Warmer weather and better growing conditions may account for the fact that no field was entirely lost a second time. (94% of one field was lost, however).

The question arises as to whether better yield and sugar content might not have been produced by saving the best 53.12 acres of the original stands and carefully working them, at the proper time. Unfortunately no data or proof can be given to support or refute this idea.

Since no check plots were kept in these fields the results are subject to your own interpretation.

PHOSPHOROUS DEFICIENCY BLIGHT OF SUGAR BEETS often called BLACK HEART BLIGHT

R. A. Jones[1]/

In 1926 A. R. Williams, fieldman in the Wheatland Wyoming Beet District of the Great Western Sugar Company, had in his territory a field of beets that was dying from some unknown cause. The field had been in corn the previous year, and for sixteen years before that had been in alfalfa. In August a good portion of the beets had died except along certain irregular strips. On these strips the beets were normal and it developed that they were exactly on positions where refuse sweet clover had been hauled and burned before the field was plowed for beets.

The facts regarding the case were examined by several observers among whom was Asa C. Maxson, Superintendent of the Great Western Experimental Farm. His conclusions were that it was a nutritional problem, and the missing element had been supplied from the ash of the burned sweet clover. There seemed to be two possibilities, it was either potash or phosphorous or both that had made the difference. The next year tests were made with these two elements and it was definitely proven to be a phosphorous deficiency. Treblesuperphosphate alone corrected the difficulty, which ever since has been known as Black Heart Blight.

A study of the reoccurrence of the so-called Black Heart Blight has been conducted in Montana, Wyoming, Nebraska, and Colorado the past year. The first noticeable symptom in the leaves of beets suffering from a lack of phosphorous is a slight burning around the edge, which in later stages may cause the death of the entire leaf. As the damage progresses the leaf tissue dies between the veins.

In fields where the fertility is high in all respect except for phosphorous, and the leaves are large there often appears the copper colored leaf. This type of leaf is not positively identified with phosphorous deficiency, but always does occur along with the positive symptoms. It may be called the "paralytic" leaf. It is small with edges rolled inward from the sides and also from the top. The leaf thus resembles a paralytic hand with the fingers drawn

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1/Anaconda Sales Co.

inward. The tissue between the veins is usually dead. The appearance of the leaf is best shown in the transparencies and actual specimen exhibited at the side. As far as is known this leaf is a positive symptom of phosphorous deficiency and is never the result of any other cause.

Another very typical leaf symptom is shown in the attempt of the beet to put out small leaves at the center of the crown. As the larger outer leaves die the beet attempts to recover by putting out new leaves. In extreme cases however, all leaves die and the root succumbs to the ordinary processes of decay.

Root systems are less easily identified than those in the leaves. In the great majority of cases there is no apparent disorder in the root except its small size. Beets suffering from extreme phosphorous deficiency seldom reach a size of over three inches in diameter. More often they are one-half to one and one-half inches in diameter in the late summer or fall. The first pronounced root symptom is found as a small brown spot on the shoulder of the beet or in a recess usually not over half-way down on the root, Sections of the same beets show that the discolored portion is near the outside, or apparently develops from the outside, inward. The dead portion of the root develops as does the dead portions of the leaf. In the leaf the veins or main channels of food distribution are the last portions to be affected. At the outer edge it is more difficult to transport food materials, hence if there is a shortage of nutritive materials the most distant points are affected first. The same is apparently true with the root. Dead tissue forms at the shoulder or portion most distant from the source of food supply.

Phosphorous deficiency has been designated by various terms, Late Blight, Root Blight, and especially Black Heart Blight. Late Blight and Root Blight are quite appropriate but Black Heart Blight is confusing. As stated above phosphorous deficiency affects the shoulder of a beet or a recess lower down. The process of decay only reaches the heart of the beet in most severe cases. The term Black Heart Blight is more applicable to Rhizoctonia or Fusiarium. It is very poorly applied to the effects of phosphorous deficiency. A better term would be phosphorous deficiency blight, or for short P.D.B.

The indications are that the blight is not a disease. No organism has yet been definitely associated with it. The ordinary organisms of decay, of course, enter the beet and carry out its destruction after death takes place in the tissue by starvation.

The final proof that the symptoms just described are the result of phosphorous starvation is found in the fact that a field of beets showing the symptoms will recover when treated with a phosphate fertilizer. Several such demonstrations have been made in the Wheatland area. The recovery can never be complete, of course, but beets that have been almost completely defoliated for want of phosphorous can be made to grow an entirely new set of tops when side dressed with phosphate fertilizer.

A typical case of phosphorous deficiency blight occurred in the Greeley, Colorado, district this year. William Nicholson, who had experienced the blight in the Wheatland territory, was in charge of the field at Greeley. On the twelfth of August four rows were side dressed with phosphate. Within thirty days there were good tops on the treated beets, while the adjacent beets on each side were either dead or had very poor tops.

Samples dug from the treated portion indicate a yield of eight tons per acre as against the yield of five tons per acre on the untreated portion of the field. It is obvious that it would be impossible to produce a good yield by correcting a difficulty as late as the twelfth of August, but the fact that the tops grew again on the beets is sufficient evidence that phosphorous was the cause of the blight.

The literature, and especially that from Utah, describes what is termed "Late Blight," which according to the evidence presented is phosphorous deficiency blight. It is stated that late blight is very greatly favored by drought and that in past years has caused great losses to the beet growers in Utah. Drought, of course, causes phosphorous deficiency according to the ordinary laws of solubility. When moisture decreases, soluble phosphorous decreases, or in other words, phosphorous is not dissolved from the soil and hence the crop suffers for lack of this element.

Moisture affects solubility of phosphorous in still another way. Carbon dioxide is the principal means by which the phosphate in the soil is made available. When moisture is limited bacterial activity and the formation of carbon dioxide is also reduced. Furthermore the activity of the crop itself is retarded by lack of moisture and there is a corresponding decrease in the amount of carbon dioxide given off by the plant. The reduction of moisture thus causes a reduction of available phosphorous and a deficiency occurs.

The publications from Utah also state that a high pH favors phosphorous deficiency. This again is in full accord with the principles of solubility. As the pH rises or the soil becomes more alkaline phosphates are held in a more insoluble state. The deficiency is thus favored by a high pH which is according to the findings in Utah.

Phosphorous deficiency blight occurs only in extremely deficient soils. Actually such soils represent a small percentage of the total beet acreage. On these soils the crops usually do not pay more than the cost of harvest, and sometimes not even that amount. They do illustrate in the communities where they occur, how near the danger line the soils are becoming as regards the supply of phosphorous.

The symptoms of mild phosphorous deficiency cannot be detected in the plant. From an economic standpoint it is this unnoticeable handicap or deficiency that really reduces production on a large acreage. The extreme symptoms of deficiency as discussed calls to our attention the need of more watchfulness regarding the phosphorous supply in average soils or fields that have not yet become depleted to the danger line.

Note: A series of "color" photographs were shown which illustrated clearly the phosphorous deficiency symptoms of leaves and roots at various stages of development.

APPLYING FERTILIZERS TO SUGAR BEETS IN ONTARIO

H. W. Brown[1]

Sugar beets have been grown as a commercial crop in Ontario, Canada, for 40 years. It is the purpose of this short presentation, to show what part commercial fertilization plays in the production of this crop and what is the

1/Agricultural Research Dept., Canada and Dominion Sugar Co.,Ltd.,Chatham,Ont.