Potato Production Challenge

1. Seed Piece

   A high quality seed piece will have fewer stems … two to three. The stem will have more vigor and less disease. The quality seed piece will decompose more slowly and provide more food to the plant over a longer period of time.

   By controlling the number of stems per seed piece, it is easier to plan the number of plants per acre more accurately. This is very important for obtaining the maximum yield per acre.

   The seed piece must be able to germinate in cool soil and have early vigor. This is a hormonal response.

   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.

   If seed pieces do not have adequate calcium, additional calcium can be added to the seed furrow at the time of planting.

   Seed germination is determined by the ratio of ABA : Gibberellic Acid and cytokinin.

2. Early Growth.

   When the soil is cool, the early growth is slower. The plant, however, has adequate food from the seed piece. It is important to control rhizoc at this period.

   When the plant begins to make food, independent of the seed piece, it may go into a period of "malaise" … non-active growth. Some people claim that this is due to the mineralization of nitrogen … inadequate nitrogen for the young plant.

   Closer observation, however, shows that this is a problem on "older potato ground" … not "new" ground.

   The same problem may occur on the fruit trees planted on old potato ground.

   This primarily is a hormone problem (too high rates of Cytokinin : Auxin) and also a possible Zinc, Manganese, Copper insufficiency.

3. Later, Early Growth.

   This period really begins our challenge. Following are important things to observe:

   - Rapid top growth with longer internode length. Vertical growth is rapid. (This is bad)
   - Strong lateral growth. Smaller internode length. The plant should have a "boxy" appearance. (This is good)

   The longer internode growth is caused by an excess amount of auxin production in new leaves and higher level of gibberellic acid. The primary cause is excessive nitrogen.

   Excessive growth normally begins after soil temperatures rise. Stolonization is reduced and can be inhibited. This results in a few early set tubers with a skip in tuber set until plant growth slows down. This is a hormone problem caused by excessive nitrogen.

4. Insufficient Plant Growth.

   Other than inadequate fertilizer use, several things can reduce plant growth. Each reason is due to inadequate production of auxin in the new leaves … particularly leaves on the vertical stems (not lateral branches).

5. Flowering Period.

   Flowering is caused by higher ethylene in the plant. Increased ethylene is caused by plant stress. If plants are not stressed, flowering is reduced or eliminated.

   It is extremely important to reduce flowering (see point 6, below).

   There are two ways to reduce ethylene production (plant stress).

   A. Load up the plant with calcium (University of Wisconsin Research)
   B. Change the SAM cycle on the plant (accepted plant physiology)

6. Post-Flowering Period.

   The 7 to 10 day period of post-flowering (flower drop) may be the most significant period in the determination of yield.

   During this period, the plant undergoes a tremendous change in hormone balance. Plant "weakness" is often observed. This observed "weakness" is always greater if the plant has a "heavy" tuber load. Irrigation during this period may compound this problem.

This event can become the beginning of "early dying". The root system will become more dysfunctional. This has been a real problem for Norkota and some other varieties.

7. Continuous Set and More Even Sizing

   This is a problem of continually vigorous plant growth. It is that simple. The important issue is "maintaining the control of roots over the tops" during plant growth. THE most IMPORTANT criteria in all plant production is the maintenance of CONTINUOUS plant root hair growth. Please re-read the last sentence.

   Why?

   Plant growth, tuberization, tuber sizing, and disease resistance is controlled by CONTINUOUS root hair growth. It is the new meristematic root hair tissue that "perks up fertilizer nutrients" and makes some important plant hormones.

   If root hair growth slows down, plants will become disabled and "early dying" will begin. Tubers will not uniformly size. Sequential sizing results from an excessive amount of hormones produced in the plant compared to the hormones produced in the roots.

8. Early Dying.

   See point 7.

9. Tuber Quality of Table Stock and Seed Potatoes.

   Since these potatoes are dug earlier than other potatoes, they have some unique challenges.
   - Tuber shape
   - Tuber uniformity
   - Skin set.

   The above program will control both tuber shape (soil applied Nitrate Balancer) and controlling plant vigor. It will also control tuber uniformity … reduces sequential sizing.

   Skin set is another matter. Please think of the tuber as a fetus that gets food and hormones from the mother through the umbilical cord … stolen. The skin set does not occur until it is time to be born. The signal to be born (skin set) is triggered by the decrease of hormone (IAA) that the mother plant transfers to the tuber … through the stolen.

   As long as the mother transfers hormone (IAA) to the fetus (tuber), the tubers will want to continue to grow. The skin will not set. Vine killing stops the hormone from the mother. This forces the tubers to be born prematurely. After about 20 days from vine killing, the skin may set … if the vine killing is 100% effective.

Now, comes the interesting part. If the movement of hormone (IAA) from the mother to the tuber can be decreased 30 days before killing,

- The tuber will size faster
- The skin set will begin earlier.

10. Yield and Quality.

The yield and quality is determined by both:

- Movement of sucrose volume from the leaves to the tubers in both volume and consistency.
- Conversion of sucrose to starch in the tubers.

There are two distinct periods of tuber weight.

- Sizing period before bulking.
- Bulking period.

Any potato grown can bulk tubers. This is triggered by plant senescence or vine killing.

Only skilled growers can size tubers during the growing season … before the bulking period. This requires a continuous flow of sucrose to the tuber. This requires a lot of sucrose flow from the leaves to the tuber. What is necessary for this to happen?

- Control nitrogen
- Control Irrigation
- Control vigorous plant growth
- Increase new root hair growth
- Keep cellular pH high with K^+ and Na^+. Polyamines will also increase cellular pH.
- Continually trigger sucrose movement out of the cells and into the phloem tissue.

If the above practices are followed (Nitro Plus + Nitrate Balancer + Calcium 5 X), they will automatically cause these things to happen. Note: K levels in the plants petioles before bulking should be over 11%.

The sucrose that moves into the tubers during the sizing period will give the grower a better quality and quantity of yield than the sucrose that moves into the tuber during the bulking period. Sizing added to the tubers during the sizing period will make the difference of yield of 400 bags per acre and 600 bags per acre.

11. Harvest and Post-Harvest Quality

The grower's major concern is the quality for the marketability of his or her crop. This has been much more important than higher yields.

As mentioned before, we must not allow the plant go into senescence. Even though we think that this is normal at the end of the season, we must not allow it to happen.

IF WE KILL GREEN VINES, TUBER QUALITY WILL PROBABLY BE BETTER.

Providing that we get through the season with healthy roots and control plant vigor, tuber quality will be good … until the last 30 days before vine killing. Tuber quality (high sugars and lower gravity) is normally affected during the last 30 days before vine kill or harvesting the crop. The oldest tubers are more greatly affected.

POST-HARVEST (STORAGE) QUALITY MUST BE CONTROLLED PRE-HARVEST.

Why is the last 30 days most important for quality control? Why are the older tubers more sensitive to quality?

For the same reason that all storage tissue of many crops are sensitive to quality (storage) during post-harvest. Ethylene increases in the storage tissue and causes an enzyme to form. This enzyme (PAC MAN) increases with age. It causes cell tissue "break down". Then, the tissue deteriorates. Starches turn to sucrose and rotting (fermentation) begins.

Nothing smells worse than rotting potatoes … unless it is rotting onions. It is a fermentation process caused by PAC MAN. It begins working in older tubers about 30 days before vine killing and accelerates during the pre-harvest and post-harvest period … just like canler growth.

How do we inhibit this process?

How do we inhibit PAC MAN?

The same way it is inhibited in other crop's storage tissue … calcium, calcium, calcium, and more calcium. (University of Wisconsin).

- Recommendation: Apply 15 to 20 gallons (60 to 80 liters) per acre of Nitro Plus every 7 days … 21 days, 14 days, 7 days before vine killing.

Note:

A. Do not use CAN 17 or Calcium Nitrate as late nitrate nitrogen will decrease quality.
B. Make sure that vines are thoroughly killed. Do not allow regrowth. This is a killer of quality.
C. Protect the crop against any early dying.
D. If crop begins to die, immediately kill vines. One bad tuber will cause PAC MAN to get into other tubers in storage.

12. Cracking.

This normally happens toward the end of the season when the soil is wet and nighttime temperatures drop.

Water density is greater when temperatures drop.

Water expands when temperature rises.

In fairly cool soil, tuber absorbs more water from the soil and plant. When temperatures rise, the additional water in the tuber expands. The pressure is so great that the tuber can crack.

This can happen after harvest.

This can happen in storage.

How can it be reduced? The same way it is managed in fruit … calcium, calcium, calcium. This will increase cell wall strength.

Things To Observe

1. Count the average number of stems per seed piece. This will indicate the quality of seed pieces or effectiveness of calcium treatment in the cover soil.

2. Observe for interruption of young plant growth on old potato land. Determine if foliar spray will resume faster growth.

3. When plants begin rapid growth, determine if they are growing in a "boxy" appearance. If not, treat them immediately.

4. Note the amount of flowering and areas of the field with more flowers. Dig up plants in the non-flowering area. Compare the roots with those of plants from more flowering area.

5. Once a week, dig up plants and observe roots.

   White roots = healthy plant
   Dry tan-colored roots = trouble

6. Very carefully observe plants and plant roots about 1 week after flower drop. Plants with poorer roots will be more subject to "early dying".

7. Dig up plants with shorter internodes and compare
   - Continuous set
   - Size uniformity

   with taller plants and longer internode length.

8. Compare roots from diseased plants with those that have no disease. Plants grow from the roots up. Plants die from the roots up.

9. Note plant with early dying. How much of the field has senesced before vine killing?

10. Tuber quality

    Have gravity run on the largest tubers …
    - 60 days before vine killing
    - 30 days before vine killing
    - 0 days before vine killing
    - At Harvest

    Do you see a difference?

Typical Fertilizer Program:

The amounts should be recommended by a professional. Following are some criteria.

Broadcast:
70% of potash
100% of sulfur

Band apply to the side and below seed pieces:
100% phosphate
100% secondary and micronutrients
40% of nitrogen
Include a minimum of 100 lbs per acre of ammonium sulfate

Early sidedress:
30% of Nitrogen
30% of Potash

Balance of Nitrogen:

Have it all on by 60 days after emergence.

Do not apply nitrogen later … even if plants look like they need some. Get it on early.

Micronutrient program in dry starter program:

100-130 pounds per acre of MICROMATE® CFM will guarantee that there will be no deficiencies in:

- Calcium
- Magnesium
- Zinc
- Manganese
- Iron
- Copper
- Boron.

Apply P, K, S according to soil tests.

If it takes more than 240 pounds of nitrogen per acre in order to raise 420 bags per acre, something is wrong. Let's find the cause.

QUESTIONS
AND
ANSWERS

Question: Will Nitro Plus always increase yields?

Answer: According to research at University of Wisconsin and Oregon State University, very significant yield increases will only occur during "stress conditions."

Question: Will Nitro Plus always increase tuber quality?

Answer: According to research, YES!!

Note: Quality is becoming a bigger concern than yield … particularly for processing tubers held in storage.

Question: How much Nitro Plus should be used per acre?

Answer: Most of the University work was done at levels of 100 lbs. per acre and 200 lbs. per acre of Calcium.

Most growers are using between 80 and 100 lbs of calcium per acre.

Question: Why is Nitro plus recommended every 20 days?

Answer: The effect tends to diminish after 20 days following application.

Question: Why do you add Nitrate Balancer to Nitro Plus?

Answer: Nitro Plus causes a spurt of new root growth. Nitrate Balancer causes lateral root buds off of the new roots.

Question: Why can we not just foliar spray calcium?

Answer: Foliar Calcium may help plant stress; however, it will not move down to the tubers. Calcium is non-mobile in phloem tissue.

Question: When is calcium most needed in the tubers?

Answer: When the tuber is sizing … particularly during bulking.

Question: Is Nitro Plus just a calcium source?

Answer: No. It is the unique form of nitrogen that causes a burst of new root growth. This keeps proper hormone balance in the plant. It also inhibits "early dying."

WARNING!!! DO NOT MIX NITRO PLUS WITH ANY FERTILIZERS CONTAINING PHOSPHATE OR SULFUR.

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