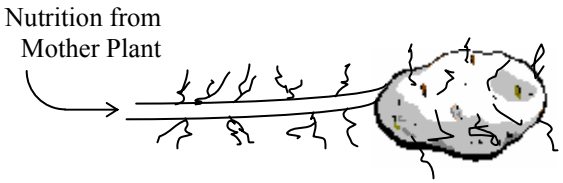
The Language of the Potato Plant (1)

The potato tuber is a subterranean plant with an umbilical cord connected to the mother plant.



Roots for Supplemental Nutrients

Although most of the food comes from the mother plant,the tuber and stolon has roots in order to absorb additional nutrients.

Since the tuber does not convert photosynthates,all of the photosynthates must be supplied from the mother plant.

Since the tuber is a plant,it must control cellular formation and control cellular pH…or cells will collapse and sugars will be lost back to the mother.

The major factor that controls potato production is the hormone balance throughout the growing season. The hormone balance changes as the plant undergoes various stages of growth ….vegetation, tuberization, and bulking. It is altered by various nutrient applications and stress conditions.

The hormone balance drives potato production and every other crop production. This balance is greatly affected by nitrate accumulation in the leaves. High levels of nitrate cause the plant to produce higher levels of IAA and auxins. This causes accelerated growth of the vegetation parts. Under periods of STRESS, it causes higher levels of ethylene in the plant.

Ethylene is the aging hormone. It is responsible for early dying of potatoes. It is also responsible. For enzymes (polygluactronase) which weaken cell wall tissues. They act like Pac Man inside of the plant and tubers. In order to obtain maximum yield and quality, ethylene levels in the plant must be controlled.

Ethylene levels will increase when the plant comes under STRESS. This is apparent by excessive flowering under STRESS conditions. Ethylene causes flowering.

During the condition that causes STRESS, the damage to plants will be greater when leaves contain higher levels of nitrate. There are also conditions that predispose the plant to various diseases. It is noticed that well fertilized crops can collapse after STRESS conditions occur.
Disease infestations always follow.

As we now consider the plant, we observe that nitrate creates a hormone balance that stimulates top growth. It increases photosynthesis. Under STRESS conditions, however, it encourages ethylene formation which causes all of the negative effects of STRESS …..

- Disease susceptibility of plants
- Early dying
- Disease susceptibility of tubers
- Physiological disorders of tubers

It is impossible to grow economic yields without the use of nitrogen. We must understand how to control ethylene levels in the plant when using optimal ratios of nitrogen. How can we control ethylene levels in the plant?

Hormones produced by the roots (cytokinins) control ethylene levels in the plant. The ratio of IAA to cytokinins will affect growth of auxiliary buds in the rooting area and vegetation parts of the plant. The plant must maintain root dominance during the growing season, if maximum yields are to be maintained. This is not only important for potatoes but also for other crops.

A “root dominant ” plant will have a distinctive look. It will have more branching points (lateral growth). It will have a “boxy” appearance. It will maintain this boxy appearance throughout its growth cycle. Tubers will continuously set. There will be no skips in tuber set. Plants will be resistant to disease. They will not die early.

If plants do not have the above appearance, they are not root dominant. They do not have the proper hormone balance for maximum production. Under STRESS conditions, the root system becomes more dysfunctional and the hormone unbalance becomes more severe.

STRESS always starts in the roots. Dysfunctional roots limit hormone production by the roots. This allows ethylene levels to increase. Bad things then begin to happen. Root growth is the key to maximum yield and disease resistance.

Root hair growth must be continuous. New root growth develops directly behind the root cap.

This is where new meristematic tissue is formed. An abundant amount of calcium is needed in this zone, or new tissue will not properly form. Roots will begin to “leak ”.

A “leaky ” root will leave a trail of sugars and amides which allow a highway for disease attraction.

This is called Chemitaxi (chemical taxi). A "leaky " root becomes dysfunctional and ceases to produce hormones.

The absorption area for water and nutrients by the roots occur about 10 mm behind the root cap.
After root parts are 7 to 14 day old, they cease to be functional for water and nutrient uptake.

CONTINUOUS ROOT GROWTH IS NECESSARY FOR PROPER HORMONE BALANCE.
It is also necessary for water and nutrient uptake. Anything that affects new root growth will cause plant STRESS.

If we understand the above, we can then proceed with a practical understanding the various things that we see. It is simple to understand. Solutions to the problem can then be investigated.

High levels of nitrates in the leaves produced high levels of organic acids in the leaves. These organic acids MUST be neutralized by either K, Mg, or Ca. Although potassium can help neutralize these acids, they prefer calcium. These organic acids will get calcium. They always increase the calcium gradient inside of the plant.

As organic acids increase in the leaves, they "suck" more calcium into the leaves.
This causes the depletion of calcium at root tips, stolon tips, and tubers. The following things then happen:

- When stolons begin to swell, the growing point is aborted. No tubers form.
- Growing tubers lose calcium back through the Xylem tissue. This causes hollow heart and predispose tubers to disease and lower starch.
- Root tips do not have enough calcium in the rhizosphere for normal tissue development. Roots leak. Disease invades. Hormone production from roots decrease.Ethylene levels in the plant increase. The result is STRESS.

How do we avoid the above problems?

Research: The University of Wisconsin shows that the level of calcium in the seed piece will determine quality,vigor,and disease resistance.High levels of calcium in the seed pieces will carry over into higher yields,the year of planting.

1. Replace the use of nitrate nitrogen with ammoniacal or amine nitrogen.
This will reduce organic acids in the leaves.

2. Apply ample amounts of soluble calcium in the "cover soil"at the time of planting. Apply ample amounts of soluble calcium in the root zone particularly the "stolon zone".This will help control rhizoctonia and early soil borne diseases.

3. Foliar apply the same hormones that are produced by the roots in order to insure ethylene control in the plant.

4. Keep K levels in the potash above 10 % K in the petiole. The higher you can get it, the more sugar will move out of the leaves to the tubers.

5. Always use at least one pound of boron per acre in this program.

Conclusion:
The major objective of the above answer is to reduce STRESS. If our analysis is correct, the crop will have:

- Higher yields
- Less disease
- Better quality tubers
- Less STRESS on growers who store spuds.

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