

Potato Biology



- **Structure of a potato plant and tubers**
- **Dormancy and sprouting**
- **Controlling sprouts in stored potatoes**

FIGURE 9. A typical potato plant during early tuber initiation.

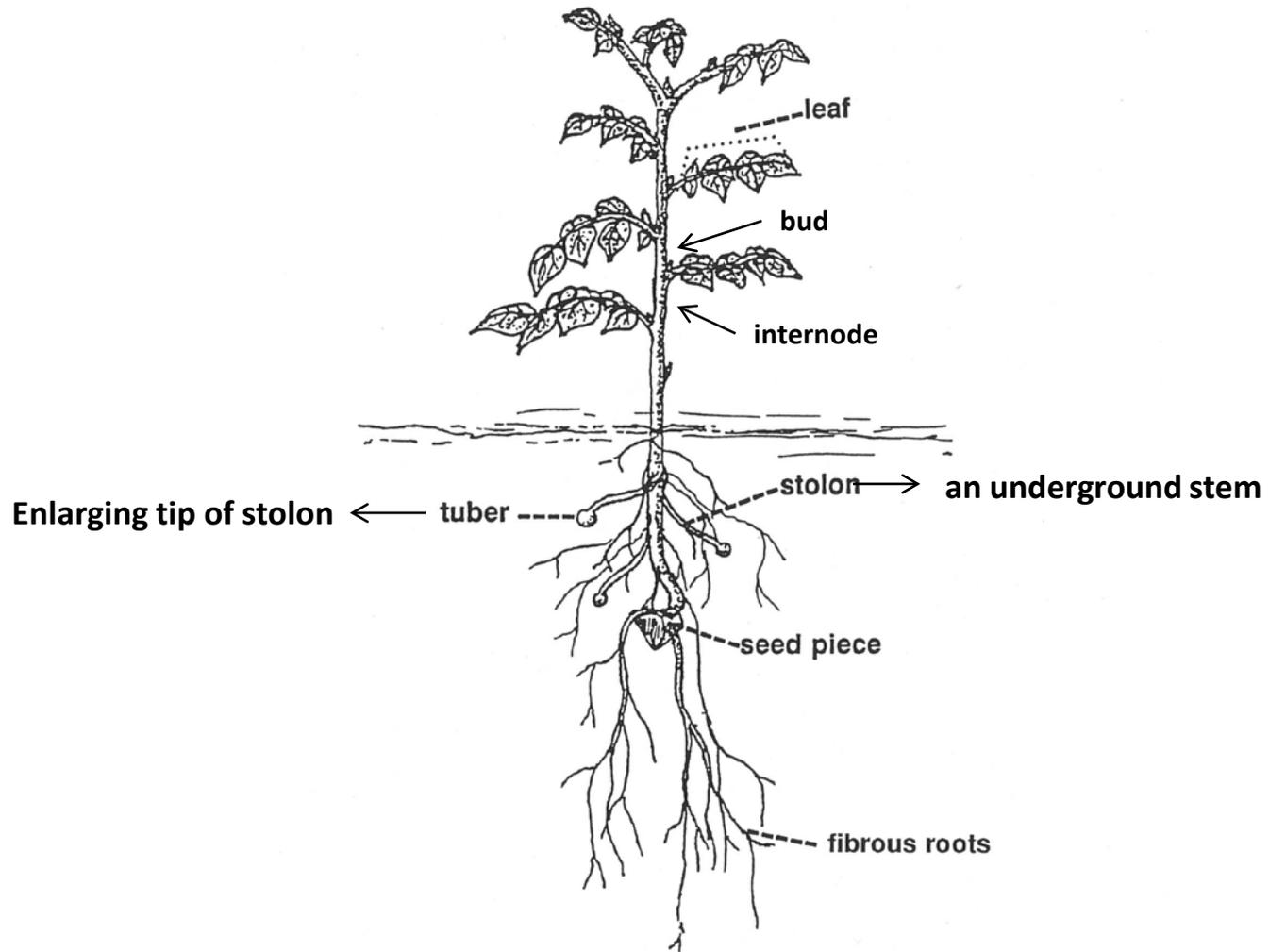
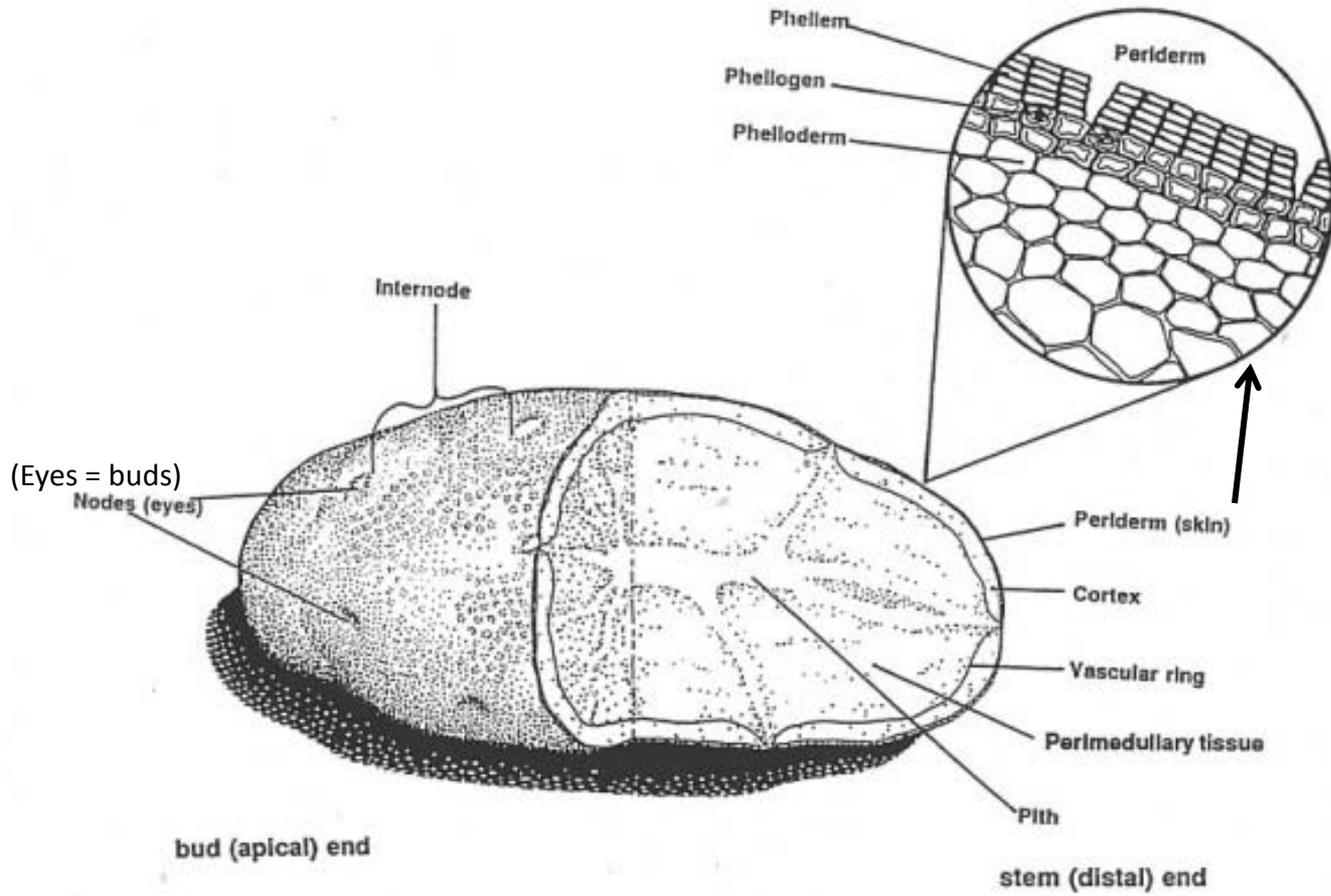


FIGURE 10. The anatomy of a potato tuber.



Sprout growth = cell division



- Only portion of a mature potato tuber that can “grow” are the small clusters of cells in each eye called “sprout meristems”
- Rapidly repeating cycles of cell division, enlargement, and elongation within meristems after dormancy break, results in sprout growth

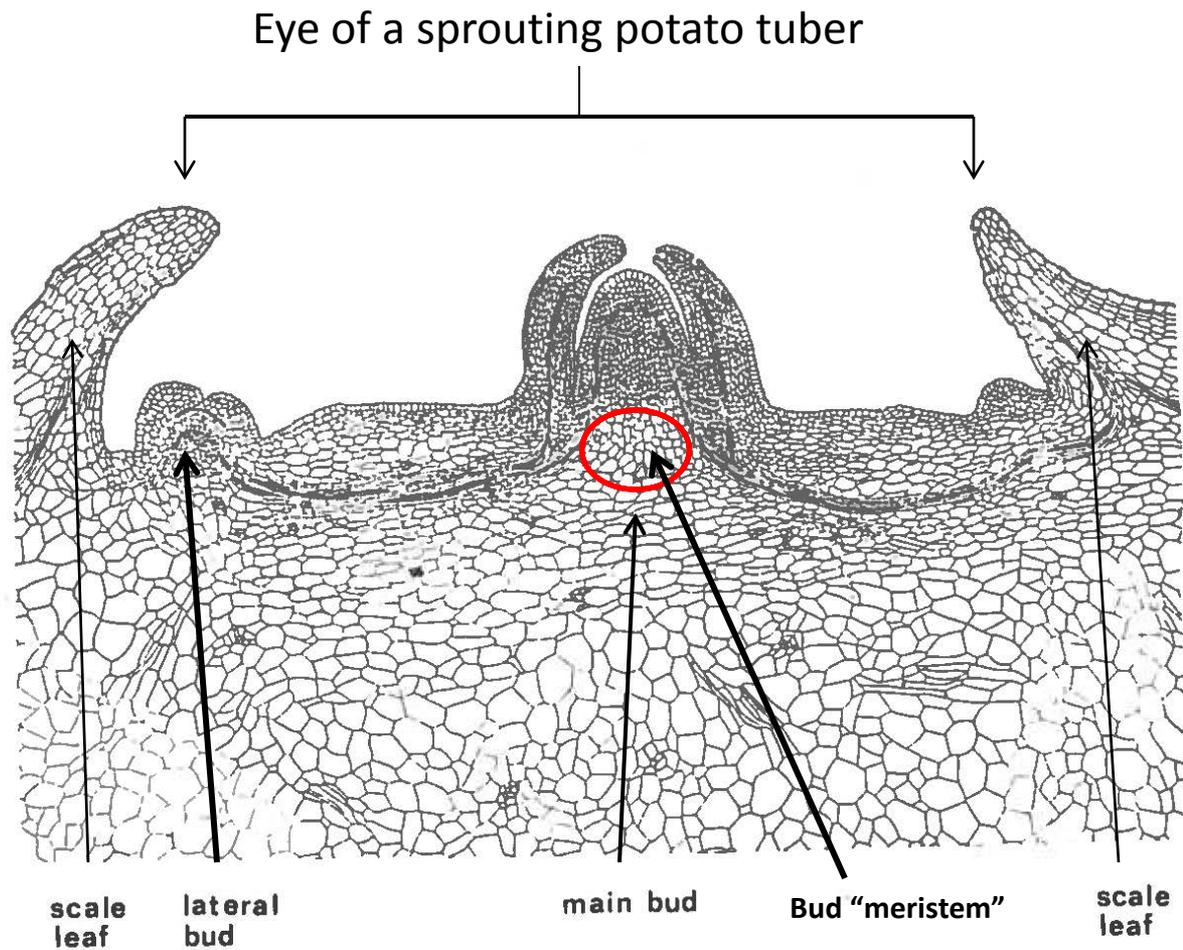


Fig. 1.10. Drawing illustrating structure of potato buds and surrounding tissue (from Artschwager, 1924).

Dormancy and sprout growth



- **Mature, healthy potatoes are harvested in a dormant state**
 - Dormant eyes will not sprout even if tubers are held under conditions conducive to sprouting
 - Each variety, crop, and field has its own period of “natural” dormancy
 - When the period of natural dormancy “expires”, eyes begin to sprout

Potato Dormancy



- **Factors affecting**
 - - variety or cultivar
 - - growth in field: poor fertility, water or heat stress, disease, all shorten dormancy
 - ✦ Healthy, green plants right up to harvest --> longest dormancy
 - - storage: temperature and temp uniformity

Sprout control and suppression



- **Low Storage Temperature**
 - Longer natural dormancy
 - Slows the growth of sprouts after dormancy breaks
 - Processors dilemma: also increases sugar
- **Chemical sprout suppression**
 - Prevents sprout growth through herbicidal action (CIPC, clove, mint, etc.)
 - Temporarily suspends/suppresses normal cell division cycle (DMN)

DMN- History



- 1960's: British scientists detect volatiles from stored potatoes that suppress sprouting
- 1970's: volatiles identified
 - dimetylnaphthalene(DMN) one of the most active
- 1996: Registered in the US
 - 1,4 Sight, Ship, and Seed
- 2011: Registered in Canada
- 2012 Registration for selected European countries anticipated

Characteristics of 1,4 Sights(DMN)



- Liquid at room and storage temperature (MP = 5°C)
- Applied by wicking, cold aerosol, or hot fog
- Highly volatile (20,000x more than CIPC)
 - Spreads and penetrates through pile
 - Absorbed by potato skin and eyes
 - Residues decline rapidly over 4-6 weeks

DMN mode of action (MOA)



- **Triggers genetic response in tuber meristem**
 - Inhibits expression of genes that promote cell division
 - Enhances expression of genes that inhibit cell division
 - Extends dormancy period
- **Completely reversible**
 - Once residues <1.0ppm, sprouts resume normal cell division(growth)
 - Can be used in storages where seed will be held, with no effect on seed performance
- **Gene expression for proteins involved in resistance to water loss also enhanced**
 - Anecdotal evidence of shrink and pressure bruise reduction

Sprout Control: 1,4Sight®



UTC (8 wk @ 50F)

7-10ppm DMN (8 wk @ 50F)



DMN-Timing and rates



- **Timing**
 - 7-14 days after potatoes go into storage
 - Repeat every 6 weeks
 - Shorter interval if sprouting resumes
- **Rates**
 - 7-10ppm (~ 1 gallon per 350-400 mt)
 - Higher rates needed if large “headspace”

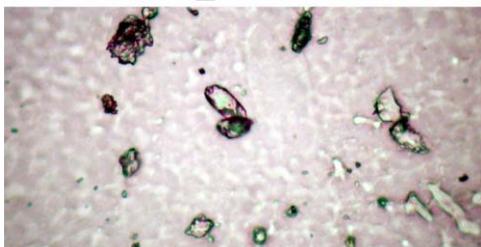
CIPC



- **CIPC (chloro isopropyl carbamate)**
 - registered as an herbicide and later as potato sprout inhibitor, circa 1960.
 - Most widely used potato sprout inhibitor in the world
- **Chemical characteristics**
 - Solid at room and storage temperature (MP=40°C)
 - Very low volatility as solid
 - Apply by melting and thermo fog at 300-305°C

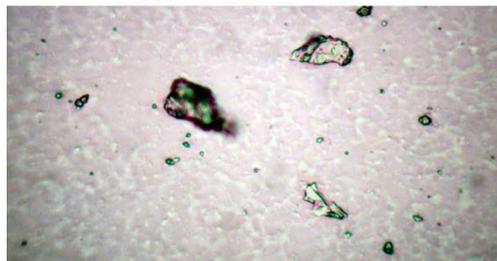
Sprout Control: CIPC

Small particles



5-35 μm

Large particles



20-70 μm

- Thermal fog of CIPC cools and deposited as crystals on tuber
- Solid CIPC crystals slowly give off CIPC vapor over very long time (sublimation) \Rightarrow long-lasting residue and sprout inhibition
- Major limitation: good coverage only where air and fog can be forced through the potato pile

Sprout Control: CIPC



- Mode of action: Herbicide that inhibits cell division by interfering with spindle tube formation
- Vapor contacts “peep” when skin breaks as eyes are “opening up”
- Results in “cauliflower” sprouts - peeps where cells enlarge briefly but do not elongate

If CIPC residue drops < 2.0ppm



- Lateral bud growth
- Sprout rosettes
- Tuber sprouts
- Internal sprouting
- “Permanent” disruption of normal sprouting



CIPC application, timing, and rates



- **Timing**
 - Inhibits wound healing (suberization)
 - Should wait 3-4 weeks after storage to apply
- **Application**
 - Hot fog in “forced-air” ventilation
 - Not for use where seed will be held
- **Rates**
 - In bulk storage with good air distribution, one 20-30ppm treatment can hold entire storage season

CIPC – DMN combinations



- **Early DMN treatment will extend sprout control period for lower rates of CIPC**
- **DMN following CIPC will re-distribute CIPC in pile**

Comparison of DMN and CIPC



• DMN

- Cold or hot fogged
- Very volatile
- Penetrates pile
- Residues dissipate rapidly
- Need repeat applications
- Reversible
- Can be used in seed area
- More expensive
- May reduce shrink

• CIPC

- Hot fog (in storage)
- Very low volatility
- Limited pile penetration
- Long lasting residue and sprout control
- Treat one time (in bulk)
- Irreversible
- No use near or on seed
- Relatively inexpensive