University of Minnesota Agricultural Extension Service, St. Paul — October 29, 1954

What's New with Fertilizers in Minnesota?

H. E. JONES and W. P. MARTIN*

Commercial fertilizers are playing an increasingly important role in Minnesota crop production. In 1940 only 18,627 tons were used by farmers. In 1953 the usage had jumped to 266,145 tons. It will be nearly 300,000 in 1954. Our estimates indicate that from 1,500,000 to 1,750,000 tons could profitably be used on present Minnesota crop acreage.

Changes in Fertilizer Application

Along with the increase in use has come important changes in fertilizer materials and in the way they are applied. The 1949 Minnesota legislature enacted a fertilizer law requiring that mixed fertilizers for field crop use contain not less than 27 per cent plant food.

Due to this and to the wholehearted cooperation of the fertilizer industry, the average plant food content of mixed fertilizers has increased from 25.9 per cent in 1947 to 36.1 per cent in 1953. More important has been the nearly $2,000,000 saved for Minnesota farmers through reduced freight and handling charges.

In 1940 phosphate was the principal fertilizer applied. It still remains important to a balanced fertility program but potash and, particularly, nitrogen are giving profitable returns on more and more acres each year. In 1950, for example, only a few thousands of acres of corn had straight nitrogen fertilizer applications.

In 1954 more than a half million acres received some nitrogen either as a side-dressing or as a broadcast application before planting. This increase was made possible by an intensive educational program demonstrating the value of nitrogen in increasing corn yields and by a tremendous step-up in nitrogen supplies.

The widespread use of anhydrous ammonia and nitrogen solutions along with solid forms of nitrogen has resulted in a new multimillion dollar industry within the past two years in Minnesota. This industry is the custom application of nitrogen and other fertilizers.

The progress in fertilizer recommendations by the University of Minnesota Agricultural Experiment Station based on its fertilizer experiments has been equally as rapid as the increase in fertilizer sales.

In 1945, for example, recommendations for corn on fields low in organic matter which had not grown legumes or received manure for two years were about 40 to 50 pounds of plant food per acre. This meant from 100 to 125 pounds of such grades as 4-24-12, 5-20-20, or 8-16-16 in the row at planting time.

A similar field in 1954 would receive a recommendation for 175 to 200 pounds of plant food per acre applied partly as a broadcast treatment before planting, partly as a starter in the row at planting time, and partly as a side-dressing of nitrogen at second cultivation.

New Way to Use Soil Tests

In 1949 the University of Minnesota started a soil-testing laboratory to better serve farmers in determining the fertility needs of their soils. It had long been known that fertility levels varied widely from field to field and farm to farm due to differences in soils and their treatment. Use of the soil test has greatly increased the efficiency of fertilizer use through more specific recommendations for these varying conditions. It is no longer necessary to give a general "shotgun" recommendation for a given area of the state. Each field can have its own prescription.

Steps have been taken to improve the effectiveness of the soil-testing program. More reliable testing procedures are being used in the laboratory. The Soils Department is beginning an experimental program that will give soil test results an even better correlation with crop yields than in the past.

Among the most important steps is a change from making the recommendations at the central laboratory on the St. Paul Campus to making them in the county agent's office. The laboratory with its specialized equipment and well trained staff will continue to run the analyses, but in many counties your county agent will make the recommendations. He will be backed up, of course, by the technical soils staff in the Institute of Agriculture. We think this will simplify the reports, speed up recommendations, and increase their effectiveness.

Guide for Fertilizer Use

The extension specialists in soils and the staff of the Soils Department have prepared a new bulletin to help you keep up on the new developments in fertilizer use. This publication entitled *Guide to Fertilizer Use in Minnesota* will be ready for distribution about mid-December. It has a number of features which we think you will like.

One section of the bulletin describes the plant foods normally supplied by fertilizers and how they help crop growth. Another section defines some of the commonly used fertilizer terms such as "fertilizer ratio," "fertilizer grade," "mixed fertilizers," "speciality fertilizers," and "straight goods."

For example, "straight goods" is a term used to designate fertilizer materials containing only one of the three major plant foods—nitrogen, phosphorus, or potassium. These materials are used either to supply a single nutrient needed for crop growth or in the manufacture of mixed fertilizers. The bulletin describes the more important "straight goods" fertilizers and their uses.

The lime, nitrogen, phosphate, and potash needs of different areas of the state are outlined with the use of maps. These maps are based on soil test results since the testing program was begun in 1949 and emphasize the im-

(Continued on Page 3)

* Extension Soils Specialist and Head of Department of Soils, respectively.

Changes in Dairy Feeding

PAUL E. NEWMAN*

Progress in poultry and swine feeding during the past 20 years has been phenomenal, but new developments in dairy cattle feeding have been far less dramatic.

Some changes, however, can be pointed out and must be considered.

1. **High fixed costs are developing in dairying.** Barns and milk houses must meet rigid health standards. Building and equipment costs are high. Wage rates have increased more than feed and milk prices. Most of these costs are about so much per cow no matter how much milk she produces. Consequently, today more than ever before, a high level of production per cow is essential for profit.

Even though grain costs per cow go up nearly as fast as production, other costs per cow are more nearly stationary. Consequently, there is a sharp drop in cost of milk production as the level of production increases (table 1).

2. **The productive level of our dairy cows is increasing—particularly in the better herds.**

In 30 years, production of all dairy cows in United States increased 25 per cent from 163 pounds of butterfat per cow in 1920 to 209 in 1950. The average of all Dairy Herd Improvement Association cows, however, has increased more strikingly from 247 to 370 pounds of butterfat per year. This is an increase of 50 per cent and is even more significant since there are five times as many cows being tested now as 30 years ago. This upward trend is constant and shows no signs of reversing itself in the foreseeable future. A 300-pound fat herd is commonplace, 400 will soon be average for good herds, 500 is a common goal frequently surpassed.

The individual dairyman today is competing against more efficient dairymen than he was yesterday. He must increase his level and efficiency of production to stay in business.

3. **A cow's nutritional needs are much more critical and exacting at higher levels of production** (table 2).

Table 2. Daily Requirements of 1,200-Pound Cow Producing 40 Pounds Milk Daily vs. One Producing 80 Pounds Daily 3.7 Per Cent Butterfat

	Required for maintenance plus		Supplied by 25 lbs. mixed alfalfa-grass hay	Extra needed for	
	40 lbs. milk	80 lbs. milk		40 lbs. milk	80 lbs. milk
Total digestible nutrients, lbs.	21.6	33.9	12.3	9.3	21.6
Protein, lbs.	2.65	4.54	1.65	1.00	2.89
Phosphorus, lbs.	.094	.162	.052	.042	.110

* From Morrison, F. B., *Feeds and Feeding.* The Morrison Publishing Company, Ithaca, N.Y., 1954.

In herds of lower testing breeds and approaching a 500-pound fat average, most of the mature cows will reach 80 pounds of milk daily during part of their lactation. The feeding problem for a 40-pound producing cow is not especially critical, but for an 80-pound producing cow it is. To supply 21.6 pounds of total digestible nutrients from an average grain ration would mean feeding at least 30 pounds daily. This level is neither desirable, physiologically advisable, nor economically practical.

4. **Quality in roughages is increasingly important.** Better roughages have higher feeding value per pound and can be fed the cow in larger amounts. More of the needs of high producing cows can be met with high quality roughages, and excessive grain feeding need not be resorted to. The feed cost per hundred pounds of milk can be lowered with good roughages.

5. **Grain feeding must be carefully planned.** The only purpose of grain is to supply what roughages cannot or do not (table 3). This means grain rations must be first of all high in energy, the common lack in all roughages. Other qualities of the concentrates must be adapted to the roughage. These include the level of protein, calcium, and phosphorus, and whether or not vitamin A and D should be included.

The amounts of concentrates fed must be carefully adapted to the level and quality of roughages consumed.

Rate of concentrate feeding must be carefully related to kind and amounts of roughage. Otherwise either it will be wasted or the cow will be underfed.

With increasing levels of milk production per cow, the necessity of a good dry cow feeding program is much greater. The heavy producer must have reserves to draw from during the peak of her lactation. Otherwise she cannot reach her full production and even more important her production in the later part of her lactation will be seriously lowered.

The most important nutritional advances with dairy cattle in the immediate future will come from a greater knowledge of what goes on in the rumen and why. Basic rumen research information is rapidly being uncovered from which practical applications will eventually be possible. For a few years yet we must be careful that the enthusiasm of our advertising departments does not exceed the real knowledge of research people in the field.

As dairy feed people we must remember that our individual success is dependent on the degree to which we can help the individual dairyman operate more efficiently and profitably.

Table 3. Roughage Differences Affect Amount of Grain Required

Roughage quality	Daily rate eaten	Grain needed annually by cow producing 10,000 lbs. of milk	Approximate milk: grain ration during lactation
Average	2 lbs. per 100 lbs. body weight	3,924 lbs.	3:1
Excellent	2.5 lbs. per 100 lbs. body weight	2,038 lbs.	6:1
Annual saving in grain per cow		1,886 lbs.	

Table 1. Milk Production Costs at Increasing Levels of Milk Production, 1953

Costs	Pounds of milk (3.7 per cent butterfat) yearly		
	5,000	10,000	15,000
Grain and roughage costs per cow			
New York conditions—Grain	$ 87.81	$168.73	$251.38
New York conditions—Roughage	66.20	84.96	97.45
New York conditions—Total grain and roughage	154.01	253.69	348.83
Minnesota conditions*—Total grain and roughage	90.00	130.00	165.00
Feed costs per hundredweight of milk			
New York conditions	3.08	2.54	2.33
Minnesota conditions*	1.80	1.30	1.10
Labor and overhead costs per hundredweight—New York conditions	2.81	1.78	1.61
Total costs per hundredweight—New York conditions	5.89	4.32	3.94

* Minnesota figures, based on DHIA records, are included on feed costs to relate figures to local conditions. They were not a part of Dr. Newman's presentation.

MINNESOTA FEED SERVICE

Published by the University of Minnesota Agricultural Extension Service, Institute of Agriculture, St. Paul 1, Minnesota.

Feed Service Committee—S. B. Cleland, chairman; Rodney Briggs; Cora Cooke; William Flemming; Lester Hanson; Harold Jones; Harold Searles; and Harold B. Swanson. Gwen Haws, editorial assistant for committee.

* Vice-President, Beacon Milling Company, Inc., Cayuga, New York.

Introducing Three Key Staff Members

These newly appointed University of Minnesota staff members will be working closely with Minnesota feed, seed, and fertilizer dealers in the future. They are (from left to right) Skuli Rutford, William P. Martin, and William T. S. Thorp.

Skuli Rutford

William P. Martin

William T. S. Thorp

Skuli Rutford, newly appointed director of the Agricultural Extension Service, will head a staff of 400 full-time workers in 87 Minnesota counties and on the St. Paul Campus of the University. County agricultural, home, and 4-H agents work under his leadership.

The new director is a native of Minnesota and has been assistant director since 1943. He has also served as a county agent, as head of the Minnesota Rural Rehabilitation Administration, and as a specialist in land use and conservation at the University.

William P. Martin, new head of the University's Soils Department succeeded C. O. Rost, who retired June 30. Dr. Martin is a native of Utah and came to Minnesota from Ohio State University where he had been professor of agronomy and bacteriology. He is a graduate of Iowa State College and has served on the Univeristy of Arizona and U. S. Forest Service staffs.

William T. S. Thorp, new director of the School of Veterinary Medicine and assistant dean, came to the University from the National Institutes of Health. Dr. Thorp is a graduate of Michigan State College where he received his Doctor of Veterinary Medicine degree. He served at Pennsylvania State College for 10 years before joining the staff of the National Institutes of Health in 1947. There he was in charge of the laboratory aids branch.

FERTILIZER USES - - Continued from page 1

portance of soil tests in a sound fertilizer program.

Most of the bulletin is devoted to a series of tables outlining general guides for fertilizer use on each of the important crops grown in Minnesota. The recommendations are given on the basis of high, medium, and low soil test levels.

How Recommendations Are Made

An important change from previous publications giving fertilizer recommendations is that all recommendations will be made in terms of the pounds of each of the plant foods—nitrogen, phosphate, and potash—needed per acre. Outlining the general fertilizer recommendations in this manner will permit each dealer to supply the farmer from the grades of mixed fertilizers and the "straight goods" he normally handles.

Recommendations are also divided into those for soils with fine-textured and those with course-textured surface soils. This division takes into account the amount of clay which might act as a reservoir for plant nutrients and the amount of available moisture that different soils can hold.

Since the laboratory is not as yet making tests for nitrogen, recommendations for this nutrient are based on the level of organic matter in the soil, the number of years since legumes or manure has been used, and the crop to be grown. Each of the tables also carries recommendations for methods of applying the fertilizer.

A typical recommendation for a farmer desiring good corn yields might be as follows:

Situation: A silt loam soil with corn after corn and no manure application. Organic matter medium, phosphate test low, potash test medium.

Fertilizer needs as indicated by table: 55 pounds of nitrogen
80 pounds of phosphate
30 pounds of potash

Fertilizer might be applied as follows: 100 pounds per acre of 0-48-0 or 250 pounds of 0-20-0 broadcast prior to plowing.

190 pounds per acre 4-16-16 or 150 pounds 5-20-20 in row at planting time.

140 pounds per acre 33-0-0 or 55 pounds 82-0-0 side-dressed at about second cultivation.

The bulletin also sounds a warning in regards to fertilizer use. Commercial fertilizers have an important place in any soil fertility and conservation program in Minnesota. But they will not take the place of drainage, liming, good crop rotations, or erosion control. They should be used along with these basic soil management practices.

The kind and amount of fertilizer to use depends upon the state of fertility of the soil and the crops to be grown. It must be understood that there is no best fertilizer for any crop on all soils, nor is there any best fertilizer for all crops on one soil. Fertilizer use for any specific field or crop can best be determined by the use of soil tests well correlated with fertilizer experiments.

Seed and Fertilizer Dealers Set Meetings

Five special regional meetings are being arranged for retail seed and fertilizer dealers in certain parts of Minnesota. The meetings are being sponsored by the University of Minnesota Agricultural Extension Service, Minnesota Crop Improvement Association, and Minnesota Seed Dealers' Association. For details see your local county agent.

Dates for the meetings follow:

Nov. 16, Worthington—Rock, Nobles, Murray, Cottonwood, and Jackson Counties.

Nov. 17, Granite Falls—Redwood, Lyon, Lincoln, Yellow Medicine, Lac qui Parle, Chippewa.

Nov. 18, Mankato—Le Sueur, Nicollet, Brown, Watonwan, Martin, Waseca, Sibley, Blue Earth, Rice, Faribault.

Nov. 19, Rochester—Goodhue, Wabasha, Winona, Houston, Fillmore, Mower, Dodge, Olmsted.

Nov. 23, Stillwater—Washington, Chisago, Isanti, Anoka, Ramsey, Dakota.

Stilbestrol Shows Promise in Beef Rations

WISE BURROUGHS*

Several outstanding research developments have come to light during the past year in beef cattle nutrition. Most striking perhaps has been the good results obtained with stilbestrol placed in cattle supplements as a feed additive.

Stilbestrol when added to cattle supplements increases live-weight gains markedly and decreases feed costs appreciably. Live-weight gains appear to be stimulated on all types of cattle rations. However, the greatest stimulation is noted on the better rations containing generous amounts of grains.

Gains have been stimulated as much as 37 per cent on high corn fattening rations which amount to as much as three-quarters of one pound additional gain per steer per day. On high roughage rations where cattle are being wintered to gain moderately, stilbestrol stimulates gains by approximately 10 to 15 per cent.

Both heifers and steers respond to stilbestrol feeding. However, somewhat more response is noted in steers. Age of cattle does not appear to be consequential in the response of stilbestrol upon growth and fattening. Cattle weighing 600 pounds appear to respond as well as cattle weighing 1,100 pounds. However, extremes in weight below or above this range have not been tested.

Feed costs on all types of cattle rations and with different kinds of cattle are reduced from 10 to 20 per cent. This saving in feed costs with current feed prices represents a saving of approximately 2 cents to 4 cents per pound of gain. Appetite is stimulated moderately by stilbestrol feeding, the stimulation in feed consumption averaging about 5 per cent.

* Professor of Animal Husbandry, Iowa State College.

EDITOR'S NOTE—In his presentation to the Fifteenth Annual Animal Nutrition Short Course, September 13-14 at the University of Minnesota, Dr. Burroughs reviewed many new developments in beef cattle nutrition. We here present a condensed version of of his remarks on the use of stilbestrol in beef cattle nutrition.

Stilbestrol in Fattening Cattle Supplement, Iowa State College, Ames, Iowa

112-day feeding period (8 steers per lot)	Milligrams of stilbestrol fed daily per steer			
	None	2.75	5.5	11.0
Av. initial weight, lbs..	691	693	696	696
Av. final weight, lbs..	941	968	992	1039
Av. daily gain, lbs.	2.23	2.46	2.64	3.06
Av. daily ration				
Ground corn, lbs.	12.7	12.7	14.6	14.6
Silage, lbs.	11.8	11.9	11.8	11.7
Hay, lbs.	2.5	2.5	2.5	2.5
Supplement, lbs	2.0	2.0	2.0	2.0
Feed required per 100 lbs. gain, air-dry basis, lbs.	940	864	874	756
Cost of feed per lb. gain	22.1¢	20.2¢	20.9¢	18.3¢

In one experiment at Iowa State College different levels of stilbestrol were added to the ration. These levels—0, 2¾, 5½, and 11 milligrams daily per animal—showed a progressive favorableness to the higher levels. Based upon all experiments conducted to date, the most desirable level appears to be 10 milligrams per animal daily. Although excellent results were obtained with 5 or 6 milligram levels of stilbestrol, slightly better results were obtained at the 10 to 12 milligram level.

One of the more encouraging features of mixing stilbestrol in cattle feeds is the absence of undesirable side-effects in bringing about faster gains and cheaper gains in the feedlot. Contrary to the experimental results obtained earlier with stilbestrol pellets given by implantation under the skin, no signs of restlessness, riding, udder development, and high tailheads have occurred in cattle given stilbetsrol by mouth by mixing it in feeding supplements.

The physiological action of stilbestrol when given orally therefore appears to be somewhat different than the physiological action of stilbestrol when given by pellet implantation.

Although dressing percentage and carcass grade seem to be lowered with stilbestrol implantation, there has been little or no alteration observed in carcass quality when stilbestrol is fed.

Finally the meat tissues from stilbestrol-fed cattle appear to be free of harmful residues of stilbestrol. This same situation is also true of the offal organs of cattle. Even the stilbestrol taken into the digestive tract in the feeding supplement appears to be quantitatively eliminated within a very short time. Data of this nature have been submitted to the Food and Drug Administration in Washington for approval.

WARNING

The information concerning diethylstilbestrol feeding in this report is in the experimental stage only and the materials and procedures described do not constitute recommendation for usage. Any person making use of these results at this time must assume all responsibilities for any hazards which may be involved.

IN THIS ISSUE...

- WHAT'S NEW WITH FERTILIZERS IN MINNESOTA? H. E. Jones, Extension Soils Specialist, and W. P. Martin, Head of Department of Soils, University of Minnesota
- CHANGES IN DAIRY FEEDING. Paul E. Newman, Vice-President, Beacon Milling Company, Inc., Cayuga, New York
- INTRODUCING THREE KEY STAFF MEMBERS
- STILBESTROL SHOWS PROMISE IN BEEF RATIONS. Wise Burroughs, Professor of Animal Husbandry, Iowa State College

UNIVERSITY OF MINNESOTA, INSTITUTE OF AGRICULTURE, ST. PAUL 1, MINNESOTA

Cooperative Extension Work in Agriculture and Home Economics, University of Minnesota, Agricultural Extension Service and United States Department of Agriculture Cooperating, Skuli Rutford, Director. Published in furtherance of Agricultural Extension Acts of May 8 and June 30, 1914.

UNIVERSITY OF MINNESOTA
Institute of Agriculture
Agricultural Extension Service
St. Paul 1, Minn.

SKULI RUTFORD, Director

Minn. 9—10-54—2M
Permit No. 1201

PENALTY FOR PRIVATE USE TO AVOID PAYMENT OF POSTAGE, $300

FREE—Cooperative Agricultural Extension Work, Acts of May 8 and June 30, 1914.