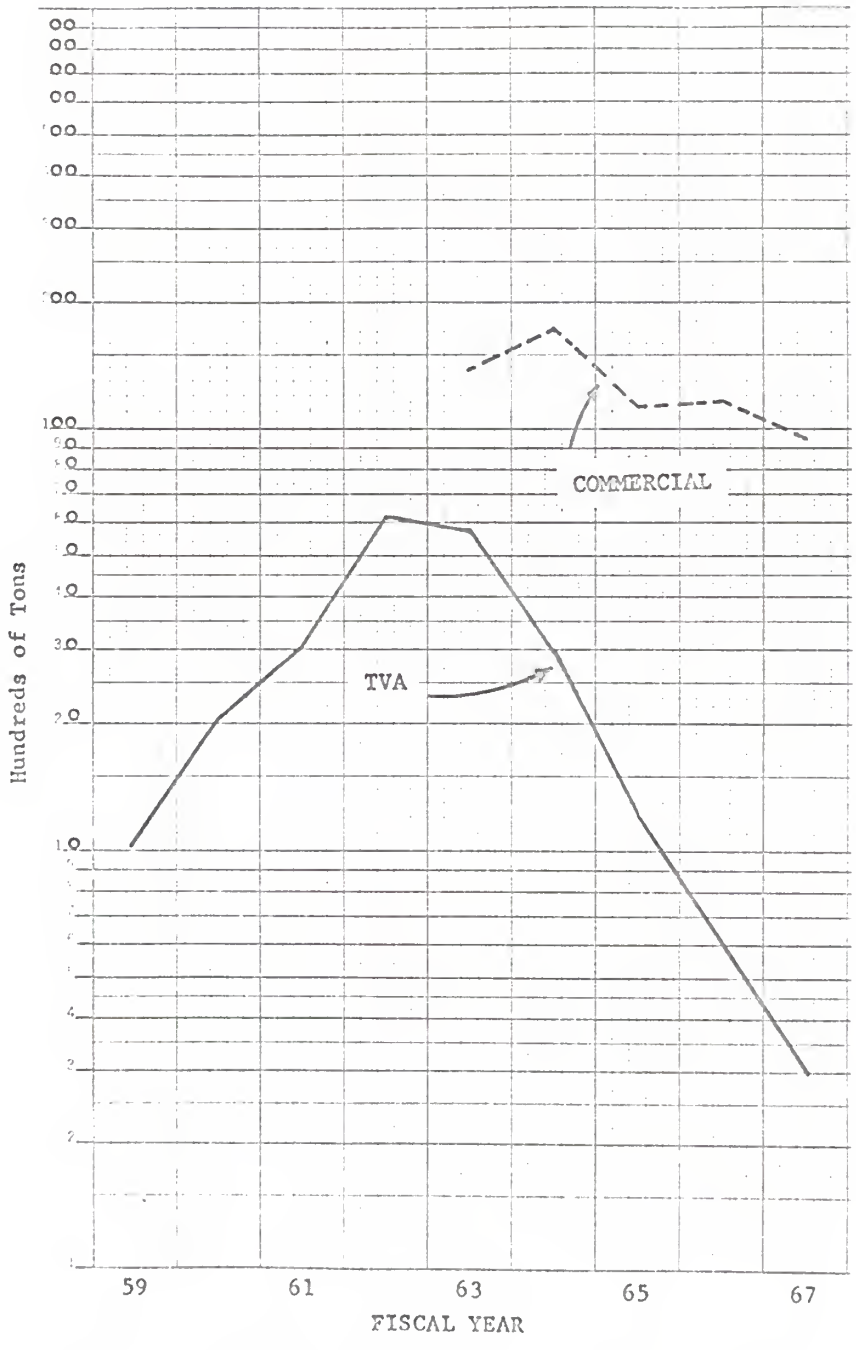

Fig. 1. - Volume of TVA and Commercial 30-10-0 Fertilizer.

It is difficult to determine the effect of the introduction of 30-10-0 on specific fertilizers. The changes, both increases and decreases, in volume of individual fertilizers have been so great that to say to what degree 30-10-0 has substituted for or displaced any other fertilizers is impossible. We may, however, hypothesize in the following manner.

One of the significant trends that has taken place in the fertilizer industry since 30-10-0 was introduced has been the increase in nitrogen consumption. A comment often encountered in questionnaires and interviews with dealers was that use of 30-10-0 helped farmers realize the need for more nitrogen. While it would appear that this is certainly true to some extent, to what degree we cannot say. Furthermore, it may be that more credit should be given to the educational techniques of the introductory program rather than to 30-10-0 itself.

In the long-run we might conclude that some of the credit of increased nitrogen and total fertilizer consumption should go to 30-10-0's introduction into the state. In the short-run, however, it appears that the preferential price treatment that 30-10-0 received probably caused its substitution for other fertilizers in some cases. This possibility was suggested by several dealers and will be elaborated on further.

Turning to the effect that 30-10-0 has had on farmer fertilizer practices, we again encounter the problem of deriving any statistically significant correlation. During the last 10 years the number of farmers using fertilizer has increased greatly as has the average rate of application. No doubt the educational and demonstrational techniques of the introductory program contributed to these trends.

Of one effect on farmer usage we can be more certain. That is that the number of crops to which fertilizer is applied increased during the

introduction period. In the 1950's it was not common practice to apply fertilizer to pasture grasses. In certain areas of the state it was shown that the plant nutrient analysis of 30-10-0 was well suited to a once over application on pasture. The practice has gained a wide following.

Other Inverted Ratio Fertilizers

Since the debut of 30-10-0 in 1959, there have been several other inverted ratios introduced. The largest volume of these is 29-14-0. Others include 20-10-5, 20-20-10, and 10-6-4. The aggregate volume of these other manufactured inverted ratios (excluding 30-10-0) is plotted in figure 2 along with the volume of total 30-10-0 and total manufactured inverted ratios.[11]

The volume of all manufactured inverted ratios has increased significantly during the 1959-67 period. The volume of 30-10-0 at the end of the period was nine times the initial volume. For the other manufactured inverted ratios, the 1967 volume was 100 times more than the volume in 1959.

Blended Inverted Ratio Fertilizers

Although the growth in consumption of manufactured inverted ratio fertilizers is impressive, it does not tell the whole story. A fertilizer with a 30-10-0 analysis can also be produced by blending various other fertilizers. The combination that is used almost exclusively is a blend of approximately 80% ammonium nitrate and 20% 18-46-0.[12] Although blended 30-10-0 is not a chemically homogeneous product as it is when manufactured, tests by the Kansas Experiment Station indicated that, if handled properly, its

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[11]Source: Kansas State Board of Agriculture, Tonnage of Commercial Fertilizer Reported By Manufacturers, op. cit.

Note: Semi-logarithmic graph paper has been used so that growth rate may be compared.

[12]A survey of blenders indicated this combination was used almost unanimously. For a copy of the questionnaire, see appendix, p. 47.

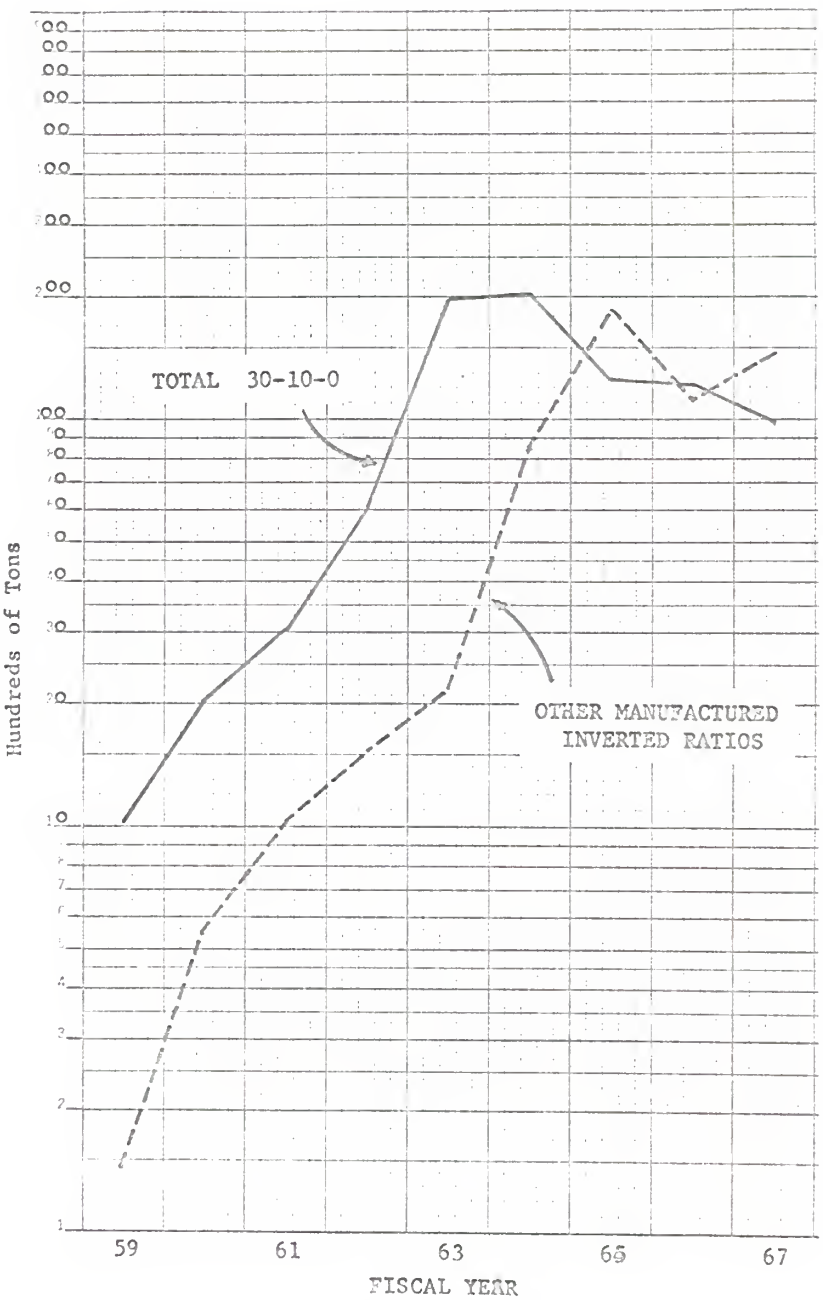

Fig. 2. - Volume of Total 30-10-0 and Total Other Manufactured Inverted Ratio Fertilizers, (1959-1967).

performance is comparable to the manufactured product.[13]

Bulk blending is a relatively new industry. As recently as 1959 there were no bulk blending plants in the state. By 1967 the state had licensed 111 dry blending facilities.[14]

Bulk or "custom" blending can result in an almost infinite number of analyses of fertilizer. Likewise, there can be many grades of inverted ratios. Those blenders responding to the questionnaire listed 24 grades that had been sold in quantity of 10 tons or more. These grades ranged from 20-5-4 to 37-13-0. The average volume of inverted ratios, per blender, was 187 tons in 1967. The estimated volume of blended inverted ratio fertilizer consumed in the state in fiscal year 1967 was 16,850 tons.[15]

Yet, there is still one more source of inverted ratio fertilizer. Blending is not limited to dry materials. Liquid fertilizer materials can also be blended to give a "custom" analysis. There were 114 licensed liquid blenders in the state in 1967.[16] These blenders can create liquid inverted ratios by combining liquid nitrogen solutions and liquid mixed fertilizers. A survey showed that 81% of the liquid blenders used 10-34-0 as a source of mixed fertilizer while 37% used 11-37-0. There were 17 different inverted ratios reported blended.

In 1967 the average volume of inverted ratios was 93.6 tons per liquid

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[13]Results of research with wheat, corn and grain sorghum are summarized in the appendix, pp. 43-46.

[14]Source: Kansas State Board of Agriculture, "Licensed Custom Fertilizer Blenders", (Topeka: 1967).
Note: Approximately 15% of these blending facilities are not yet functional.

[15]Estimate was calculated from the "Survey of Blenders".

[16]Kansas State Board of Agriculture, "Licensed Custom Fertilizer Blenders".

blender and the estimated volume for the state was 8,145 tons.[17]

Since data for total volume of blends is not available, the volumes of liquid and dry blends were estimated for each of the years during the introduction period.[18] These figures are plotted in figure 3. Total blends had the very rapid annual growth rate of 74%. This growth rate seems more creditable when one considers that the raw materials of blends have also been growing rapidly.

To summarize, the volumes of manufactured inverted ratios, blended inverted ratios, and total inverted ratios have been plotted in figure 4. Further analysis of this data will be undertaken later.

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[17]Estimate was calculated from the "Survey of Blenders".

[18]Trends for dry blends and liquid blends were estimated from data on growth in blending plants and volumes at the beginning and end of the period. These trend figures were then deflated, respectively, by the annual variations in total mixed fertilizers and in total liquid fertilizers (The latter was weighted twice the value of the former).

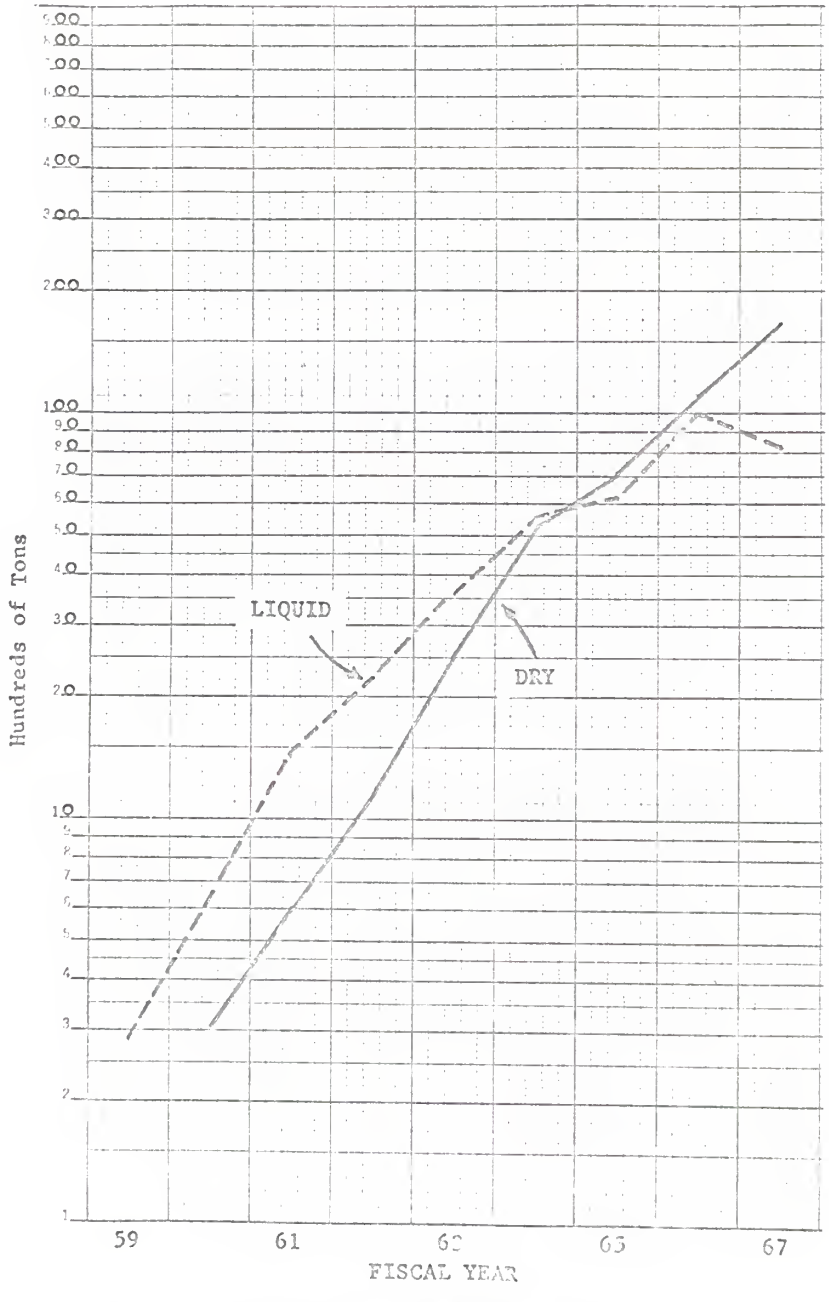

Fig. 3. - Volume of Dry and Liquid Blended Inverted Ratio Fertilizer, (1959-1967).

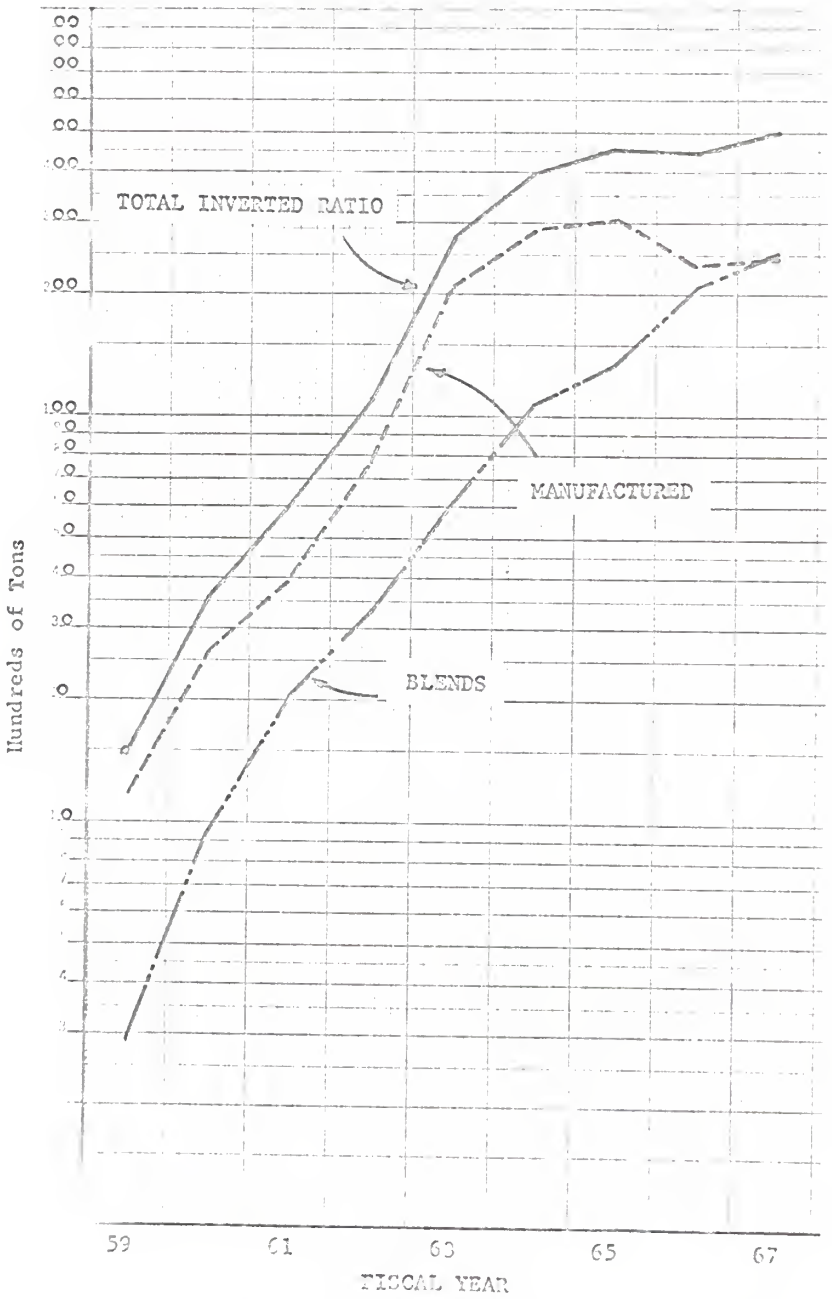

Fig. 4. - Volume of Total Manufactured Inverted Ratio, Total Blended Inverted Ratio, and Total Inverted Ratio From All Sources, (1959-1967).

EVALUATION OF 30-10-0

Previous to 1958 many farmers were using fertilizer practices involving two or more applications of fertilizer, each time with a different grade. The sum of these multiple applications often equaled an inverse ratio.

The best example is the fertilization of grain sorghums. A starter (15-60-0 or 11-48-0) is applied during planting. Later nitrogen is side-dressed. 30-10-0, or some other desired inverted ratio, allows the farmer to combine the two operations into a once-over application. It is done by broadcasting the inverted ratio before planting or by banding it during the planting operation.

In the questionnaire, 48.6% of the dealers indicated that they had sold 30-10-0 for use on grain sorghum; more than for any other crop. Another 14.3% sold 30-10-0 for use on corn.

Wheat is another example where using an inverted ratio allows a once-over operation. Tradional practices have been to use a starter fertilizer (superphosphate, 11-48-0 or 15-60-0) applied with the seed in the fall. In the late winter ammonium nitrate is broadcast. Another alternative has been to apply anhydrous ammonia or liquid nitrogen before planting instead of the nitrate in the late winter. Results from KSU experiments comparing 30-10-0 with these alternatives has been reported by Lindell and are summarized in the appendix.[19] In most cases the effects on yield and nitrogen content of

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[19]David L. Lindell, "Nutrient Uptake of Wheat From Several Fertilizers As Evaluated by Laboratory Analysis", (Unpublished Master's Thesis, Department of Agronomy, Kansas State University, 1963), pp. 52, 53. See summary in appendix, pp. 43, 44.

straw and seed were comparable. Twenty percent of the participating dealers sold 30-10-0 for application on wheat and 3.6% for application on oats.

Another 20% indicated that 30-10-0 was sold for use on bromegrass. These dealers were generally located along the eastern edge of the flint hills in northeast and east central Kansas. An additional 3% sold 30-10-0 for use on general pasture land.

Summarizing the results obtained by the KSU Experiment Station, we may conclude that in most cases 30-10-0 performed as well as the same quantity of plant nutrients available in other grades and/or forms. On farms where labor is a limiting factor, use of an inverted ratio for a once-over application of the year's fertilizer needs may be the deciding factor.

Storage and handling qualities were a topic discussed with dealers and a few farmers. Some dealers reported that 30-10-0 shipped during the first few years of the introductory program would acquire a more than normal bag set. If fertilizer is left setting for several months, some caking is usually normal but in the case of TVA's 30-10-0, caking was sometimes enough to leave it unusable.

There were also some complaints about its handling qualities in the field. Several dealers said they had had purchasers comment about how it had collected moisture if left in an open bag or a drill or planter. One farmer personally testified that after a night of heavy dew he had to use a screw driver to unclog his planter.

Almost all such complaints were about TVA 30-10-0 distributed in the early part of the introduction period. That distributed in the later part of the period appeared to be less of a problem. It was also stated that the 30-10-0 manufactured in the state by a private firm was of superior quality relative to TVA's 30-10-0.

EVALUATION OF INTRODUCTION TECHNIQUES

Evaluation of the one-dealer-per-county technique can be approached in several ways. Let us begin by examining the progress in implementing the technique.

Table 1. Implementation of the One-Dealer-Per-County Technique

Fiscal Year	Number of Dealers	Number of Counties	Volume of TVA 30-10-0
1959	26	22	1,046
1960	36	32	2,067
1961	44	40	3,031
1962	76	58	6,168
1963	75	59	5,781
1964	41	31	2,933
1965	NA	NA	NA
1966	4	4	NA

It should be noted that "one-dealer-per-county" is not an entirely accurate description of the technique. In the first year, four counties had two dealers. At sometime during the introduction period seven counties had two dealers within their boundaries, two counties had three dealers and two more counties had four dealers. It was true however, that except in two cases, the dealer's regular trade territories did not overlap. Thus it might be more accurate to term the introduction technique "one-dealer-per-trade-area".

Introduction started in the fall of 1958 (fiscal year 1959). That the program got off to a quick start and progressed rapidly is evident.

During the initial stage of introduction (1959-61) expansion occurred in the number of dealers, number of counties and volume of product.

The latter stage of introduction began in 1962. Several significant occurrences resulted in a change in the market situation.

In fiscal year 1962 a second wholesale distributor began participating in the distributor demonstration program. This resulted in a large increase in volume of TVA 30-10-0 distributed and in the number of dealers and counties distributing it. Also in 1962, the number of participating dealers and the volume of TVA 30-10-0 they distributed reached a maximum. With the entrance of a second distributor, the one-dealer-per-trade-area situation no longer held true. This fact will be discussed in the section on price and margin policies.

Another significant event in 1962 was the production of the first commercial 30-10-0. The volume in the first full year of production (fiscal year 1963) was 13,804 tons; more than twice the 6,168 tons of TVA 30-10-0 distributed in the peak year.

In 1964, Kansas production of another inverted ratio (29-14-0) was begun. Its first year volume was 6,237 tons. Later, still another inverted ratio (30-15-0) was produced by a third Kansas firm.

In fiscal year 1964 consumption of total 30-10-0 reached a peak of 20,066 tons. The following year the sale of other manufactured inverted ratio fertilizers, and all inverted ratios reached a maximum.[20]

With the increased availability of commercially produced inverted ratio fertilizer, TVA began to phase out its 30-10-0 introduction program. The decline in number of dealers and volume was quite rapid. Most of the dealers who participated in the introduction program continued retailing

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[20]See figure 2, p. 10 and table 3, p. 41.

30-10-0. After discontinuing the TVA introduction program, their source of 30-10-0 became commercial producers. This process, from beginning to end, was implemented as TVA had designed it.

That the introduction process was effective is born out by the following data. The growth rate of TVA 30-10-0 in the initial four years of introduction was 80.5% per year. Only two other fertilizers can show a more rapid growth rate during a similar introduction period. Between 1962 and 1966, 8-32-12's consumption grew from 324 to 11,371 tons, an annual growth rate of 142%. 18-46-0 had an average annual growth rate of 127% during the first five years on the market.[21]

More representative of initial growth rates of recently introduced fertilizers are: a five year average rate of 50% for 16-48-0, a four year average of 50% for liquid nitrogen, and four year average growth rate of 15% for 16-20-0. Indeed, five fertilizers introduced during the 1960's never doubled their initial year's sales; some even declined after their first year's sales. In this light the initial growth rate of 30-10-0 seems quite phenomenal. There are several explanations for this growth.

Analyzing the area of introduction sheds light on one reason why sales of 30-10-0 grew rapidly.

The fertilizer consumption patterns of counties, both in volume and by types of grades, varied greatly through the state. While all 105 counties sold some fertilizer in every year of the initial stage of introduction, the first participating distributor consistently supplied TVA 30-10-0 only to dealers located in high volume counties.

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[21]Computed from data given in: Tonnage of Commercial Fertilizer Reported By Manufacturers, op. cit.

As the table below shows, the third of the state with the lowest volume of fertilizer sales had only four dealers whereas the third of the state with the highest volume of sales had 24. This policy put a given quantity of product into the hands of the highest potential customers.

Table 2. Placement of Dealers in Relation to County Fertilizer Volume

County Volume[a] (tons)	Number of Counties	Number of Counties With Dealers	Number of Dealers
Less than 1,000	34	4	4
1,000 - 4,000	36	21	30
4,000 or more	35	24	29

[a]1959

The map of figure 5 will help to illustrate the distribution of fertilizer consumption in the state. Also shown are the locations of the dealers that participated in the TVA 30-10-0 introduction program during the initial state of introduction.

The picking of high volume areas for the introduction of 30-10-0 undoubtedly accounted to a large degree for the ready acceptance it received and for the rapid growth rate in the initial stage of introduction.

There are several advantages in the one-dealer-per-trade-area technique. In the initial stage of introduction the supply of TVA 30-10-0 was limited. This technique allowed the widest distribution of a given quantity of the product.

Another alternative would have been to divide the given quantity of TVA 30-10-0 among more dealers. This approach would have increased the problems associated with distribution. Not only would there have been more final destinations to ship to but the increased number of shipments would have meant small or partial carloads to each dealer.

Fig. 5. - Location of Dealers Participating in TVA's 30-10-0 Introduction Program.

By keeping the number of dealers small in the initial introduction stage, administrative problems and costs were held down. Fieldmen for the distributor did not have to introduce and explain the new product and program to as many dealers. They were able to give the selected dealers more time and effort in explaining the use of 30-10-0 and the objectives of TVA's program. This approach enabled a more effective implementation of the program.

Finally it allowed the distributor (and TVA) a closer observance of acceptance patterns and market development. Personal contacts with dealers more readily brought out problems associated with 30-10-0's handling qualities, methods and rates of application, and use of inverted ratio fertilizers in general.

To complete the evaluation of the one-dealer-per-trade-area technique we must examine a few offsetting disadvantages.

While restricting the number of dealers may allow more control over introduction, it also restricts the number of potential consumers that can have contact with it. If the argument that each farmer must experiment with a product before he uses it in proper volume is valid then the technique restricted market development in those areas where no dealer existed. Countering this argument is the assumption that most Kansas farmers are progressive and follow the Experiment Station's recommendations closely. Also the results reported by the participating farmers probably served as a strong impetus for those farmers who had 30-10-0 available only after the introduction program ceased.

Another problem of the technique was the selection of the most suitable dealers within each area. Following are some of the criteria used for dealer selection.

Probably the most important criterion was the dealer's receptiveness to the program. Some dealer's did not want to be burdened with the extra work involved in complying with the introductory program's agreement.

A related factor was the distributors' feeling of whether the dealer could be depended on to carry out the terms agreed upon. Two dealers, when interviewed, indicated that they had no intention of complying with their responsibilities. They wanted to retail the product, simply for its commercial value. While this was a small minority of the dealers it does indicate a problem in selection of dealers.

Another useful criterion is the volume of fertilizer the dealer has been handling in the past. A dealer with a recent history of high volume would indicate either that he is in a small trade area where there is a large per-acre demand for fertilizer or that he has a large trade area containing many fertilizer consumers. Either case would be indicative of a large potential for a new fertilizer. An incentive to utilize this criterion is readily available data to the distributor of past sales by his dealers.

A third basis for selecting dealers is to compare the trade areas of dealers located in the same region. The dealer with the largest trade area would be the best selection, all other things being equal. When comparing dealers within a similar agronomic region, relative size of trade areas and volume are generally positively correlated.

A final criterion for selecting a dealer is the services he offers to his customers. Examples are application equipment and soil testing assistance. It has been shown that dealers which offer extra services are generally better informed, more progressive and more successful. It may be assumed that to some degree their customers are also better informed and more progressive.

In many cases dealers pointed out that one reason why 30-10-0 did or did not sell well in their area were the results from soil tests.

It appears that the distributor did a good job of selecting the dealers. Only a few did not carry out their responsibilities at least in part.

Educational Techniques

An integral part of the one-dealer-per-trade-area technique was an educational program designed to benefit both dealers and farmers. TVA's 30-10-0 was to be applied according to soil tests and experiment station recommendations. Check strips were to be left by the farmer for a comparison of results. This information was to be returned to the dealer so that he might disseminate it among potential users.

Except in a few cases there was little or no feed back of this information to the dealer. Unfortunately this source of experimentation and result information was generally untapped. In a few cases however, farmers applied 30-10-0 at various rates and quantitative results were obtained in cooperation with the county extension service. This information was of benefit to all.

In one county this was a significant factor in increasing the application rates on bromegrass. While this process could have been of great value it must be realized that it is difficult to enforce such a program.

In some of the cases it was the attitude of the dealer that was the cause of this lack of feed back, or for that matter, for the lack of any educational program at all. In several interviews the dealer frankly admitted that his interest in the 30-10-0 introduction program was entirely commercial rather than educational.

This conflict of purposes, i.e. educational versus commercial,

undoubtedly occurred in many cases. However, most dealers, even if their purpose was commercial, did comply at least half heartedly with their responsibilities.

As an additional point it should be noted that for most farmers in Kansas the current problem is not a question of whether or not to fertilize, but rather a question of how much fertilizer to apply. In the latter 1950's, many farmers were still not using fertilizer. In this case the check strip with no fertilizer applied was of more value than it would be today.

Price and Margin Policies

An interesting phase of the study was the evaluation of the price and margin policies of the participating dealers. As was stated previously, the price of TVA 30-10-0 was discounted at the manufacturers level. The distributor was allowed a larger than normal markup. This was to offset increased costs of the introduction program to the distributor.

A dealer complying with the responsibilities in the agreement would also have some extra expenses, although not many. Since, in a one-dealer-per-trade-area situation he would have been in a monopolistic position, he could have increased his normal resale margin to allow for these costs. It is interesting to note how the dealers reacted to their monopolistic situation.

Seventy-three percent of the dealers indicated that they sold TVA 30-10-0 on the same margin as their other fertilizers. For TVA 30-10-0 sold in the introduction period, the average retail markup of all the dealers was $8.21 per ton or 10.4%. The fact that a large majority treated the pricing of 30-10-0 the same as any other fertilizer may represent the tendency for some dealers to treat it the same as other products; that is, commercially rather than using it as an educational tool.

Only 12% of the dealers took advantage of their market power by raising the resale margin. One dealer reported a resale margin of 14.7%, half again as high as the average.

Another 15% indicated that their markup had been less for 30-10-0 than for other products. It should be noted that most of those dealers reporting lower than normal retail margins gave ambiguous and inconsistent answers on the questionnaires. Because of the inconsistent answers and because this possibility seems rather unlikely, the lower than average retail markup should be taken with a grain of salt.[22]

The prices and resale margins of the introduction period were compared with those in 1967 when the introduction program no longer existed. While the average retail markup had decreased from $8.21 to 7.38, the average retail price rose from $78.94 to 85.85. The average percentage markup declined from 10.4% to 8.5%. After 1963 the one-dealer-per-trade-area condition no longer existed. The increased competition would tend to lower profit margins. Added competition from other inverted ratios and from blends would result in the same trends.

A broader way of looking at margin policies is to consider the price increase from the origin to the final consumer, i.e. the manufacturers sale price to the cost to the farmer.

During the initial stage TVA charged $62.10 per ton of bagged 30-10-0 and the average cost to the farmer was $78.94. This represented a $19.84 or 27.2% increase in price from manufacturer to final consumer.[23]

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[22]Calculations based on "Survey of Dealers Participating in the Introduction of TVA 30-10-0".

[23]Calculations based on TVA "Price Schedules", distributor "Price Announcements", and "Survey of Dealers Participating in the Introduction of TVA 30-10-0".

TVA increased the price in 1962 to $63.00 per ton and again in 1963 to $66.00. The average retail price in 1967 was $83.85, a markup of 31.5%. However, by 1967 TVA 30-10-0 sales were only 3% of total 30-10-0 volume. The price of commercially manufactured 30-10-0 at the manufacturers level was $73.00 per ton. Whereas the increase in price from manufacturer to final consumer of TVA 30-10-0 used in demonstration programs was 31.5%, the manufacturer to final consumer markup of commercial 30-10-0 was only 17.5%.[24]

The decline in average overall margins, as well as at the dealer's level, as the increase in commercial 30-10-0 sharpened competition raises a question about preferential price treatment.

The observation that total volume began to decrease shortly after TVA's volume decreased might suggest that TVA misleadingly underpriced 30-10-0 in the introductory period. The argument continues that its price was low enough so that 30-10-0 was substituted for other fertilizers even though the 3-1-0 ratio was not the desired analysis. Then as commercial 30-10-0 with its more realistic price began to replace TVA's 30-10-0, the loss of the preferential price treatment caused substitution to subside and thus a subsequent decline in total volume of 30-10-0.

This argument is summarized by the following statement. The preferential price treatment motivated greater usage of 30-10-0 than was the actual need of a 3-1-0 ratio. Hence it resulted in a misallocation of resources.

While the argument may have some validity for the specific grade 30-10-0, it can be declared invalid on two counts for inverted ratios in general.

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[24] Ibid.

We cannot conclude that the inverted ratio was merely a substitute for other fertilizers because it was less expensive. Although 30-10-0 sales have declined substantially, the volume of all inverted ratios from all sources has not.

Another explanation for the slower growth of inverted ratios in recent years is changes in prices of other fertilizers. The significant decrease in the price of anhydrous ammonia, a competing source of nitrogen, as well as methods for its more efficient application is one example. Such occurrences have altered fertilization practices during the period.

Thus we may conclude that while the preferential price treatment of 30-10-0 did accelerate its acceptance, the subsequent decline was not a result of misleading price policy. Furthermore, the continued growth of inverted ratios from other sources disqualifies the argument of a distortion of the market and a misallocation of resources.

EVALUATION OF 30-10-0 AND INVERTED RATIO FERTILIZER USAGE

Although the consumption of all inverted ratios fertilizer has grown steadily during the last eight year period, the absolute increase in volume is not the whole picture. In 1959, 30-10-0 accounted for 0.7% of all mixed, dry fertilizers sold in Kansas. By 1963, 30-10-0 had climbed to 7.7% of the total and at the end of the introduction period it accounted for 2.7% of all mixed, dry fertilizer. Even more significant, sales of all manufactured inverted ratios accounted for 13.5% of all mixed dry fertilizer at the end of the period whereas at the beginning of the period they were practically nonexistent. To complete the picture, all inverted ratios (manufactured plus blends) relative to all fertilizers, increased from 0.5% in 1959 to 7.1% in 1965 and ended the period with a 5.5% in 1967.[25] Considering the many, many grades and types of fertilizers necessary to meet the varied needs of agriculture, this was no small accomplishment.

We have seen that although the use of 30-10-0 grew very rapidly in the first four years, its volume has decreased significantly in the last four years. Similarly, consumption of most other manufactured inverted ratios has declined in the last few years. These trends are accompanied by a substantial increase in blended inverted ratios.

This can partially be explained by comparing prices of commercial 30-10-0 and a blended 30-10-0. An example that is typical of the general situation is a firm that sells manufactured 30-10-0 and also has facilities to blend a 30-10-0 grade. The price of the manufactured 30-10-0, in bag,

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[25]Annual data is given in the appendix, table 4, p. 42.

was $86.00 per ton. This was $6.60 or 8.4% above the $79.40 price for blended 30-10-0.

It is true that the manufactured product is a chemically homogeneous product that guarantees a proportionate distribution of all nutrients at all times. The blended product is not chemically homogeneous and an uneven nutrient distribution due to segregation could conceivably occur. To many farmers however, the difference in price is the deciding factor.

There are, however, considerations other than price, which have contributed to the decline in the usage of manufactured 30-10-0. There are several distinct fertilizer programs developing in the state. In choosing one of the alternatives the farmer considers labor demand during certain periods, time requirements and ease of application, tillage practices, costs of particular sources of nutrients, climatic conditions, and the analysis and amount of fertilizer needed as determined by soil tests.

One of these alternatives is to apply all fertilizers before planting. This pre-plant or "plow-down" application greatly reduces the labor requirement during planting time, especially for row crops. The pre-plant application may be a blended inverted ratio, a liquid mixed fertilizer, or either anhydrous ammonia or liquid nitrogen, followed by a phosphatic fertilizer to provide the desired overall analysis.

Another fertilizer practice of increasingly widespread use is the utilization of anhydrous ammonia as the main source of nitrogen. In the last few years the price of anhydrous ammonia has fallen to levels which make it very competitive even though it has a higher cost of application. The practice of combining its application with a tillage operation makes it the most inexpensive source of nitrogen available. The other fertilizer nutrients are applied at planting time.

These two fertilizer practices affect the use of inverted ratios. The labor saving practice of applying all fertilizer prior to planting has increased the use of inverted ratios. Liquid mixed fertilizers of an inverted ratio which are usually applied by the dealer mean the farmer has to allocate no labor at all for the application of fertilizer. In the case of dry fertilizers it should be noted that the increase in inverted ratios had been in blends and not in commercially manufactured inverted ratios. This is due to prescription blending according to soil samples, to the lower cost of the blends, and to application by bulk spreaders rather than the handling of bags in which most commercial manufactured inverted ratios are sold. It would seem plausible that this trend would continue, especially as farm size increases and farmers find labor more costly and difficult to obtain.

While applying all fertilizer prior to planting increases volume of inverted ratios, the use of anhydrous ammonia as the primary source of nitrogen has decreased the utilization of inverted ratios. Here, the primary factor is the cost rather than labor saving. The degree to which farmers use this fertilizer program depends somewhat on weather conditions. It would seem that as farmers learn to combine tillage operations and fertilizer application this practice would also increase.

Given the above as a basis for our reasoning we might speculate upon the future of 30-10-0 and other inverted ratios in the following manner.

The main competition of inverted ratios will be the utilization of anhydrous ammonia and weather conditions. The main advantage of inverted ratios is the labor saved by applying all fertilizer in one operation either by a bulk spreader for dry materials or by custom applied liquid mixed fertilizers.

Overall the use of inverted ratio fertilizers should continue to increase, though at a much slower rate than they did during their introduction period - the last eight years. The practice of basing the desired fertilizer analysis on soil samples as well as the price advantage of bulk blends, will cause the increase in inverted ratio fertilizer volume to be in bulk blends rather than commercially manufactured inverted ratios.

SUMMARY AND CONCLUSIONS

TVA developed and introduced a new product into one of the most dynamic markets in the economy; that of fertilizer. The product, ammonium phosphate nitrate, was somewhat unconventional because of its analysis - 30-10-0. It was the first inverted ratio fertilizer on the Kansas market.

To effectively and efficiently introduce this new product, TVA utilized a one-dealer-per-county introduction technique. The primary restriction was that the dealer's trade territories did not overlap. This technique, coupled with an aggressive educational program of soil testing and demonstrational check strips, was designed to rapidly develop a market for the new inverted ratio fertilizer. It was felt that this technique would minimize administrative and shipping costs and at the same time make a limited supply of the new product available to a maximum number of potential, but more important, progressive and influential customers.

TVA's objective was to introduce the product, develop a market, promote commercial manufacture by private enterprise, and then to phase out their introduction program and role in the market.

An examination and evaluation of the introduction program indicates this was indeed the succession of events. During the initial stage of introduction (1959 - 1961) the number of dealers and counties participating in the program increased rapidly as did the volume of TVA 30-10-0. The initial stage of introduction established the fact that a market did exist for an inverted ratio fertilizer.

In 1962, the beginning of the final stage of introduction, a second

wholesale distributor entered the program and the number of participating dealers and counties, and the volume of TVA 30-10-0 reached a maximum. The year 1962 also marked the beginning of commercial manufacture of 30-10-0 in the state.

Having developed the market and subsequently involving private enterprise in it, TVA, in accordance with its national objective, began diminishing its role in the market. By 1967 the volume of TVA 30-10-0 was less than 5% of the total whereas five years earlier it had been 100%.

That the introduction technique was effective is borne out by the results. 30-10-0's average annual growth rate for the initial four years on the market was 80%. Only two other fertilizers can claim a more rapid growth rate during a similar introduction period. The average growth rate of a new fertilizer is much lower than this. Almost a third of the fertilizers introduced during the last decade steadily declined after their initial introduction.

It should be noted that while 30-10-0 enjoyed a rapid initial growth rate, consumption has been declining in recent years. While this has no bearing on the effectiveness of the introduction technique, it is interesting to note some of the factors contributing to this decline. Perhaps the most significant is the substitution for manufactured inverted ratios by blended inverted ratios which have a cost advantage. Another factor is the price decline of anhydrous ammonia which has made it a very competitive source of nitrogen.

If we consider all inverted ratio fertilizers, regardless of source, we find that their volume has been steadily increasing. The primary contributing factor is the saving in time and labor allowed by a once-over application of a bulk blended inverted ratio.

REFERENCES

Books

Tennessee Valley Authority, Facts About TVA Operations, (Knoxville, Tennessee: Tennessee Valley Authority, 1964).

Periodicals

Kansas State Board of Agriculture, "Licensed Custom Fertilizer Blenders," (Topeka: 1967).

Kansas State Board of Agriculture, "Tonnage of Commercial Fertilizer Reported by Manufacturers," (Topeka: Semi-annually 1958-1967).

United States Department of Agriculture, Agricultural Statistics, (Washington: U.S. Government Printing Office, 1961 and 1967).

Unpublished Materials

David L. Lindell, "Nutrient Uptake of Wheat From Several Fertilizers As Evaluated by Laboratory Analysis," (unpublished Master's Thesis, Department of Agronomy, Kansas State University, 1960).

Tennessee Valley Authority and Snyder Chemical Co., "Distributors Demonstration Program for TVA Fertilizers in Kansas," (Unpublished Handbook).

APPENDIX

D E A L E R A G R E E M E N T

DISTRIBUTOR DEMONSTRATION PROGRAM FOR TVA FERTILIZERS

The Tennessee Valley Authority is a corporate agency of the Federal Government and is authorized to operate fertilizer research and demonstration scale production facilities at Wilson Dam, Alabama. These facilities are operated to develop new and improved fertilizers and to demonstrate the technical and commercial feasibility of new or improved fertilizer processes. The new or improved fertilizers produced must be distributed in programs of research, demonstration and education. The educational program involving the distribution and use of TVA fertilizers by manufacturers, distributors, dealers and farmers is called the distributor demonstration program. The major national objectives of this program are (1) to introduce new and improved fertilizers and fertilizer products to farmers through fertilizer manufacturers, distributors and dealers in order to create farmer demand for improved fertilizers, (2) to promote among farmers improved fertilizer use practices which are recommended by the land-grant colleges, (3) to lower the cost of plant nutrients to farmers and (4) to encourage improvements in fertilizer products, process, and distribution systems.

The distributor demonstration program to serve these purposes was worked out with the Kansas State College, the distributors of TVA fertilizers in Kansas, and TVA. The distribution through dealers is for the purpose of introducing new and improved fertilizers to farmers and for broad-scale practical farm demonstrations of improved fertilizers use practices that are recommended by the land-grant colleges but which have not generally been adopted by farmers or that need additional emphasis in the area. The distributor demonstration program statement outlines in detail how the program is to be conducted in Kansas.

This will certify that (1) we understand the objectives and purposes of the TVA fertilizer program, (2) we understand the desire to participate in the program as outlined in the current distributor demonstration program statement and (3) we agree to keep the necessary records required to implement the program and will report semi-annually to the wholesale distributor.

_____ _____

Date Accepted Name of Retail Dealer

_____

Signature of Legal Agent for Retail Dealer

Table 3. Volume of 30-10-0, other inverted Ratios, and blended fertilizers in Kansas[a] (Fiscal years 1959 - 1967)

Fiscal Year	Manufactured Fertilizer					Blended Fertilizer			Total Inverted Ratio Fertilizer
	TVA 30-10-0	Commercial 30-10-0	Total 30-10-0	Other[b] Inverted Ratio	Total Manufactured Inverted Ratio	Dry Blends (est.)	Liquid Blends (est.)	Total Blends (est.)	
1959	1,046		1,046	144	1,190	0	286	286	1,476
1960	2,067		2,067	544	2,611	306	636	942	3,553
1961	3,031		3,031	1,023	4,054	603	1,442	2,045	6,099
1962	6,168		6,168	1,525	7,693	1,142	2,225	3,367	11,060
1963	5,781	13,804	19,585	2,182	21,767	2,573	3,595	6,168	27,935
1964	2,938	17,128	20,066	8,413	28,479	5,263	5,584	10,847	39,326
1965	1,208	11,282	12,490	18,423	30,913	7,151	6,180	13,331	45,244
1966	604*	11,661	12,265	11,381	23,644	11,069	9,895	20,964	44,608
1967	300*	9,477	9,777	14,684	24,461	16,850	8,145	24,995	49,456

[a]Source: TVA, Kansas State Board of Agriculture and a survey of blenders. Method of derivation of estimates is given in footnote 19, p. 16.

[b]Includes 29-14-0, 20-10-5, 20-10-10 and 10-6-4.

*Estimated.

Table 4. Proportionate Share of the Market Held by Various Components of the Market, (1959-1967)

Fiscal Year	TVA 30-10-0[a] All Mixed	All 30-10-0[b] All Mixed	Manufactured Inverted Ratio[c] Total Mixed	Total Inverted Ratio[d] Total Fertilizers
1958-1959	0.7	0.7	1.1	0.5
1960	1.3	1.3	2.2	1.1
1961	1.7	1.7	3.3	1.5
1962	3.1	3.1	5.6	2.3
1963	1.8	7.7	11.0	4.7
1964	1.1	7.3	14.3	6.4
1965	0.4	4.4	16.0	7.1
1966	0.2	3.8	13.4	5.3
1967	-	2.7	13.5	5.6

[a]TVA 30-10-0 as a percent of all dry, mixed fertilizer.

[b]All 30-10-0 as a percent of all dry, mixed fertilizer.

[c]All manufactured inverted ratio as a percent of all dry, mixed fertilizer.

[d]Total inverted as a percent of total fertilizer.

Table 5. Fertilizer treatments employed at the Agronomy Farm, Manhattan; the Ashland Agronomy Farm, Manhattan; the Richard Evans Farm, Hutchinson; and the Newton Experiment Field, Newton, 1961-1962.[26]

Treatment No.	Pounds of		Pounds/A of Fertilizer Applied		Total Lbs/A Fertilizer
	N/A	P_2O_5/A	Ammonium Nitrate	Phosphatic or Mixed Fertilizer	
1. No treatment	0	0	0	0	0
2. NH_4NO_3 with seed	50	0	150	0	150
3. " " "	75	0	225	0	225
4. 30-10-0 " "	50	17	0	167	167
5. " " "	75	25	0	250	250
6. 0-45-0 NH_4NO_3 with seed	50	17	150	37	187
7. " " " "	75	25	225	55	280
8. 0-56-0 " " "	50	17	150	30	180
9. " " " "	75	25	225	45	270
10. 11-48-0 " " "	50	17	138	35	173
11. " " " "	75	25	207	52	259
12. 15-60-0 " " "	50	17	138	28	166
13. " " " "	75	25	207	42	249
14. 0-45-0 with seed NH_4NO_3 broadcast	50	17	150	37	187
15. Same as above	75	25	225	55	280
16. 0-56-0 with seed NH_4NO_3 broadcast	50	17	150	30	180
17. Same as above	75	25	225	45	270
18. 11-48-0 with seed NH_4NO_3 broadcast	50	17	138	35	173
19. Same as above	75	25	207	52	259
20. 15-60-0 with seed NH_4NO_3 broadcast	50	17	138	28	166
21. Same as above	75	25	207	42	249

[26] David L. Lindell, op. cit.

Table 6. The effects of fertilizer treatments on the yield of wheat in Kansas, 1961-1962.[27]

Treatment No.[b]	Locations and yields in bu./A[a]			
	Agronomy Farm Manhattan	Ashland Agronomy Farm Manhattan	Richard Evans Farm Hutchinson	Newton Experiment Field, Newton
1	34.0	4.2	25.4	13.2
2	41.3	8.1	30.2	16.0
3	45.2	5.4	31.0	15.2
4	46.8	8.6	32.8	18.2
5	49.7	7.4	36.4	17.0
6	46.0	3.9	36.9	18.5
7	49.1	4.0	37.8	18.1
8	47.0	7.5	32.8	17.3
9	49.6	3.0	35.0	16.2
10	49.2	7.4	34.8	20.4
11	48.3	4.8	35.8	18.4
12	43.7	4.3	34.2	19.0
13	52.3	5.7	36.0	19.0
14	48.0	4.3	34.4	21.3
15	50.1	5.4	36.1	20.8
16	45.2	4.6	32.4	17.5
17	48.6	8.7	35.2	18.8
18	47.7	7.7	33.0	18.7
19	50.1	10.2	38.2	19.1
20	43.4	11.4	34.6	17.7
21	52.3	7.9	37.7	18.6
LSD (.05)	5.6	N.S.	2.9	3.5
LSD (.01)	7.4	N.S	3.9	4.6

[a]Results are means of 4 replications at the various locations.

[b]For description of treatment, see preceeding page.

[27]David L. Lindell, op. cit. and Kansas State Fertilizer Handbooks, 1961 and 1962.

Table 7. Corn Grain Yields, Gerald Steely Farm, Brown County, 1962.

	Treatment	Grain Yield, bu./A.
1.	0-0-0	112.0
	Ammonium Nitrate Banded Along Row	
2.	40-0-0	113.7
3.	80-0-0	139.7
4.	120-0-0	129.9
5.	160-0-0	129.1
	30-10-0 Banded Along Row	
6.	40-13-0	125.4
7.	80-27-0	138.8
8.	120-40-0	142.1
9.	160-53-0	145.8
	20-20-0 Fertilizer	
10.	80-80-0, Broadcast	134.1
11.	120-120-0, Broadcast	140.8
12.	80-80-0, Row	132.7
13.	120-120-0, Row	134.9
	14-14-14 Fertilizer	
14.	80-80-80, Broadcast	142.7
15.	120-120-120, Broadcast	143.1
16.	80-80-80, Row	134.4
17.	120-120-120, Row	148.1
18.	120-0-0, Ammonium Nitrate, Broadcast	132.3
19.	120-40-0, 30-10-0, Broadcast	136.9
20.	120-40-40, 30-10-0 plus 0-0-60, Broadcast	136.8

Source: Kansas State Fertilizer Handbook, 1962. (Manhattan: Department of Agronomy, Kansas State University). p. 33.

Table 8. Grain Sorghum Yields, Preston Carter Farm, Russell County, 1962.

	Treatment	Yield of Grain Bu./A.
1.	Check (0-0-0)	50.1
2.	Ammonium nitrate only (120-0-0)	78.6
	80-27-0	
3.	30-10-0	79.3
4.	15-60-0 plus NH_4NO_3	76.4
5.	11-48-0 plus NH_4NO_3	75.8
6.	0-45-0 plus NH_4NO_3	76.2
7.	0-56-0 plus NH_4NO_3	75.1
	120-40-0	
8.	30-10-0	76.1
9.	15-60-0 plus NH_4NO_3	81.8
10.	11-48-0 plus NH_4NO_3	74.7
11.	0-45-0 plus NH_4NO_3	80.7
12.	0-56-0 plus NH_4NO_3	75.6

Source: Kansas State Fertilizer Handbook, 1962. (Manhattan: Department of Agronomy, Kansas State University). p. 32.

Note: Because of lack of response to phosphate application, it was not possible to compare the various phosphatic sources.

BLENDING SURVEY FORM

Plant Location: _____

Please list tonnage of high nitrogen grades* blended during the period July 1, 1966, to June 30, 1967. If exact figures are not available, use your best estimate.

Grade	Tons Made	Designate Liquid or Dry
30-10-0 (Example)	80	Dry
20-10-0 (Example)	74	Liquid

What per cent of your total volume of all fertilizers blended are high nitrogen grades? _____

Identify raw materials used in your blending program. Check appropriate materials:

Ammonium Nitrate	_____	30-10-0	_____
Urea	_____	29-14-0	_____
Urea-Ammonium Nitrate Solution (32-0-0)	_____	11-37-0 (liquid)	_____
		10-34-0 (liquid)	_____
18-46-0	_____	Other	_____
16-48-0	_____	Other	_____

SURVEY OF PARTICIPATING DEALERS

1. How did you learn of the TVA introduction and demonstration program?

2. Did you receive help from the county extension agent? e.g. setting up check strips, measuring results, etc.

3. How were farmers recruited for the demonstration program?

4. Do you have any records of crop responses to 30-10-0? Yes___, No___.

5. Below: - Concerning only 30-10-0 from TVA:
   (1) Which years was it used for demonstrational use?
   (2) What was the amount sold each year for demonstrational use?
   (3) What was the price when it was used for demonstrational use?
   (4) Which years was it sold on a commercial basis?

(1) Demonstrations Year	(2) Amount	(3) Price	(4) Commercial Year

6. For those who participated in the demonstration program, do you have a record of (1) purchasers of 30-10-0? Yes____, No____.
   (2) amounts sold to each individual? Yes____, No____.
   (3) intended use (crop) of 30-10-0? Yes____, No____.

7. In your area, to what crop was 30-10-0 most often applied? _____.

8. What was the resale margin to farmers who participated in the demonstration program? _____. As compared to other fertilizers was this margin: (1) higher_____
   (2) same_____
   (3) lower_____

9. Do you still stock 30-10-0? Yes____, No____.
   If no, is it TVA or another brand?_____.
   If other brand, when did you change?_____.

10. For 30-10-0, what is the current price?_____, resale margin? _____.

11. Do you think 30-10-0 filled a definite need or did it merely substitute for other fertilizers? Please comment.

12. Would you say demand for 30-10-0 has:
    (1) remained nearly constant_____, (2) increased_____, or (3) decreased_____. Why?

TECHNIQUES OF FERTILIZER INTRODUCTION: A CASE STUDY OF INVERTED RATIO FERTILIZERS

by

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ABSTRACT

Tennessee Valley Authority (TVA) developed and introduced a new product into one of the most dynamic markets in the economy; that of fertilizer. The product, ammonium phosphate nitrate, was somewhat unconventional because of its analysis - 30-10-0. It was the first inverted ratio fertilizer on the Kansas market.

The objectives of the study were to describe and evaluate various techniques and processes used in the introduction of 30-10-0 and to determine the effects of its introduction on the production, distribution and sales of 30-10-0 and other inverted ratio fertilizers in the state.

The 30-10-0 fertilizer was introduced by a technique in which dealers were selected such that their trade territories did not overlap. This temporary monopolistic situation coupled with an aggressive educational program was designed to rapidly develop a market for the new inverted ratio fertilizer.

TVA's objective was to introduce the product, develop a market, promote commercial manufacture by private enterprise, and then to phase out their introduction program and their role in the market. An examination of the introduction program indicates that this was the succession of events.

During the initial stage of introduction the number of dealers and counties participating in the program increased rapidly as did the volume of TVA 30-10-0. This established the fact that a market did exist for an inverted ratio fertilizer.

At the beginning of the final stage of introduction, a second wholesale distributor entered the program and the number of participating dealers and counties, and the volume of TVA 30-10-0 reached a maximum. Commercial manufacture of 30-10-0 and other inverted ratio fertilizers was also initiated during this period.

Having developed the market and subsequently involving private enterprise in it, TVA, in accordance with its national objective, began diminishing its role in the market. By 1967 the volume of TVA 30-10-0 was less than five percent of the total whereas five years earlier it had been 100%.

That the introduction technique was effective is borne out by the results. 30-10-0's average annual growth rate for its initial four years on the market was 80%. Only two other fertilizers can claim a more rapid growth rate during a similar introduction period.

Although 30-10-0 enjoyed a rapid initial growth rate, consumption has been declining in recent years. Perhaps the most significant reason is that lower cost, custom blended inverted ratios are being increasingly substituted for manufactured inverted ratios. Another factor is the price decline of anhydrous ammonia which has made it a very competitive source of nitrogen.

When considering all inverted ratio fertilizers, regardless of source, it was found that their volume has been steadily increasing. The primary contributing factor is the saving in time and labor allowed by a once-over bulk application of an inverted ratio fertilizer.