



The True Cost of Resistance: Why Rotation Just Makes Cents

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Definitions



- Tolerant
 - Herbicide never worked...probably never will
- Susceptible
 - Herbicide works on the plant...kills it dead!!!
- Resistant
 - Herbicide used to kill it dead....now it doesn't
 - Reduced efficacy or no efficacy

Types of resistance



- “Creeping” resistance
 - Herbicide doesn’t work at normal rates, but higher rates will
 - usually metabolism or uptake related
- “Uh-Oh” resistance
 - Even higher rates fail
 - Usually altered enzyme
- Cross and Multiple resistant
 - Cross= resistant to same MOA (think ALS)
 - Multiple= resistant to multiple MOA (fluridone and endothall)



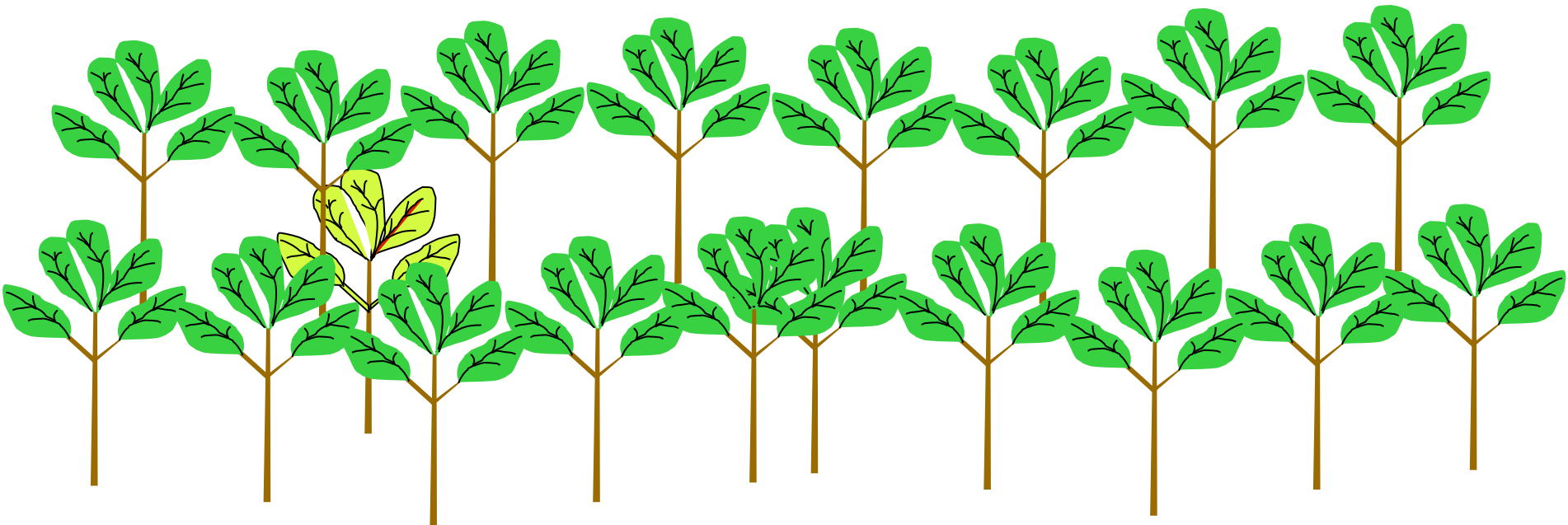
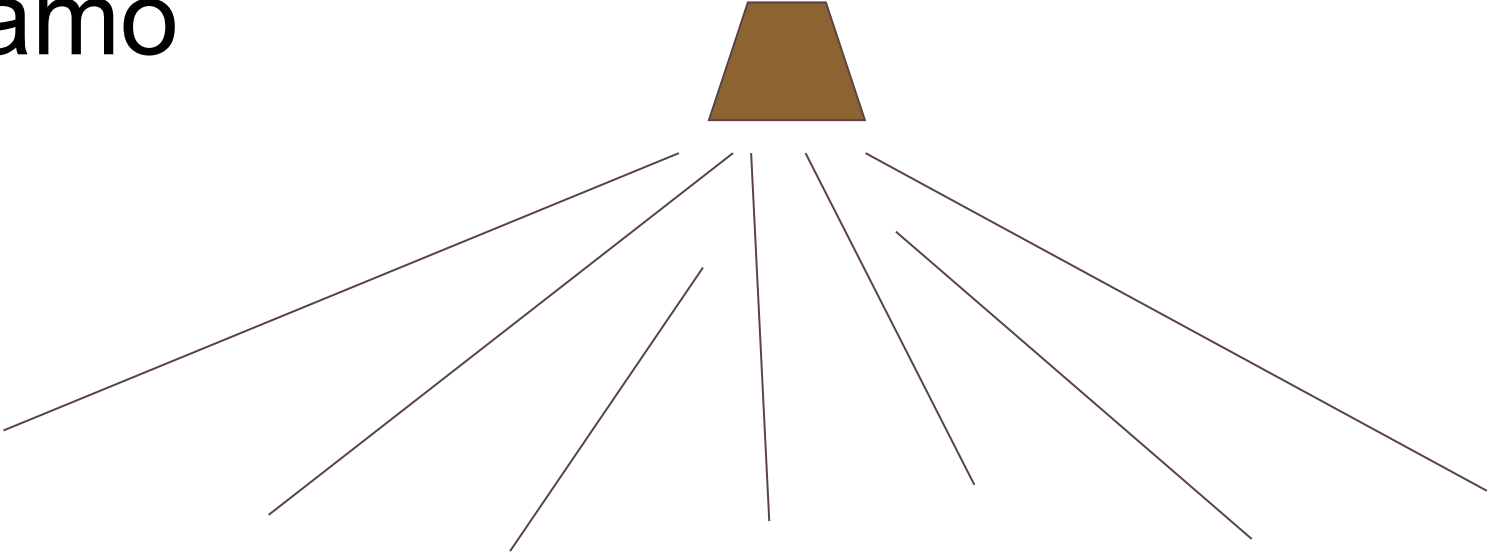
What causes resistance?

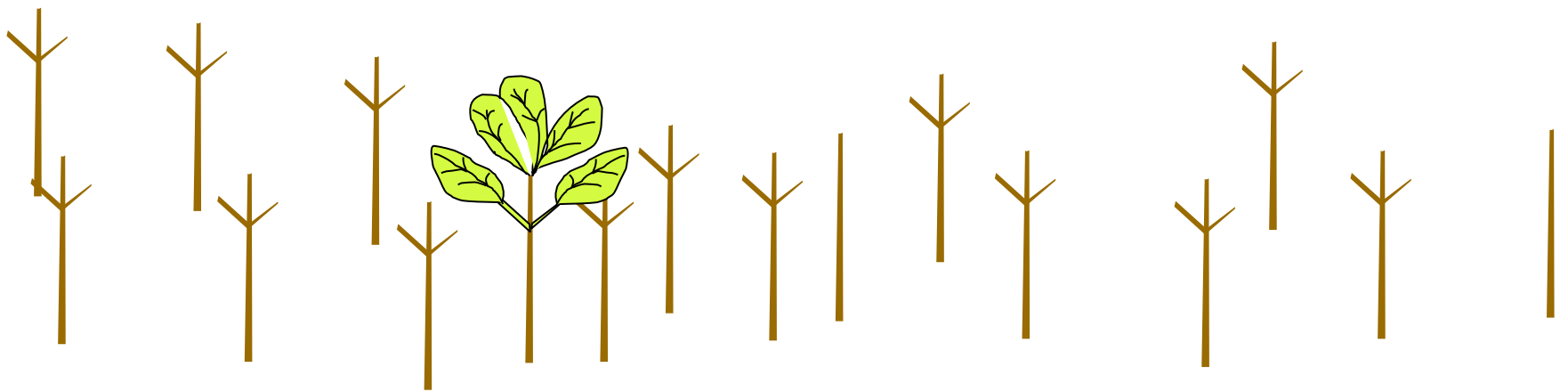
Genetics



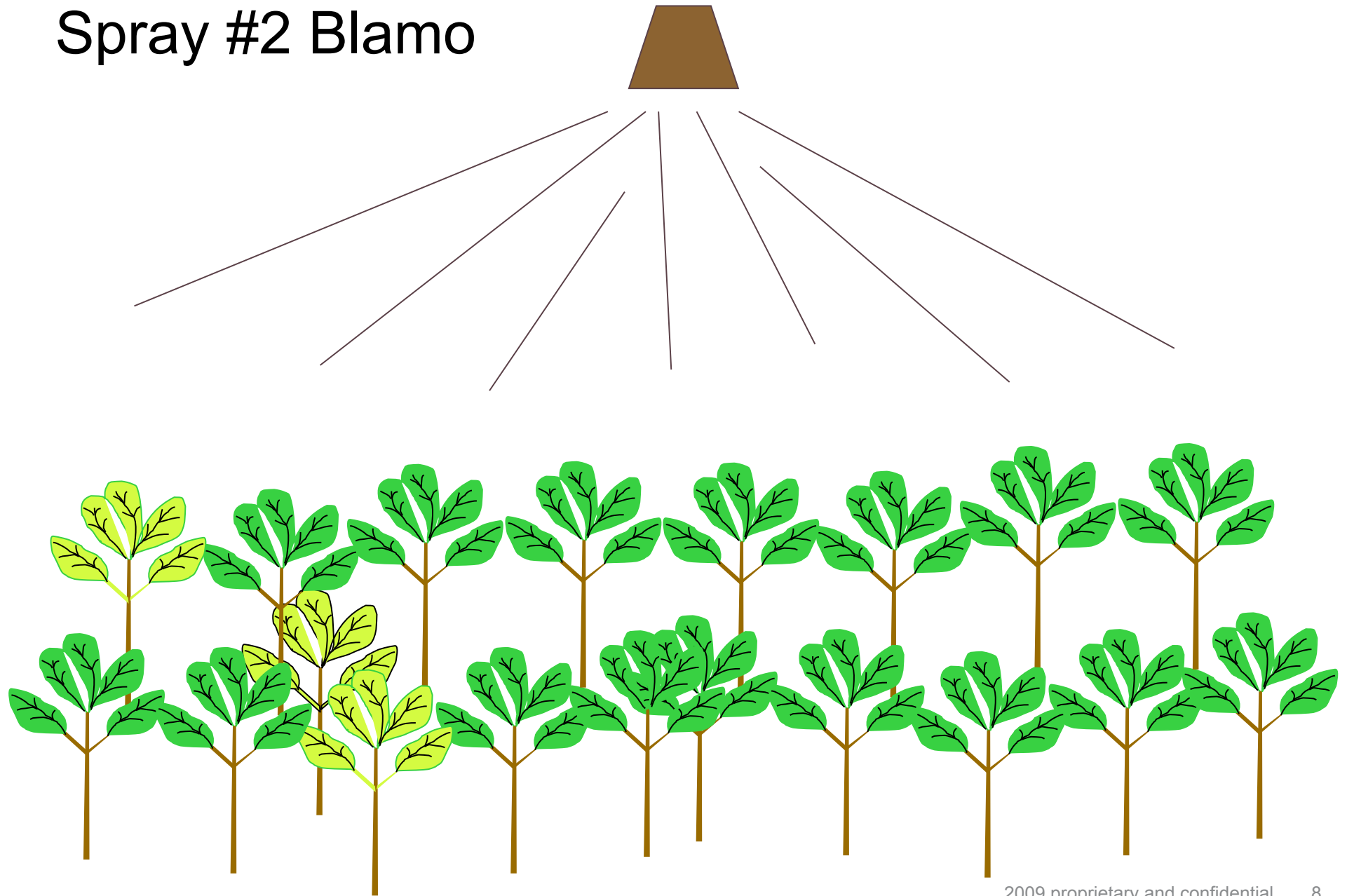
- Random mutations allow plant to survive treatment
- Typically this comes at a “cost”
 - Plant can’t compete with “normal” neighbors
- Exposure to chemical gives plant an advantage
 - Resistance would be “rare” without chemical

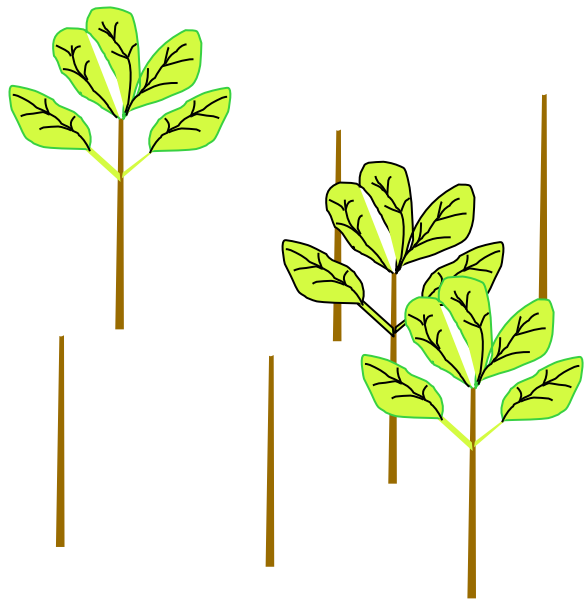
Blamo



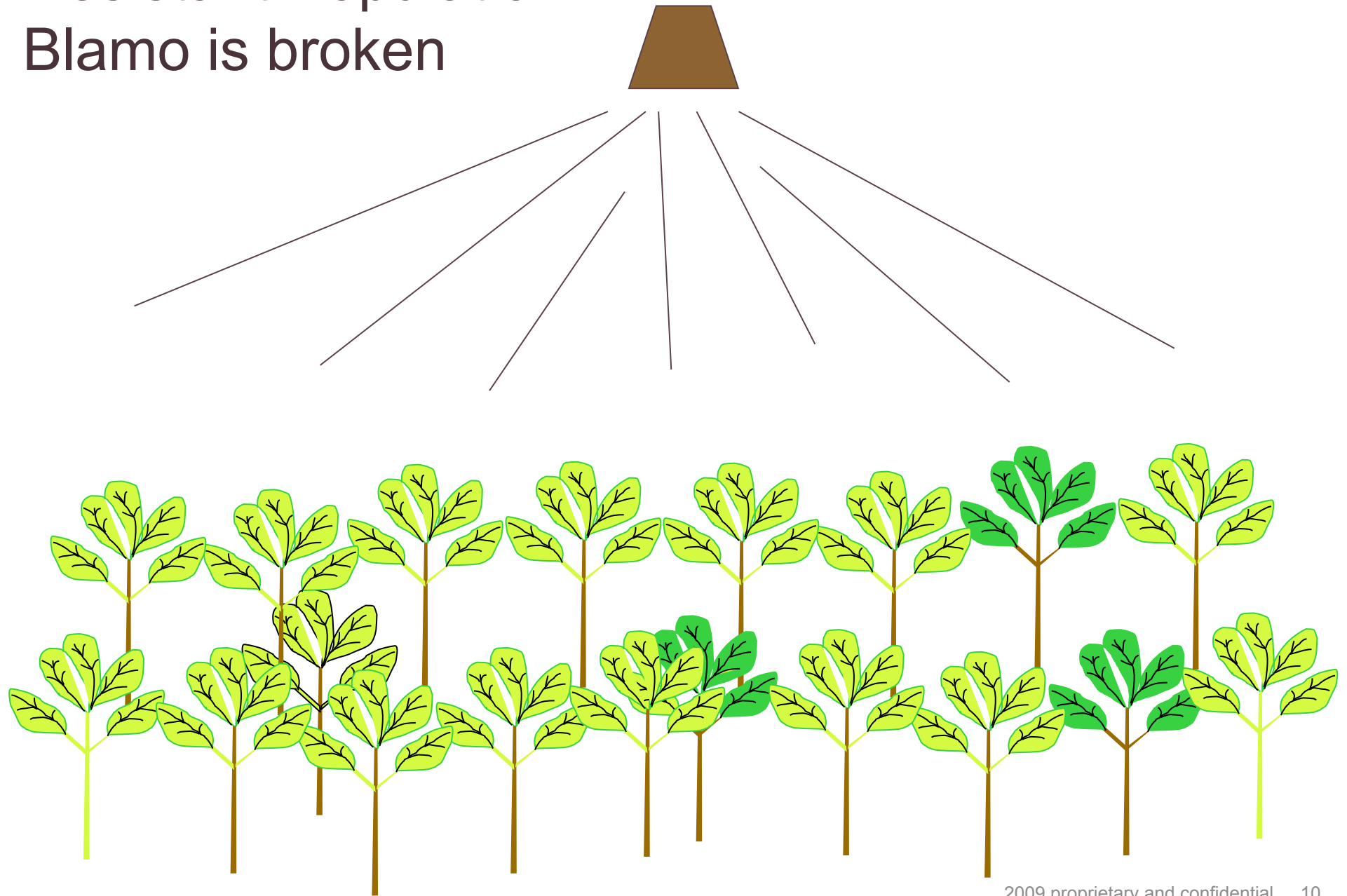


Spray #2 Blamo



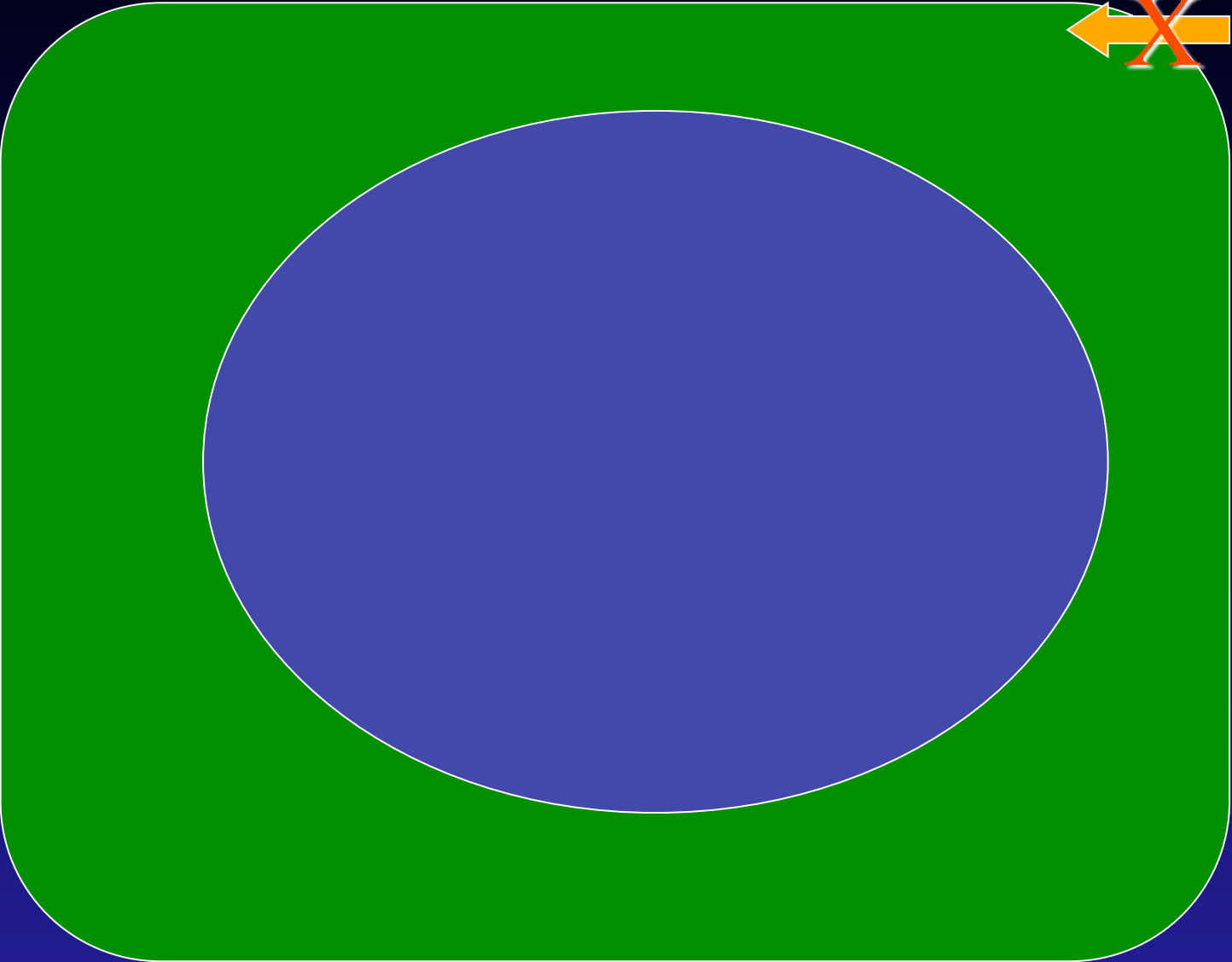


Resistant Population Blamo is broken



What is going on inside the plant?

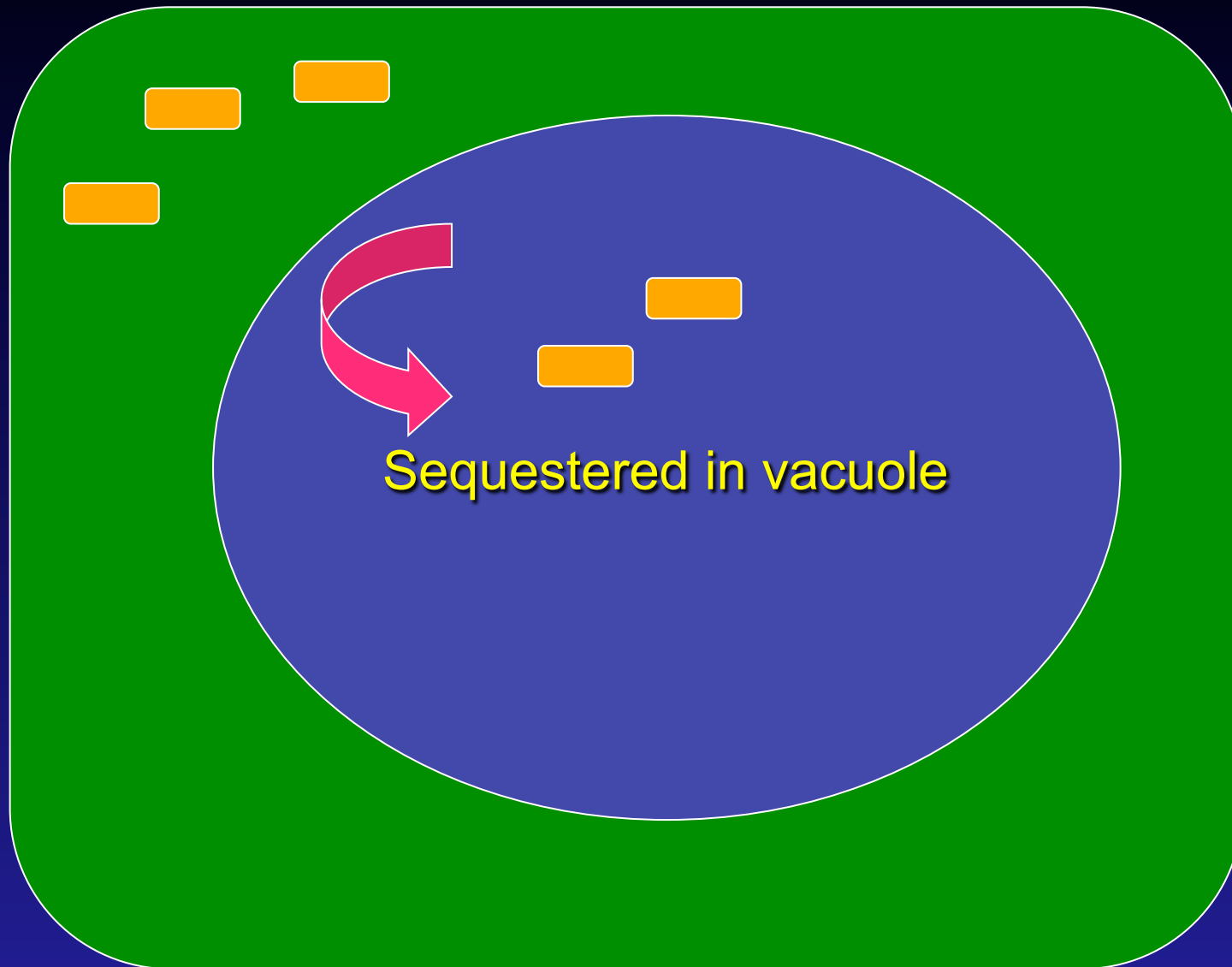
Ways to stop herbicide activity



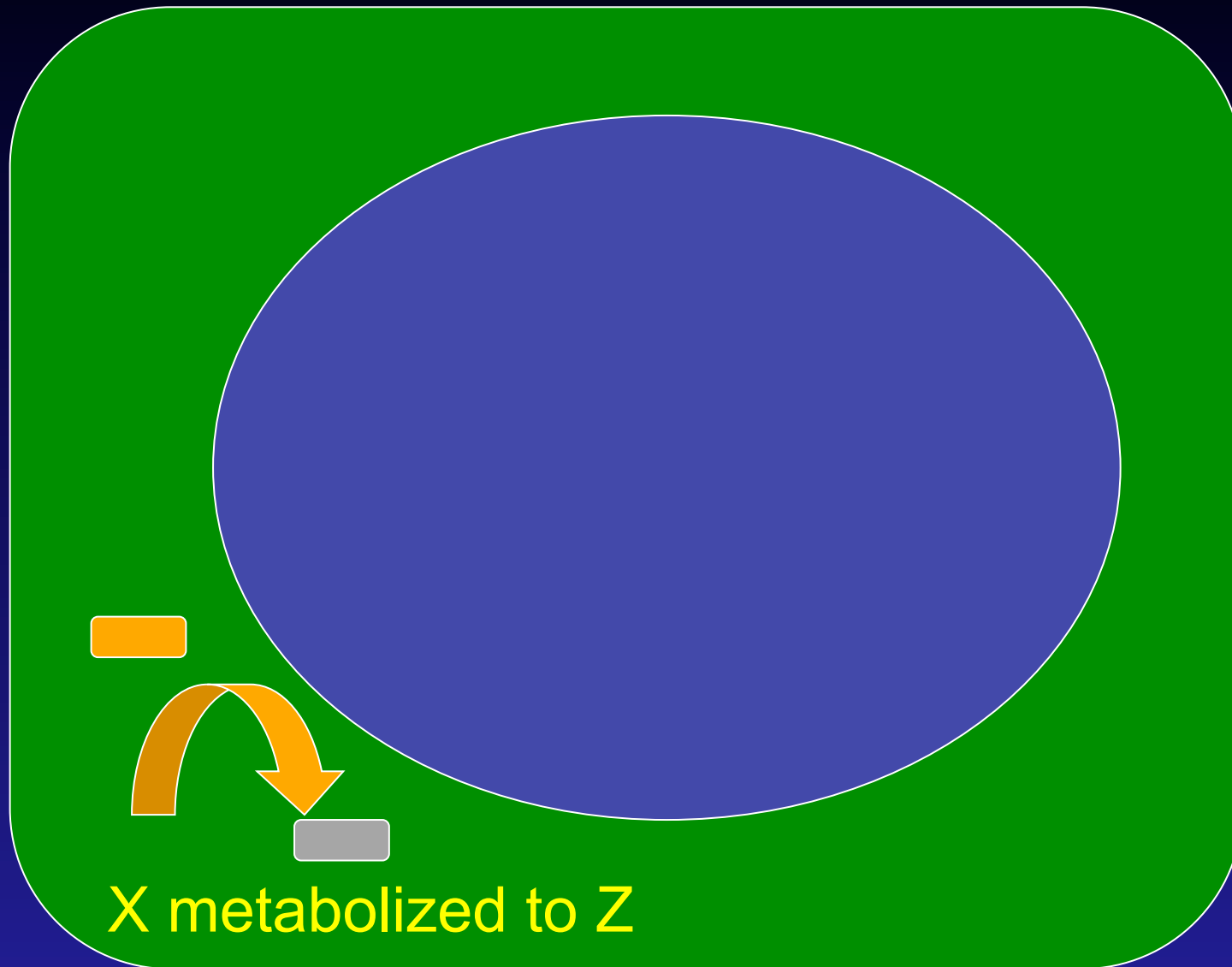
Herbicide X
not absorbed

The diagram shows a green rounded rectangle representing a plant cell. Inside it is a blue oval representing a chloroplast. A yellow arrow points from the right towards the cell wall, with a red 'X' over it, indicating that herbicide X is not being absorbed into the cell.

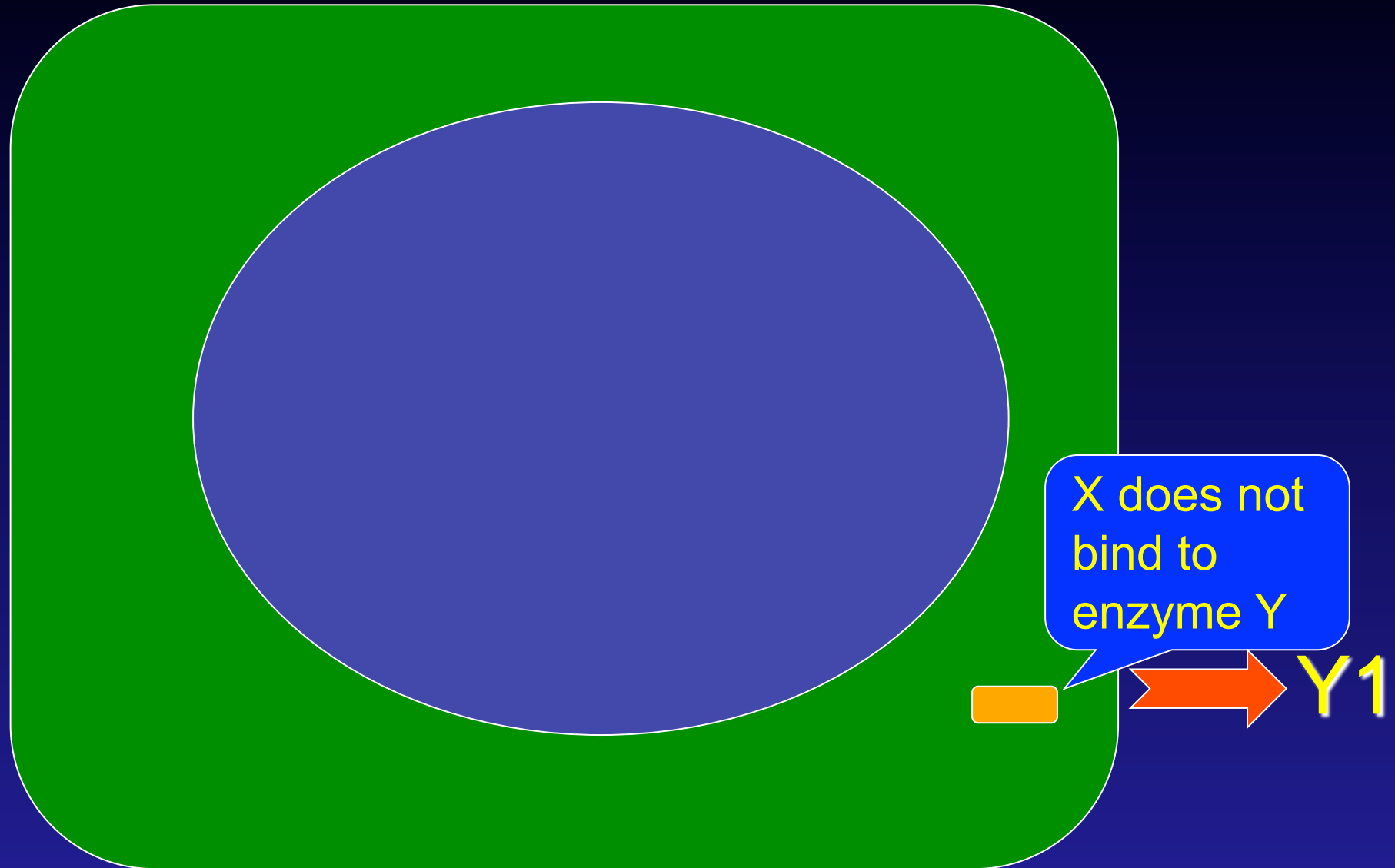
Ways to stop herbicide activity



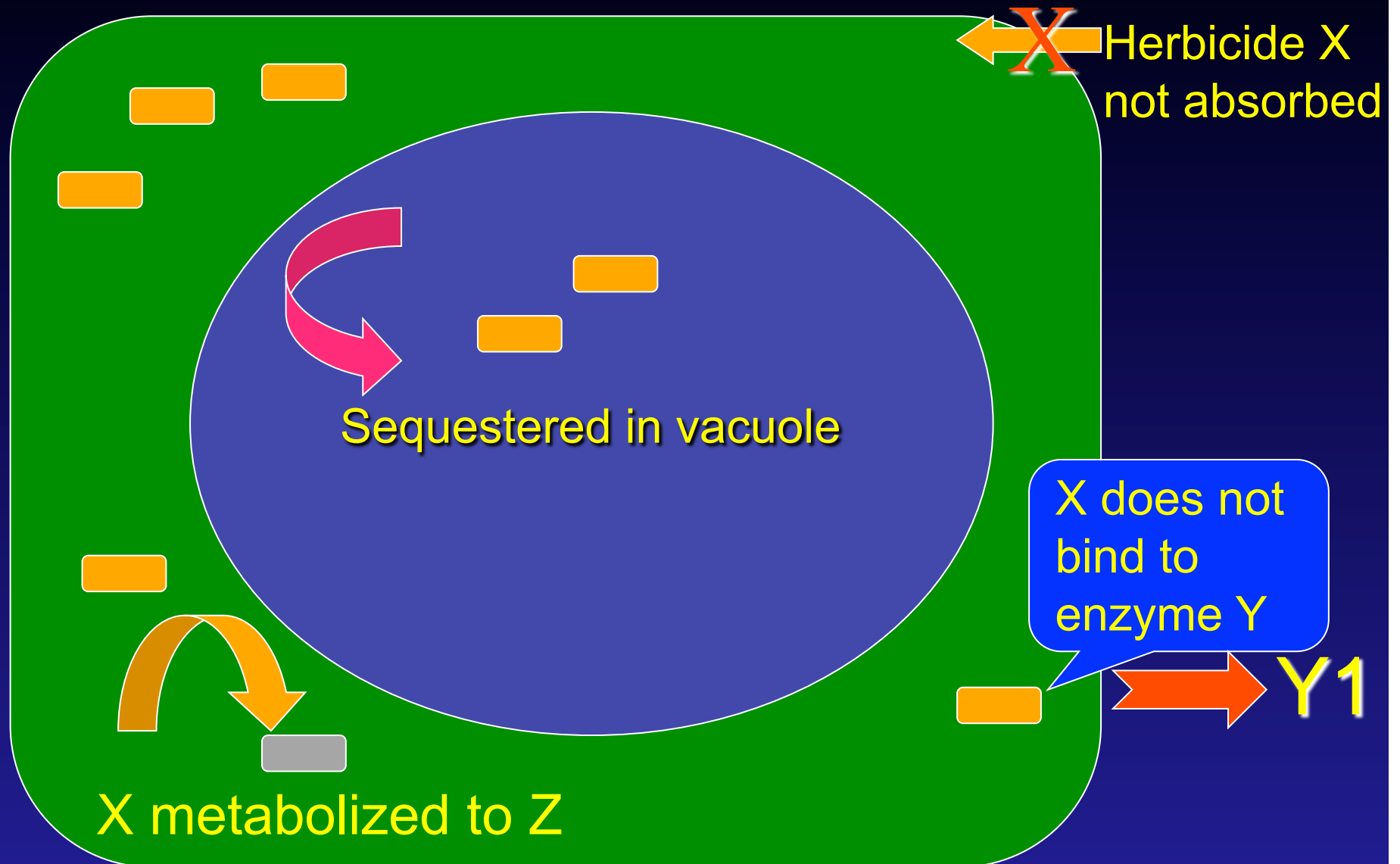
Ways to stop herbicide activity



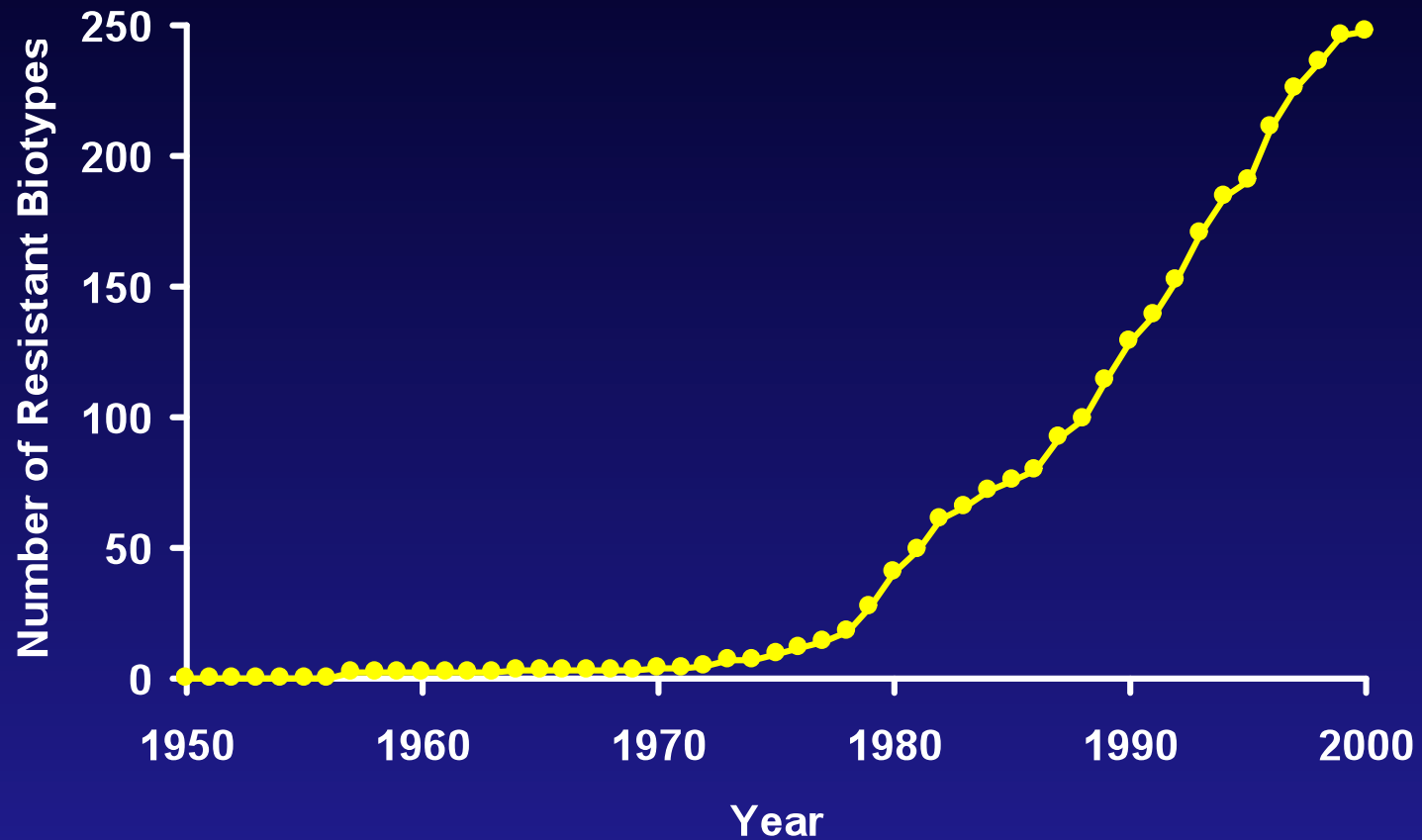
Ways to stop herbicide activity



Ways to stop herbicide activity



Development of Resistant Weeds



**Like Russian
roulette, come
up empty a lot,
but the risk is
always there**

Herbicide characteristics that favor resistance

- Herbicide with single site of action
- Herbicides used multiple times a growing season
- Herbicides used for multiple growing seasons
- Herbicide use without any other control strategy

Weed characteristics that favor resistance

- High reproductive capability
- Effective dispersal
- High genetic variability
- Rapid growth

Superweeds

- No.....herbicide didn't create the plant, just selected for it
- Herbicide does not mutate the plant, already has mutation



Who is to blame?



We break our tools



- It is the “use pattern” that allows resistance to spread
- Myths
 - Using higher or max rates will prevent resistance
 - Not if the enzyme has changed
 - Using lower rates will prevent resistance
 - Allows for “slow” changes over time



**How do we
stop it?**

Steps to prevent resistance

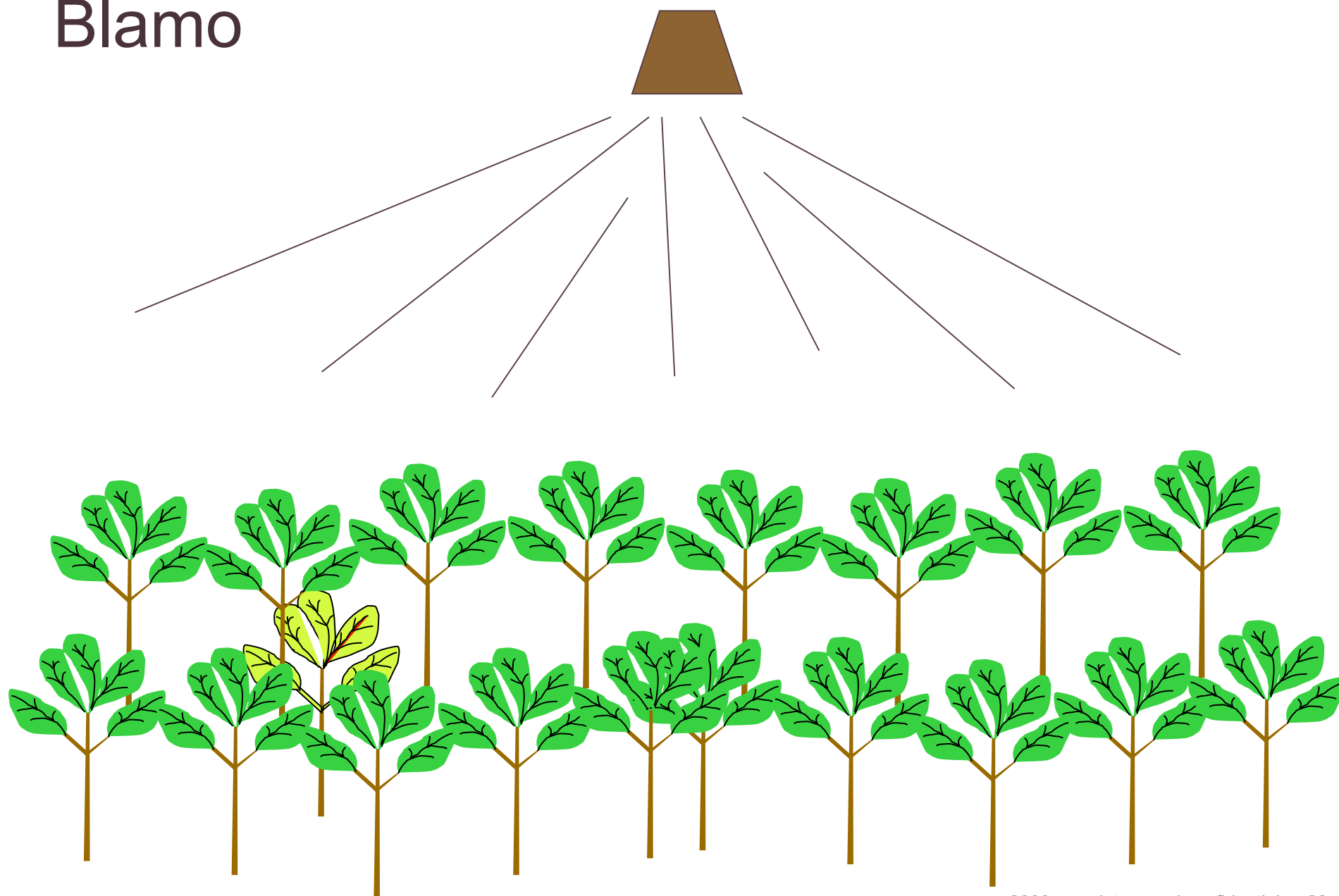


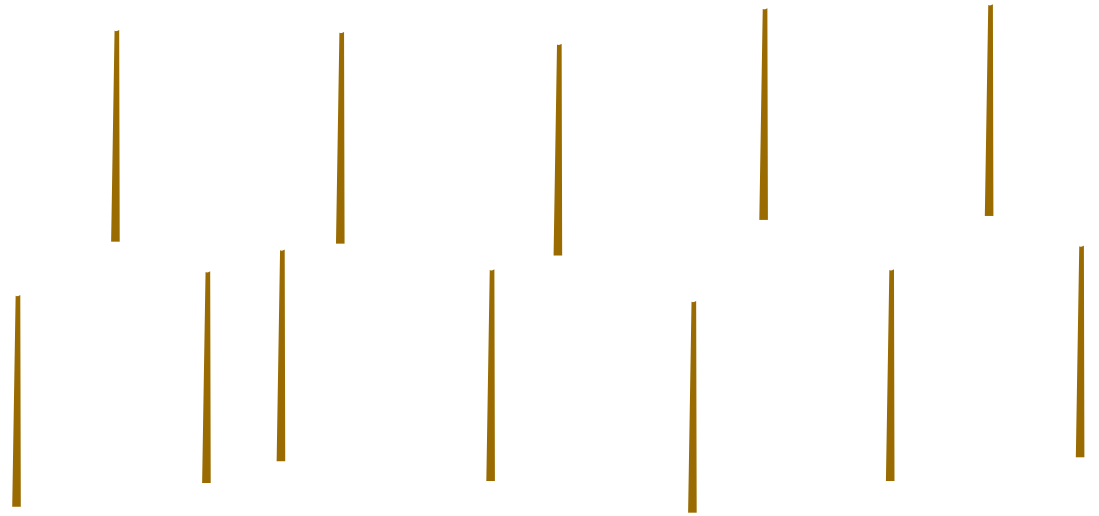
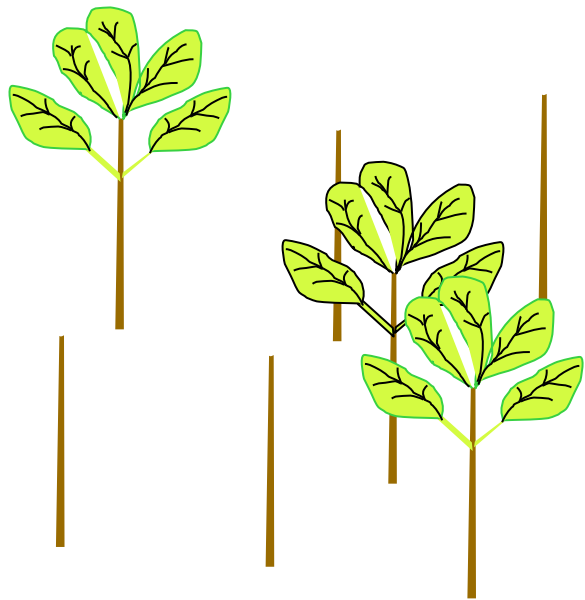
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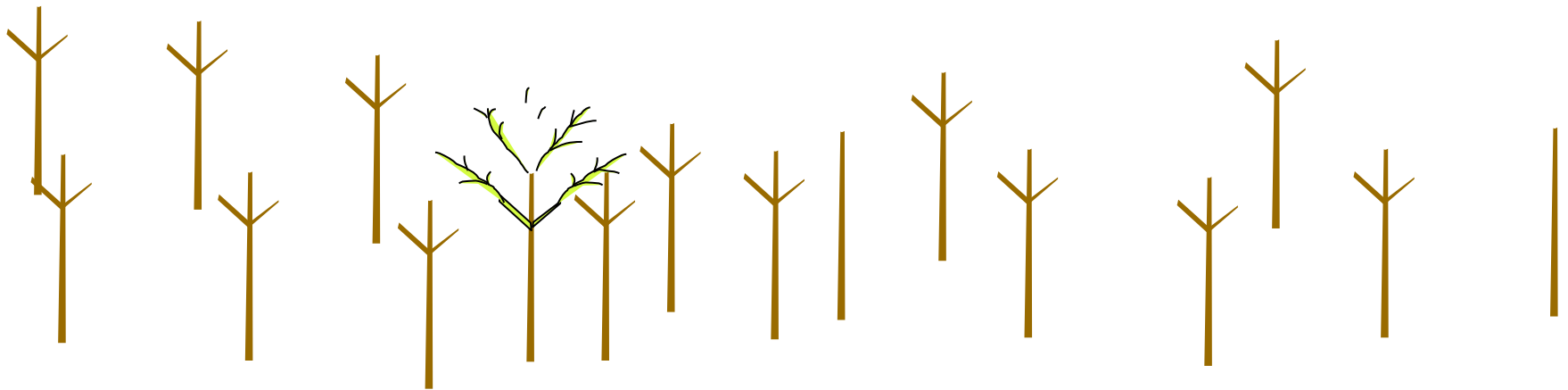
ROTATE

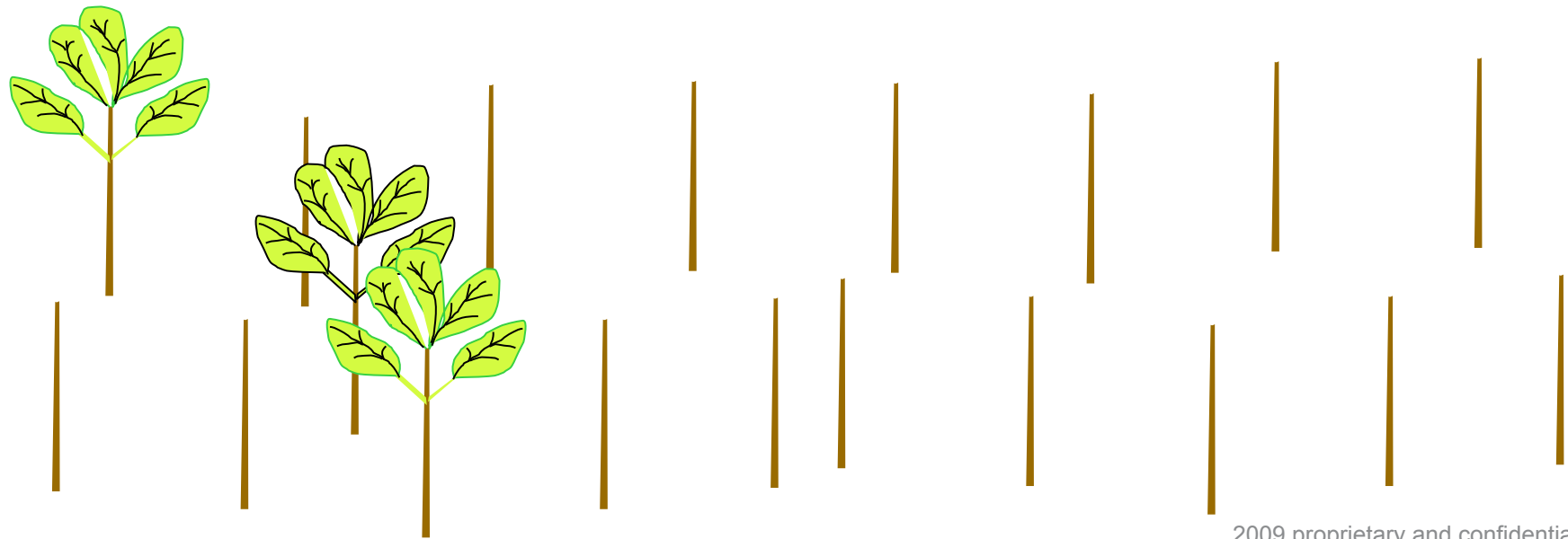
Blamo





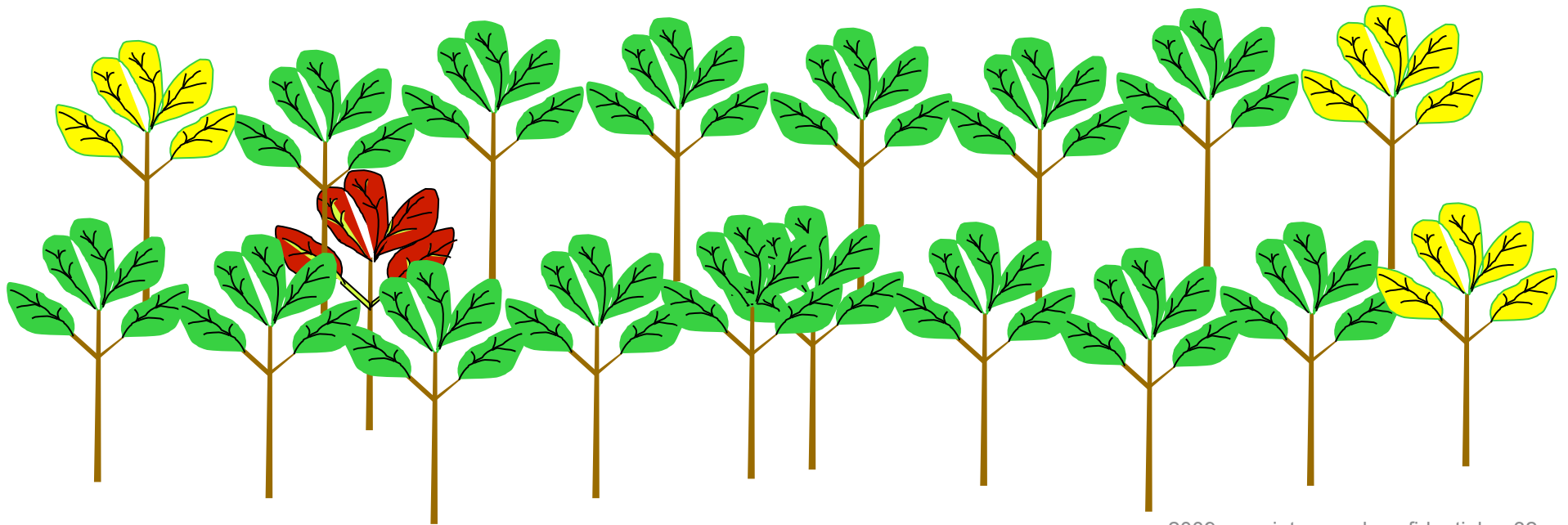
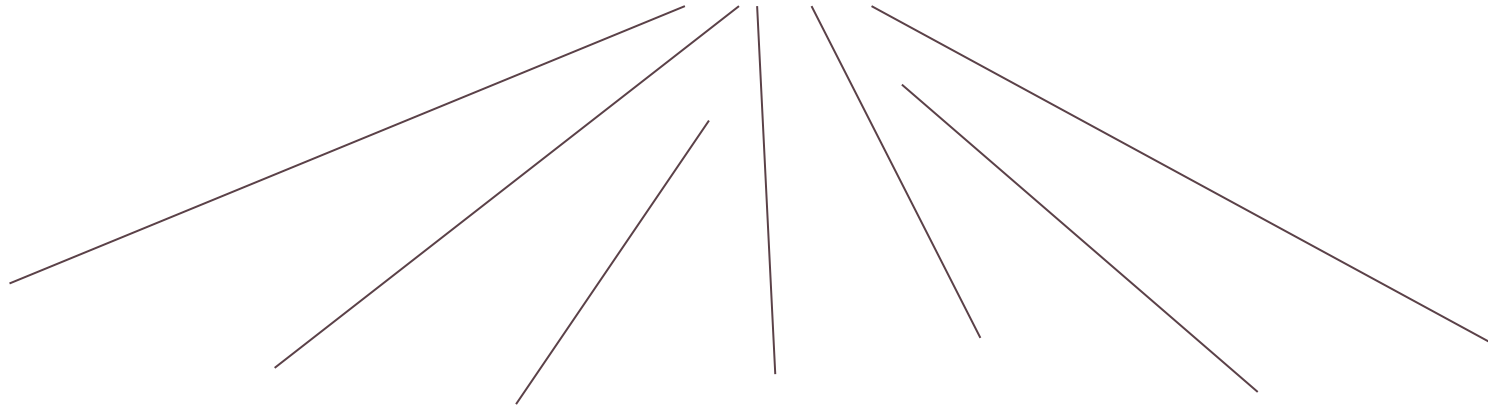
Get rid of left over plants immediately



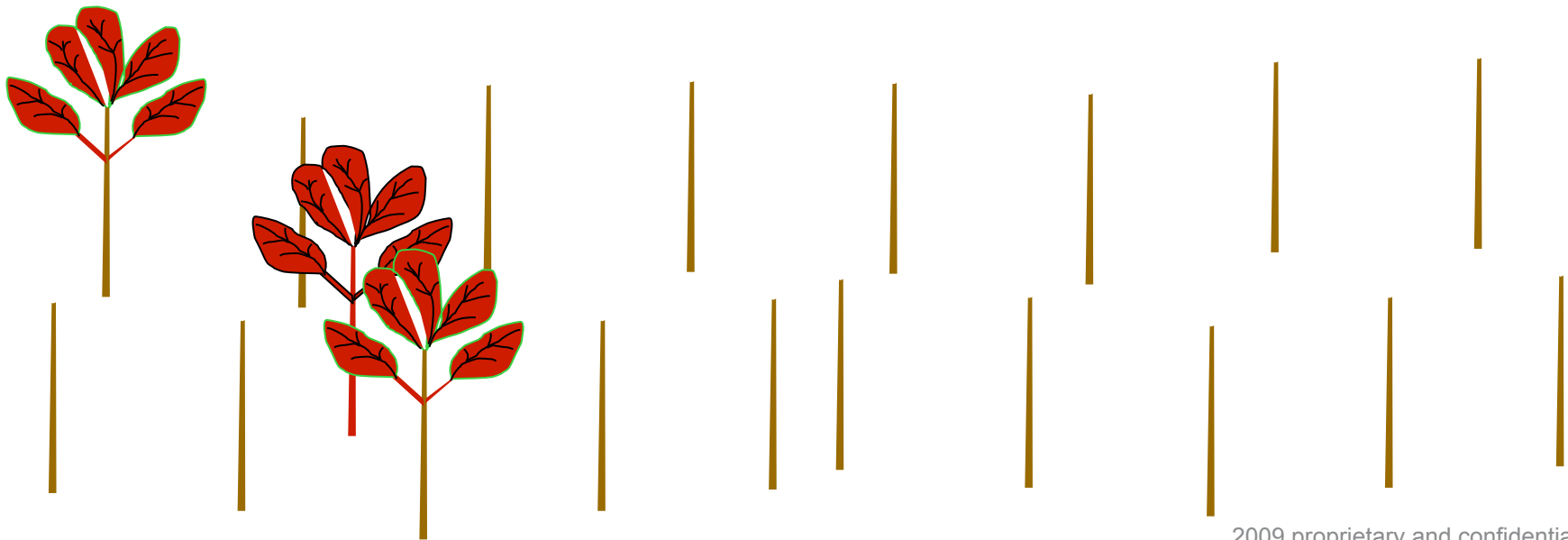


Alternate modes of action

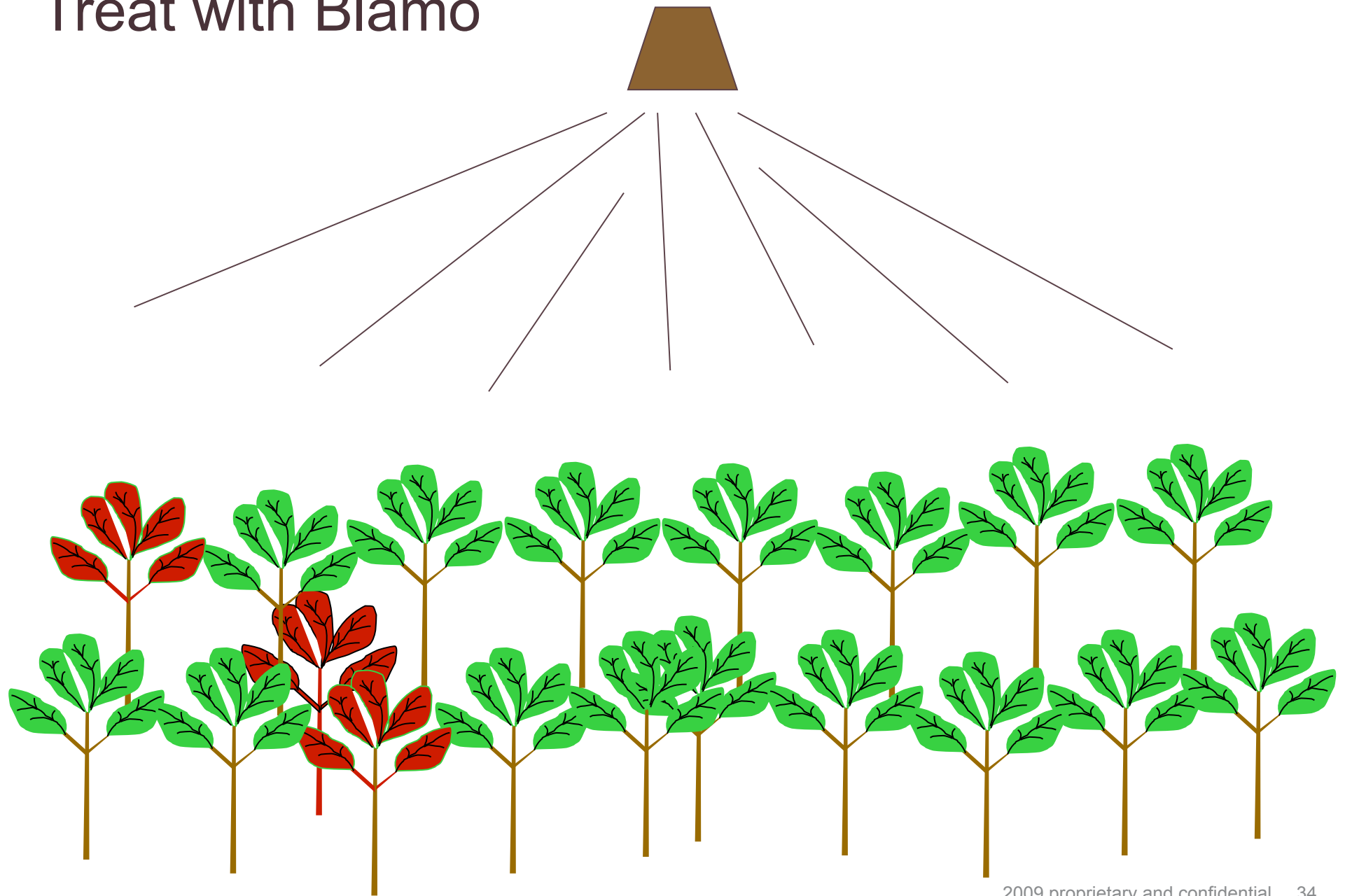
Use “Torcher” instead

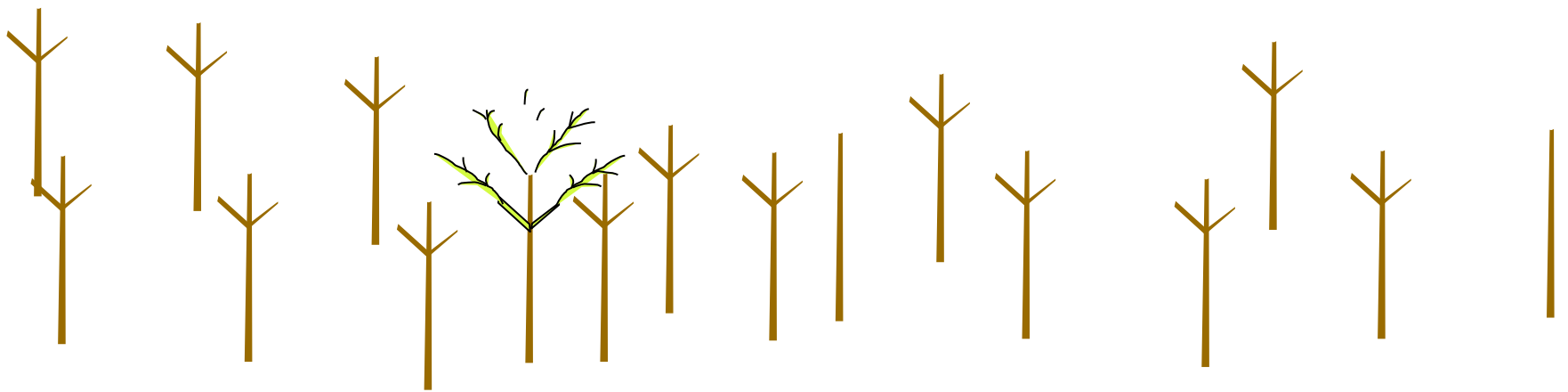


Blamo resistant plants are killed,
Torcher resistant plants remain

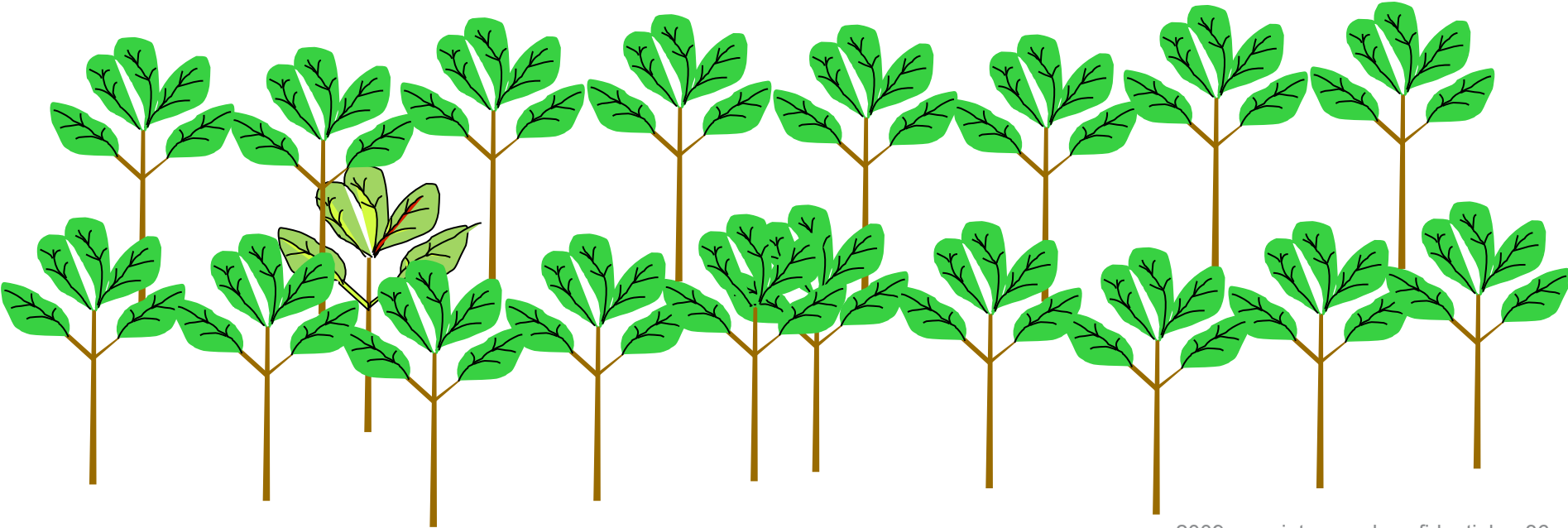
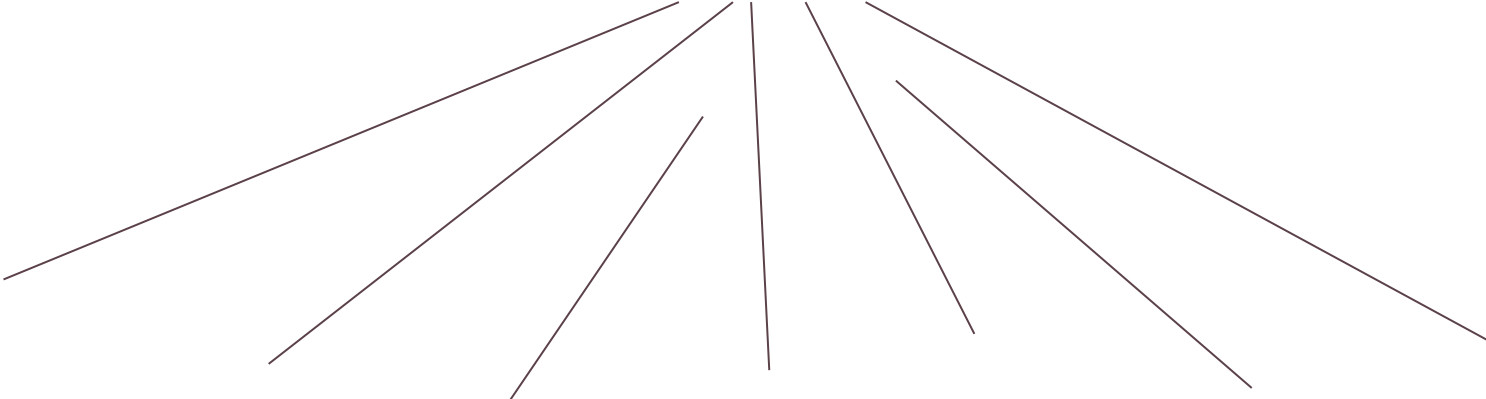


Treat with Blamo





Resistant plants can't establish



Herbicides do Fail

Herbicide application factors
inappropriate dose or timing

Climatic conditions:
rainfall patterns and temperature.

Weed factors:
**size of weeds; subsequent germination;
very high infestation.**



**But we can't
rotate, not
enough tools**

Milfoil

1. Fluridone
2. Auxins
3. Contacts
4. Others?

Curly Leaf

1. Fluridone
2. Aquathol
3. Others?



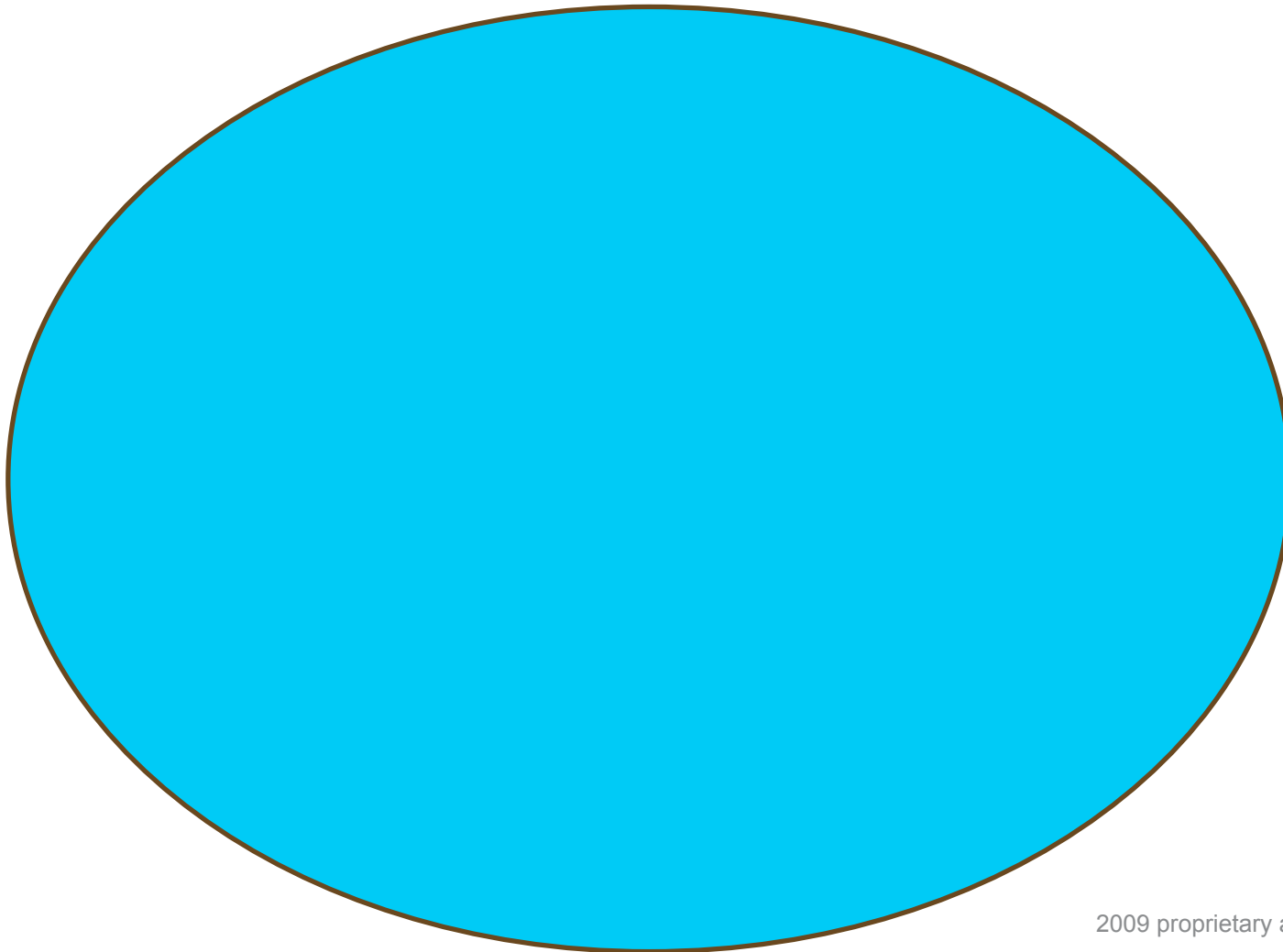
**But rotating
herbicides is
TOO expensive**

Newer tools cost more



- Cost of registration means “new” products will cost more
- What is the cost when you lose the cheaper tool???

10 acres 6 feet deep
Full of *Awfula terriblensis*



- **Blamo cost \$3,000 per year**
 - 10 years to “erradicate
 - \$30,000 to erradicate

- **Blamo + Whamo combination**
 - \$5,000/year
 - \$50,000 to erradicate

- **Cost \$20,000 more to rotate**
 - \$2,000/year to ensure control



Rotating is expensive!!!!



- **Whamo+Torcher**
 - \$10,000/year
 - \$100,000 to erradicate (have to start over at year 1)
- **Torcher only**
 - \$15,000/year
 - \$150,000 to erradicate

- **Blamo \$30,000**
 - **How long will it last????**
- **Rotate \$50,000**
- **Last forever**

- **Rotating is a \$2,000 dollar a year insurance policy to avoid \$100,000 in cost**

- **What if we have no tools left?**



We can prevent resistance



- We have the tools, we have the technology
- Do we have the commitment to make it happen?????



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Thank you again for your time.

QUESTIONS?