Table No. 3--EFFECT OF VARIOUS RATES OF APPLICATION OF COW MANURE UPON SUGAR BEETS. WITH THE ADDITION OF 150 POUNDS SUPER PHOSPHATE TO ONE HALF OF THE PLATS--1936-1937 RESULTS AT TORRINGTON, WYOMING.

| Treatments | | Harvested Beets | Tons of Beets | Percent | Gross Sugar | Apparent purity | Indicated Available |
|---|---|---|---|---|---|---|---|
| Manure Tons | Phosphate Pounds | Per Acre | Per Acre | Sucrose | per Acre | Percent | Sugar per Acre |
| 0 | 0 | 15700 | 8.9 | 16.8 | 2990 | 82.1 | 2455 |
| 0 | 150 | 19823 | 12.1 | 17.2 | 4162 | 87.0 | 3621 |
| 6 | 0 | 19482 | 13.4 | 16.9 | 4529 | 80.9 | 3664 |
| 6 | 150 | 20907 | 15.4 | 16.6 | 5113 | 84.6 | 4326 |
| 12 | 0 | 19925 | 14.4 | 17.0 | 4896 | 85.7 | 4196 |
| 12 | 150 | 20555 | 15.1 | 17.0 | 5134 | 81.5 | 4184 |
| 18 | 0 | 20378 | 15.3 | 16.5 | 5049 | 85.5 | 4317 |
| 18 | 150 | 19804 | 15.8 | 15.8 | 4993 | 82.6 | 4124 |
| 24 | 0 | 20506 | 16.1 | 15.9 | 5120 | 81.4 | 4168 |
| 24 | 150 | 20363 | 15.8 | 15.7 | 4961 | 83.0 | 4118 |

Note: All manures are applied at the above rates calculated upon a 50 percent moisture content. There are 5 replications of each treatment.

SUMMARY

1. As a whole the use of manure and legumes in the rotations have indicated increasement of yields of sugar beets and some decline in sucrose percentage but the yield increase has been so much greater than the sucrose percentage decline that profitable use of manure and legumes is usually indicated by the additional indicated available sugar per acre.

2. Excessive amounts of manure have not been profitably used if both use of manure and land is considered. Twelve tons per acre usually produces near maximum returns and 6 tons per acre produces the greatest gain per ton of manure used.

3. On phosphate deficient land less manure is needed if phosphate is added.

4. The sugar beet crop responds readily to the direct application of manure.

## SOME DATA ON RARE ELEMENTS APPLIED TO BEETS IN THE FERTILIZER

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A diseased condition of an agricultural crop has often been the stimulus to discover a deficiency in the nourishment of the plant. The crop is in a diseased condition because of some pathogene at work in the tissues, but that pathogene is very often there because of some faulty soil condition.

Many, if not most, of the plant diseases are only of economic importance because the nourishment of the plant is at fault. Very few plants develop without being in contact with sufficient number of disease spores to give them each and every wilt, blight and rot that is known to that plant. Our soil, with its decaying organic matter carries the spores of almost every known plant disease.

We have been struggling with seedling diseases of sugar beets, isolating Rhizoctonia, Phoma or Fusarium, and trying seed treatments as dusts, sprays, soakings, but in the end I can see Blackroot mainly as the result of certain physical conditions of the soil, where excess moisture, often accentuated by cold weather, puts the seedling in a condition that the ever-present fungi can easily invade it. True there are more pathogenes near the seedling when clover stems or alfalfa roots are decaying among the seedlings. Previous crop is also a big factor in the incidence of disease. It is also true that a low phosphate level is conducive to seedling diseases and we do not know how much is nutritional and how much is physical in relation to the plant infection. We do know that when the physical condition of the soil is good and the nutritional elements are present in adequate amounts, there is little tendency to plant disease.

The recognition of these facts has in recent years brought into being the term "deficiency symptoms" and this is now the "magic key" to unlock the door upon "cause and cure." Potash deficiencies, Nitrogen deficiencies, Phosphate deficiencies have had their day, and most agriculturists are on the lookout for these "rule of thumb" indications. They have been a great aid to healthier plant growth. They are easily corrected when diagnosed and have been a great aid to healthier crops.

More recently we have been made aware of the "rare elements" in plants and the evidence is accumulating that these substances, long known as present in plants in minute quantities, are essential to their normal growth. Applications of very small quantities can obviate definite plant abnormalities and diseases. Thus we have plant diseases related to Manganese deficiency, Magnesium deficiency, or lack of Copper, Boron, Iron, etc. In sugar beets the deficiency of a "rare element," or its effect upon preventing a disease, has been established in the case of "Heart Rot."

It was only in 1931 that Brandenburg demonstrated clearly that Boron deficiency occurs in the field and is the underlying cause of "heart rot" or "dry rot" in sugar beets. Already fertilizer companies are including Boron in their products. We have to guard against the tendency to think "rare elements" are a "cure all" and able to do more than they really can. "Facts about Sugar" published a report of Dr. Schmidt's work in Germany back in the February 1933 issue, and Mr. Lee Van Derlinder has given publicity to "Rare Metals in Soils" in articles of "Western Irrigation" and "New Agriculture." The most complete work on Boron and Plants of which I know has been published in England. "Boron and Plant Life" by the Boron Agr. Bureau in January 1936; "Developments in the Application of Boron in Agriculture and Horticulture" in October 1937, and "Boron in Agriculture", as Research Bulletin No. 5 of the "West of Scotland Agricultural College," in September 1937 gives a very complete picture of our knowledge to date.

In Ontario during the 1933, 1934 seasons we found some cases of "Heart Rot" of sugar beets in the alkaline soils. In 1935 we put out a preliminary

test with boracic acid on our field near Wallaceburg. The boracic acid was mixed with the seed and put in with a Planet Junior Seeder on a soil of pH 7.8, with 160 p.p.m. of available Phosphate (medium) and 35 p.p.m. of readily soluble Potash (low). The beets did not show "Heart Rot" but there was a very marked stimulus to plant growth. Our results were:-

Borax plot - 89% Stand; 10.05 tons; 16.0% sugar; 88.4% purity; 3216 lbs. per acre

Non " " - 89% " 8.60 " 16.3% " 87.8% " 3015 " " "

Magnesium treatments, as dolomitic limestone applied in the fall, compared to Calcium lime applications, failed to show any improvement over non-treated areas, on various farms. Our typical soil, called "Brookston" has upward of 1000 p.p.m. of exchangeable magnesium, with from 5 to 10 times as much exchangeable Calcium. Very few of our soils go below 500 p.p.m. for Magnesium (Steenkamp methods).

In 1936 similar treatments of Boron gave comparable results on the Clyde soils of high alkalinity-

With Boron 11.89 tons; 14.7% sugar; 87.2% purity; 3502 lbs. per acre
No Boron 10.83 " 14.9% " 85.0% " 3235 " " "

On the Thames Clay, a soil type bordering our rivers and a Marl type near Lake Huron, we found a marked lowering of the stand of seedlings from a 2-12-6 fertilizer including Boron, which had been made up by the Canadian Fertilizer Company. The fertilizer was applied with the seed at 250# per acre, and though supposed to carry only 10 lbs. of Borax per acre, it cut the stand 12% in a moderately dry spring.

In 1937 we had adequate rainfall to disseminate the fertilizer and too much rainfall in most of our territory. We made up several tons of 2-16-6 including 5 lbs. of Borax in each 125 lb. bag of fertilizer. We found no injury to stand when applied with the seed at 2 bags per acre. We also made up our 2-16-6 fertilizer with similar quantities of Manganese Sulphate, Copper Sulphate, and Sodium Sulphate. The experiments were scattered throughout the territory on various soil types, and the series included two special fertilizer materials claimed to be superior because of the "rare elements" they contained.

Peters' All-N-One fertilizer is advertised by its bag with practically every known element and reads like a "Mendeljeff's Table" from Helium to Uranium. These claims are made on the basis of the "coal" content, and coal being of plant origin has traces of every element found in plants. This product came on the market and we wished some data on its performance.

Mineral Colloids Limited, has established an agency for selling mineral colloids in Canada, and is sparing no expense in putting the product in the hands of our farmers as a "super" fertilizer with all the advantages of "mineralization, colloidal properties, electrolytic action and even vitamins are brought into the arguments in its favour.

We applied these two "rare element" fertilizers alongside the 2-16-6 mixtures at the same rates. All the plots were seeded at one time and received the same care throughout the growing season. Unfortunately some of the districts, where the tests were placed, had an almost complete loss of

crop due to flooding, but enough good crops were harvested to give significant results. Duplicate 1/100 acre plots were dug by hand on each treatment and 6 sugar tests made per plot. The following were the results:

| Treatment | Stand | Tonnage | Sugar | Purity of Juice | Recoverable Sug. per Ac. |
|---|---|---|---|---|---|
| **Data on 3 Farms Using Sodium Sulphate in the Fertilizer** | | | | | |
| Boron in 2-16-6 | 86.3 | 10.75 | 15.2 | 85.5 | 2770 |
| Sodium in 2-16-6 | 85.6 | 10.19 | 15.1 | 84.8 | 2551 |
| 2-16-6 Alone | 83.6 | 10.07 | 14.8 | 85.1 | 2501 |
| **Data on 3 Farms Using Mineral Colloids as a Fertilizer** | | | | | |
| Boron in 2-16-6 | 77.0 | 10.79 | 14.6 | 84.9 | 2612 |
| Mineral Colloids | 75.6 | 8.54 | 14.5 | 85.2 | 2044 |
| 2-16-6 Alone | 71.3 | 10.18 | 14.2 | 83.7 | 2382 |
| **Data on 5 Farms Using Boron, Manganese, Copper, etc. in the Fertilizer** | | | | | |
| Boron in 2-16-6 | 81.8 | 10.63 | 14.62 | 85.3 | 2609 |
| Sodium in 2-16-6 | | (10.19) | | | |
| Manganese in 2-16-6 | 81.2 | 9.71 | 14.54 | 85.4 | 2366 |
| Copper in 2-16-6 | 78.8 | 9.52 | 14.72 | 85.4 | 2339 |
| 2-16-6 Alone | 77.0 | 9.95 | 14.14 | 84.7 | 2355 |
| Peters' All-N-One | 80.8 | 9.01 | 14.24 | 84.8 | 2135 |
| Mineral Colloids | | (8.54) | | | |
| Diff. for Significance | 5.6 | .64 | .60 | 1.2 | 206 |
| Significant Treatments | none | Boron above Peters' below Min.Coll. " | none | none | Boron above Peters' below |

It is apparent that Sodium, Manganese and Copper Sulphate had only a slight effect upon the beet crop and showed no significant gain.

Boron did increase the yield significantly in these tests as to tonnage, but not in sugar or purity of juice.

The Peters' All-N-One fertilizer and Mineral Colloids were significantly below the standard 2-16-6 as to tonnage without having any significant effect upon other factors.

## SUMMARY OF RESULTS OF FERTILIZER TESTS CONDUCTED FOR THE LAST TEN YEARS AT THE DOMINION EXPERIMENTAL STATION LETHBRIDGE, ALBERTA, CANADA

A. E. Palmer, Dominion Experiment Station

Tests have been made with Phosphatic Nitrogenous and Potassic fertilizers on irrigated sugar beets since 1927. Phosphates, both triple-super and ammonium phosphates have increased yields in every test and on almost every individual plot where they have been applied at the time of seeding. Nitrogen applied at time of seeding has increased yields in most trials but not always and the yield increases usually have not been as great as have been secured with phosphates.