A COMMERCIAL DEALER LOOKS AT POTATO FERTILIZATION IN THE COLUMBIA BASIN

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Potato production is one of the basic cash crops in the Columbia Basin. A number of factors influence the yield and quality of potatoes produced in the area. Among these factors are: seed quality, date of planting, previous cropping history, fertilizer practices, irrigation techniques, insects and diseases, weed competition, harvesting and handling techniques, and climatic conditions including light intensity and heat units accumulated during the growing season. This paper will deal primarily with the thoughts and observations of the author during the 1962 season, as he had occasion to observe a number of fields in the area with regard to the effect of fertilizer rates and ratios on growth and production of the potatoes.

Average Potato Fertilizer Use of 100 Growers in the Columbia Basin in 1962

In order to arrive at an estimate of current fertilizer use on potatoes in the Basin, we analyzed the records of 100 growers in the area. No attempt was made to determine previous crop history, or previous fertilizer practices, which would of course influence the amount of plant food a grower would use. Twelve of the growers were in the Othello-Warden area, eight on the Royal Slope, and 80 in the Quincy-George-Ephrata area.

The average plant food used by these growers was as follows:

Nitrogen - All the growers used nitrogen. The rate of application varied from 40-240 pounds of actual nitrogen (N) with an average of 140 pounds per acre.

Phosphate - All the growers used phosphate. The rate of phosphate application varied from 40-160 pounds actual phosphate (P_2O_5), with an average of 90 pounds per acre.

Potash - 85 percent of the growers used potash. The rate of potash application varied from 40-120 pounds with an average of 70 pounds K_2O per acre.

Zinc - 80 percent of the growers used zinc the year the potatoes were planted. The average application was 4 pounds actual Zinc (Zn) per acre.

Boron - 24 percent of the growers used Boron in rates varying from $\frac{1}{2}$-1 pound actual Boron (B) per acre. The average application was 3/4 pound actual Boron per acre.

These results indicate that the average grower in the Basin based on our own records would use the following formula:

140-90-70 + 4# Zn + 3/4# Boron per acre

Efficiency of Fertilizer Use

Nitrogen

In the Columbia Basin we can expect, at best, about 70-75% efficiency in the use of the nitrogen applied during any one year. Some of the nitrogen will become tied up in the protein of soil micro organisms, become a part of the soil organic matter complex, become leached out of the root zone by irrigation practices, or gravitate toward the top few inches of the potato hill and be unavailable to the potato roots.

During the 1962 season soil tests were taken in the potato hill every 2" to a depth of 16" in a number of fields during July and August. The potatoes sampled indicated that they were quite low in nitrogen. In nearly every case, nitrogen, as nitrate nitrogen, had accumulated in the top 2" of the hill, although the nitrate content in the soil cores below the top 2" was negligible. A good rain would have resulted in an extra 30-40 pounds of nitrogen becoming available to the nitrogen starved plants.

Generally speaking, in the fields the author observed, nitrogen did not become a limited factor when reasonable amounts were applied in a band at planting time and where ammonium sulfate or the ammonium form of nitrogen made up the major portion of the nitrogen applied.

In several cases of acute nitrogen shortage the growers added additional nitrogen (about 20# N over a 3 week period) to the plants in very small amounts in the irrigation water. The potatoes were about 2" in diameter at time of application. No apparent ill effects were noted and the growers felt that the crop had been materially assisted by this application. Our observations indicate that tissue tests or soil tests will show an impending nitrogen shortage, and additional nitrogen should be added while the plant is still active and growing and before the nitrogen shortage becomes acute.

Phosphate

The potato plant will only utilize about 15-20 percent of the phosphate applied during the current season. Competition of the micro organisms for the phosphate, reversion of the phosphate to dicalcium and tricalcium phosphate forms and positional unavailability of the phosphate will generally account for most of the non-crop use during the current season of the other 80-85 percent. Three main factors will influence greater utilization of phosphate in the Columbia Basin. These factors are:

1. Band placement of water soluble phosphate sources

2. Maintenance of adequate moisture content of the soil during the growing season (inhibits tie up of P_2O_5 in reversion forms)

3. Higher soil temperatures during the growing season (stimulates calcium dioxide production by the roots forming more carbonic acid and subsequently more availability of soil phosphate minerals)

Potash

The efficiency of potash uptake during the current season of potash applied that year, probably approaches 50-60 percent utilization. Potash applied in a band at planting time with adequate moisture during the growing season may run as high as 80 percent. The potato plant uses large amounts of potash and this requirement is particularly high during the time of tuber formation. Potash deficiency symptoms were observed in a number of fields during the 1962 season. Confirmation of potash deficiency symptoms should be made by running soil and plant analysis for the element, since several fields which appeared to have potash deficiency symptoms actually contained fairly adequate amounts of potash in the soil and plant tissues.

No potash deficiency symptoms were observed in 1962 on potatoes fertilized with 80# K_2O or more per acre, applied in a band at planting time.

Plant Food Requirements of the Potato Crop

The plant food removal by a potato crop is basic to the analysis of nutrient requirements. Information from the literature indicates the following plant food removal by a potato crop.

	Pounds Plant Food per Acre		
	N	P_2O_5	K_2O
1 Ton Tubers	7.0	2.5	13.5
Plant Growth to produce tubers	3.0	1.0	5.5
Total for Plants and Tubers	10.0	3.5	19.0

Consequently the amount of plant food required for a potato crop will depend to a great degree on the tonnage a grower anticipates growing. For instance:

	Pounds Plant Food per Acre		
	N	P_2O_5	K_2O
A 10 ton crop will remove	100	35	190
A 20 ton crop will remove	200	70	380
A 30 ton crop will remove	300	105	570

The following discussion will show why it is necessary to take other factors such as, efficiency in fertilizer use, before we decide what fertilizer ratio to use.

General Fertilizer Recommendations for Potato Growers in the Basin

Assuming that the average grower uses 140# N, 90# P_2O_5 and 70# K_2O, and assuming efficiency figures of 75%, 20%, and 60% for the N, P_2O_5 and K_2O, respectively the potato plant would have available, plant food for the current season equivalent to 105 pounds N, 18 pounds of P_2O_5, and 42 pounds K_2O. Subtracting this from what a 20 ton crop needs we get:

	N	P_2O_5	K_2O
Amount a 20 ton crop needs	200	70	380
Amount being applied	105	18	42
	N	P_2O_5	K_2O
Additional amount needed from soil or fertilizer	95	52	338

It would be impractical to make a general fertilizer recommendation for the various areas in the Columbia Basin. A fertilizer that will produce a good yield on Babcock Ridge would be very inadequate on the Royal Slope. Consequently we believe that fertilizers should be custom formulated for the different areas and individual fields.

The particular fertilizer formula a farmer needs should be based on the following points.

1. Previous Cropping History - particularly helps to estimate the nitrogen needs.

2. Soil Tests - particularly helps to indicate the need for phosphorus, potash, and boron.

3. Yield Desired - every farmer will want maximum yields, but consideration should be given to what is a practical limit because of soil, water, or other management limitations. In other words, if you think you can grow 28 tons, fertilize for this amount; however, if 18 tons is more practical, fertilize for this amount of tonnage.

Once the amount of plant food required has been arrived at, we believe the following points should be observed for maximum efficiency of plant food use.

A. Band the Fertilizer at planting time with the planter. Normally commercial planters are set to place the fertilizer in two bands approximately 2" side of and 2" below the seed piece. It is important to adjust the planter to make sure that the fertilizer is being placed in this position. We believe it is important to band all the phosphate, potash and zinc at planting time. Since growers prefer to split their nitrogen application either as a plough down or side dressing, we believe that at least 50 percent of the nitrogen should be banded at planting time if they follow this practice.

B. Use Ammoniacal Forms of Nitrogen, such as ammonium sulfate or ammonium phosphates as the principal source of nitrogen. The acidity created by these nitrogen forms will create an acidic zone around the band which will tend to keep the zinc and other micro elements in an available form. The acidity in the band will also tend to prevent the formation of nitrates, so that the nitrogen will stay put and available over a longer period of time.

C. Apply Zinc Annually. It has been our experience that growers are often uncertain as to when zinc was last applied to the field, where potatoes are to be planted. In view of the small cost involved, we

would advocate the growers using 4-5# actual Zinc per acre the year the crop is planted. This can be conveniently added to the fertilizer formula and banded at planting time.

D. Keep the Soil Moist. Once the potatoes are actively growing, keep the soil moist so that the plant food will be available at all times for this fast growing crop.