The Science of Seeds

Hybrid, Heirloom, Organic, GMO, & Beyond

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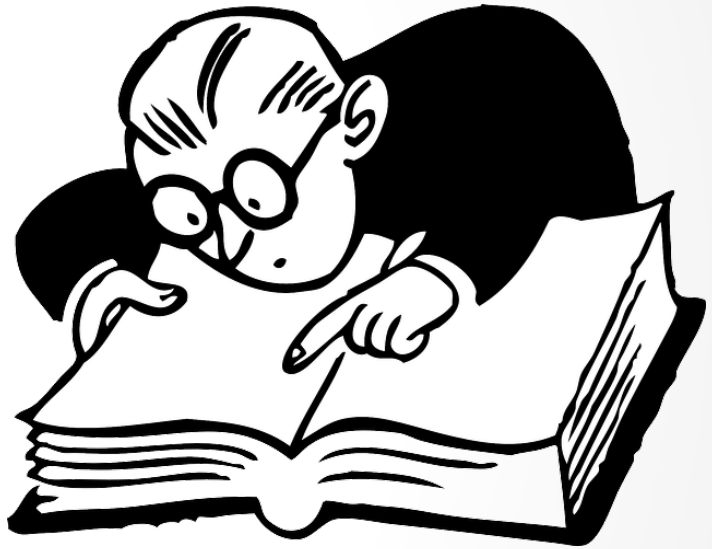
What We'll Learn

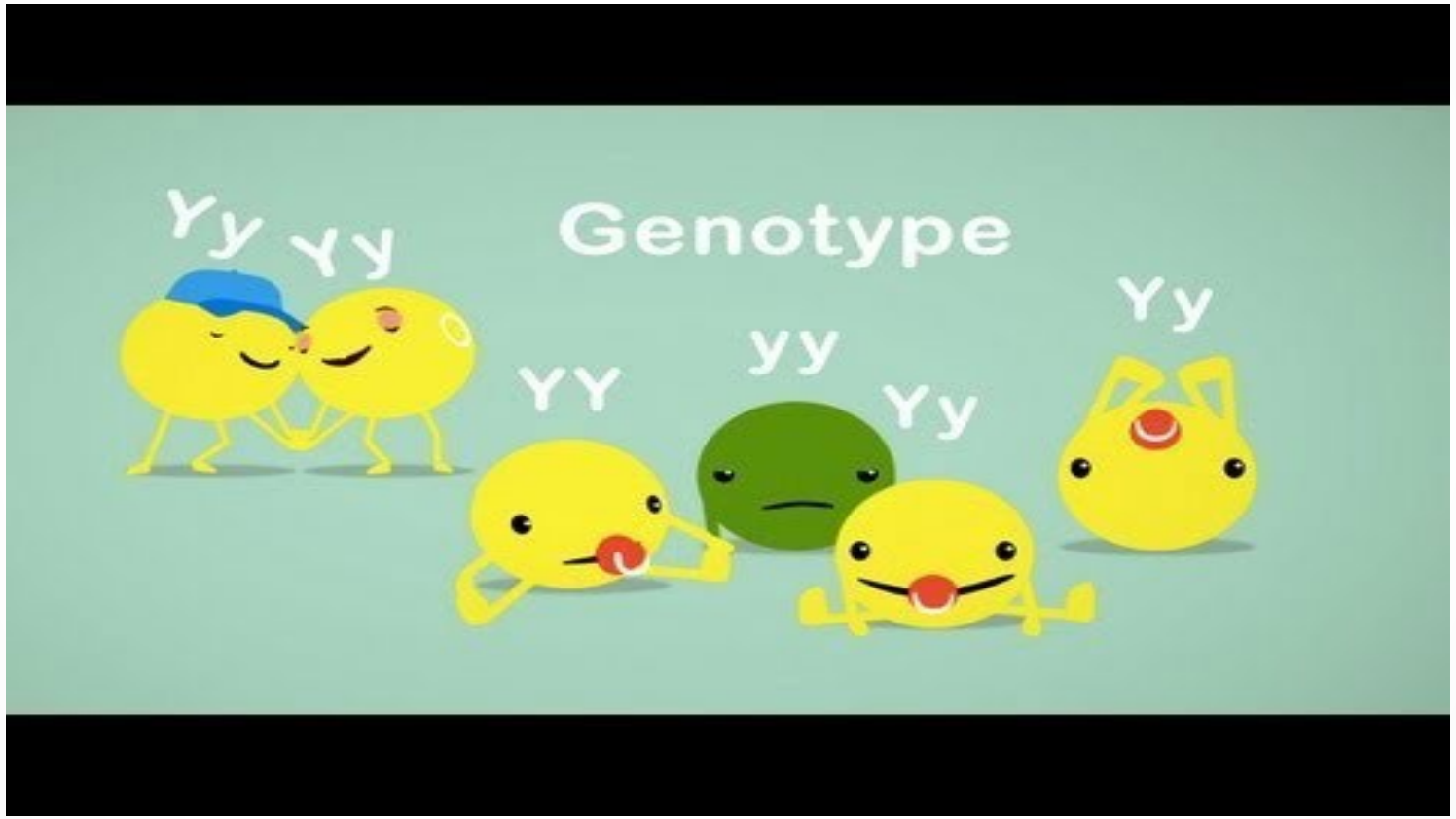
- Definitions of seed related words
- Proper storage of seeds
- How to plant seeds
- Common problems with seeds

What Do These Words Mean?

1. Hybrid
2. Open Pollinated
3. Heirloom
4. Organic
5. GMO
6. CRISPR
7. Stratification
8. Scarification
9. Leaching

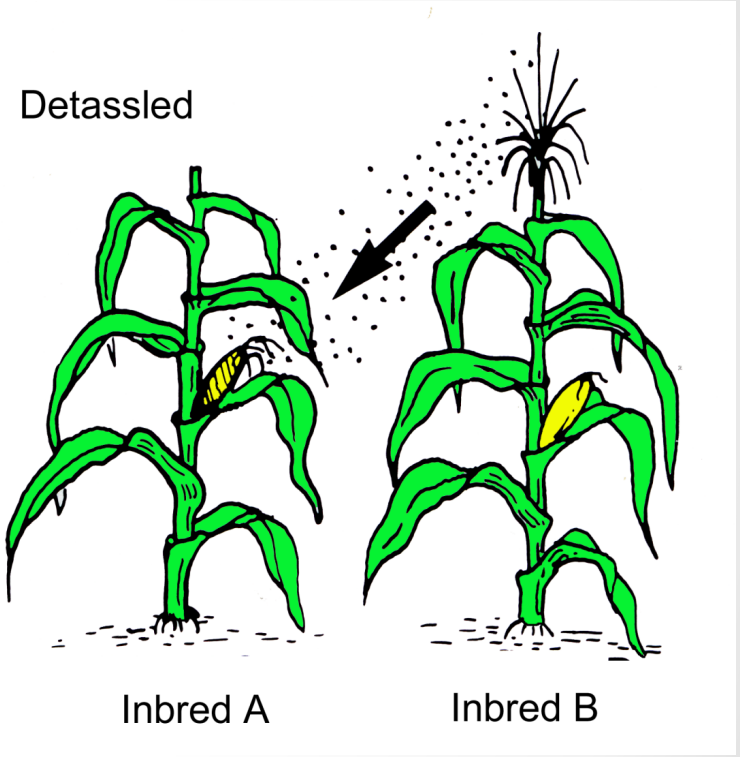


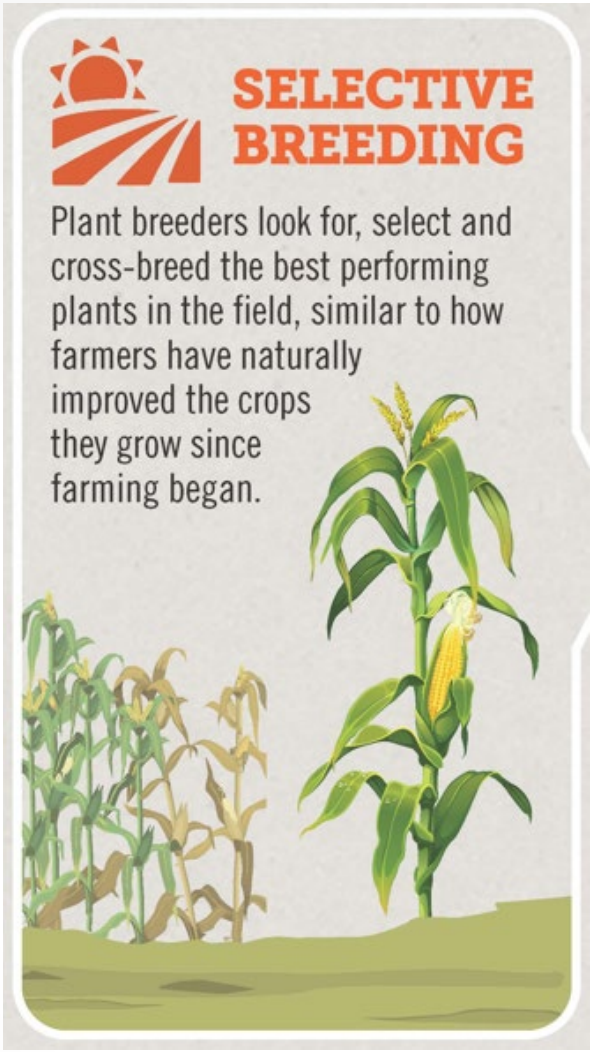
Hybridization Overview



HYBRID

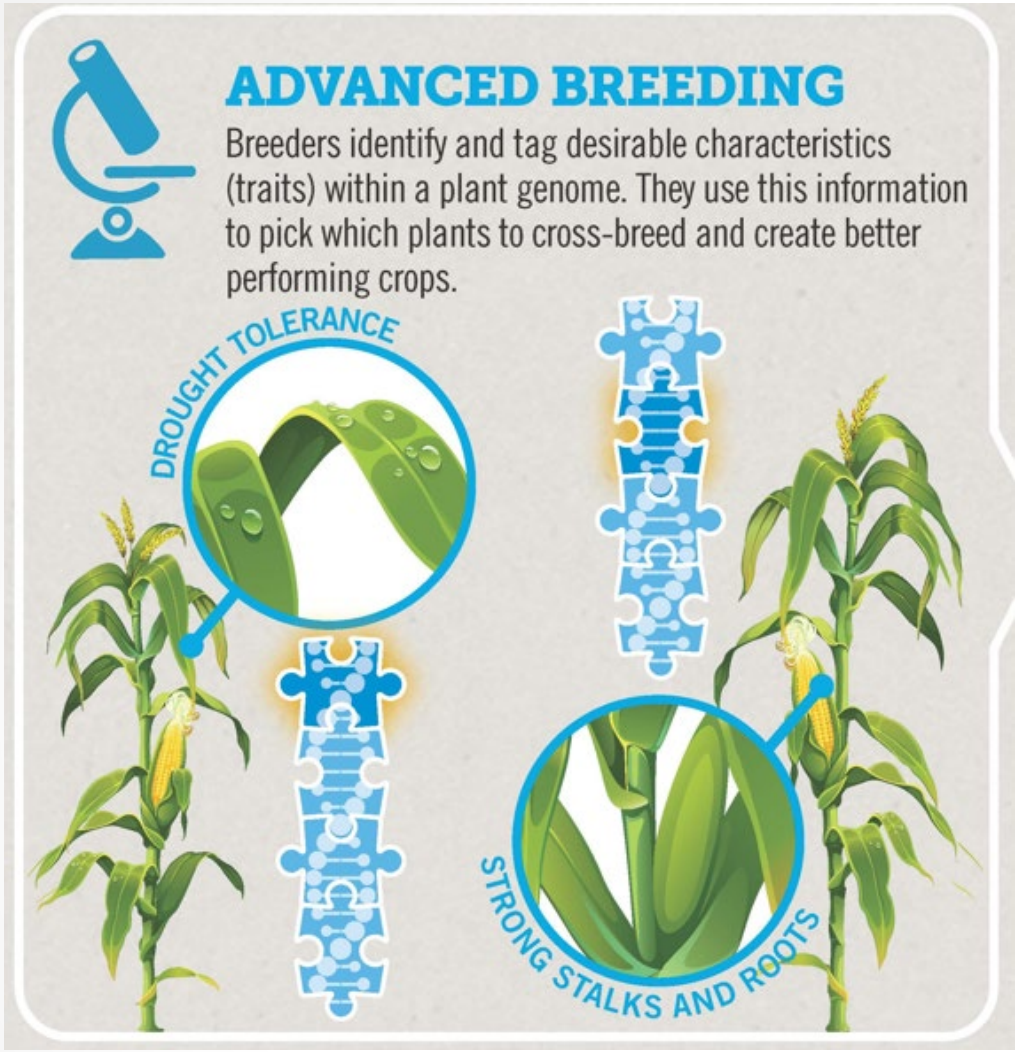
- Crossing specific parent plants produces a hybrid seed (plant) by means of controlled pollination.
- F1 Hybrid:
- “F1-hybrid seedlings are the result of crosses between two or more inbred lines. An inbred line is produced from a homozygous parent that has been self-pollinated a number of times to fix the genetic traits of the plant.”





Hybrid: Traditional Breeding Technique

Traditionally, breeders would look for certain traits in a plant and use that plant in their breeding program.



Hybrid: Advanced Breeding Technique

Breeders can now use plant genomic testing to pick which ones to continue crossing!

IFAS Strawberry Hybridization

Hybrid Seed Pros & Cons

PROS

- Hybrid Vigor
- Exactly as Advertised
- Often Bred for Certain Traits
  - Ie. Disease resistance, color, flavor

CONS

- Second Generation Seeds Inferior
  - Must be purchased each year
- Can Promote Unsustainable Monocultures

OPEN POLLINATED

- Varieties with stable traits from one generation to the next
- Genetic drift is possible
- Cross pollination possible
- Can be heirloom

HEIRLOOM

- Open Pollinated plants +
- No firm definition but:
  - May have historical/family connections
  - 50+ years as a variety (so pre 1974)
  - Some say pre-1940s to count

Open Pollination Considerations

- Self-pollinating plants:
  - Beans
  - Peas
  - Peanuts
  - Lettuce
  - Eggplant
  - Peppers
  - Tomatoes

- To reduce chance of accidental crosses, plant with 10ft between varieties.

- Wind or insect pollinated plants need to be isolated
  - Onions
  - Cucumbers
  - Corn
  - Pumpkins
  - Squash
  - Broccoli
  - Beets
  - Carrots
  - Cabbage
  - Cauliflower
  - Melons
  - Radishes
  - Spinach
  - Swiss Chard
  - Turnips

ORGANIC

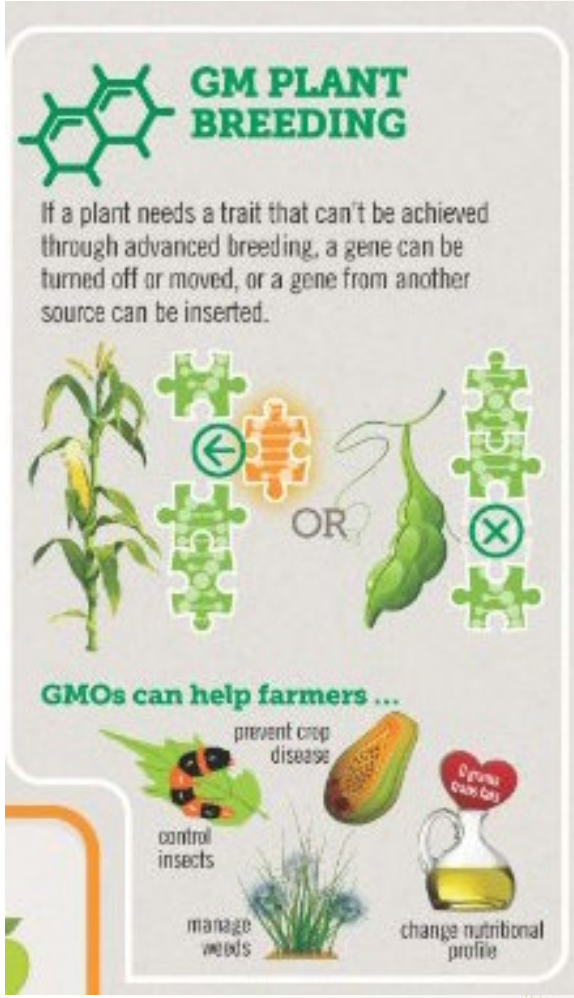
- Renewable resources
- May only use approved inputs
  - Naturally available nutrients
  - Naturally derived pesticides
- Most synthetic pesticides, nutrients, and other practices prohibited
- Approved certifier
- Handlers and processors must be certified

Organic Continued

- So… what does this mean for seeds?
  - "Certified "organic" seeds come from certified organic plants and go through processing equipment that is also certified for organic production. The facilities where organic "stuff" is processed also requires certification to organic standards." – Hannah Wooten, Extension Agent, Commercial Horticulture
- So… what does that mean for consumers?
  - The amount of non-organic pesticide in a non-organic seed is negligible
  - Organic seed is more expensive
  - You may be supporting organic farms/farming practices

What is GMO?

- Cutting a desirable gene from one organism and adding it to the DNA of another
- Done with a single cell that is then grown in the lab



GMO RESEARCH, REVIEW AND REGULATION | How Does a GMO Get to Market?

On average, GMOs take **13 years** and **$130 million** of R&D **BEFORE** coming to market

The **regulatory process** alone can take **5 to 7 years**

REGULATORY SCIENCE

75+ different studies[1] are conducted to demonstrate each new GMO is:

Safe to grow
- Crop grows the same as non-GM varieties
- Crop exhibits expected characteristics (e.g., insect resistance)

Safe for the environment and beneficial insects

Safe to eat
- Same nutrients as non-GM crops
- No new dietary allergens

REGULATORY REVIEW

More than **30 government bodies**[2] globally review and approve GMOs. In many countries, multiple agencies are involved in the regulation of GMOs.

GMOs have been grown or imported by more than **75 countries**[3] since 1996.

U.S. REGULATORY AGENCY REVIEWS

USDA > **Safe to grow**

EPA > **Safe for the environment**

FDA > **Safe to eat**

GM Seeds Approved for Use by USDA:

Corn	58	Sugar Beet	3
Potato	40	Cantaloupe	2
Cotton	28	Papaya	2
Canola	23	Squash	2
Soybean	22	Sugarcane	2
Tomato	8	Wheat	2
Rice	4	Creeping Bentgrass	1
Alfalfa	3	Flax	1
Apple	3	Pineapple	1
Radicchio	3	Plum	1

GENETIC TRAITS EXPRESSED IN GMOs IN THE U.S.

APPLE

Genetic Traits
Non-browning
Uses: Food

POTATO

Genetic Traits
Reduced Bruising and Black Spot
Non-browning
Low Acrylamide
Blight Resistance
Uses: Food

FIELD CORN

Genetic Traits
Insect Resistance
Herbicide Tolerance
Drought Tolerance
Uses:
- Livestock and poultry feed
- Fuel ethanol
- High-fructose corn syrup and other sweeteners
- Corn oil
- Starch
- Cereal and other food ingredients
- Alcohol
- Industrial uses

CANOLA

Genetic Traits
Herbicide Tolerance
Uses: Cooking oil, Animal feed

ALFALFA

Genetic Traits
Herbicide Tolerance
Uses: Animal feed

SOYBEAN

Genetic Traits
Insect Resistance
Herbicide Tolerance
Uses:
- Livestock and poultry feed
- Aquaculture
- Soybean oil (vegetable oil)
- High oleic acid (monounsaturated fatty acid)
- Biodiesel fuel
- Soymilk, soy sauce, tofu, other food uses
- Lecithin
- Pet food
- Adhesives and building materials
- Printing ink
- Other industrial uses

RAINBOW PAPAYA

Genetic Traits
Disease Resistance
Uses: Table fruit

COTTON

Genetic Traits
Insect Resistance
Herbicide Tolerance
Uses: Fiber, Animal feed, Cottonseed oil

SUGAR BEET

Genetic Traits
Herbicide Tolerance
Uses: Sugar, Animal feed

SWEET CORN

Genetic Traits
Insect Resistance
Herbicide Tolerarnce
Uses: Food

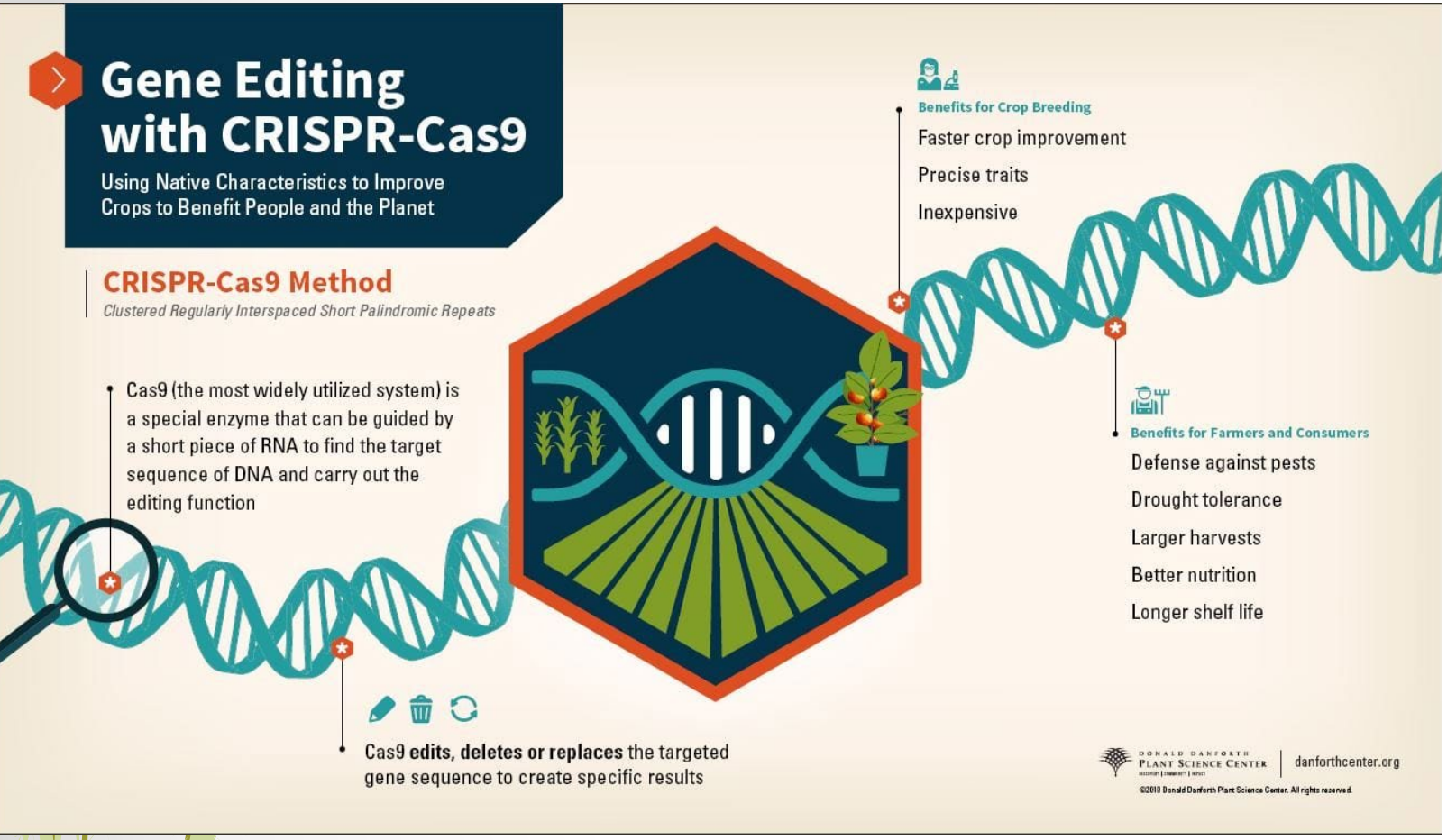
SUMMER SQUASH

Genetic Traits
Disease Resistance
Uses: Food

CRISPR

- New gene technology: **C**lustered **R**egularly **I**nterspaced **S**hort **P**alindromic **R**epeats
- Instead of adding, careful editing or subtraction of existing genes

CRISPR Video



How CRISPR Works

- An enzyme makes a precise cut in the DNA sequence.
- It is programmed to:
  - Turn on a trait in the plant DNA
  - Turn off a trait in the plant DNA
  - Replace a trait in the plant DNA

Seed Care & Use

Prepping Seeds for Storage

- Collect & Dry
  - 100 degrees for 6 hours
  - In oven with door kept open

Proper Storage of Seeds

- 1 year: at room temp
- >1 year: in fridge
- Keep DRY
- Sealable container better than plastic bag

How to Plant Seeds

We'll Be Covering:

- Stratification
- Scarification
- Soaking/Leaching
- Light
- Depth
- Care

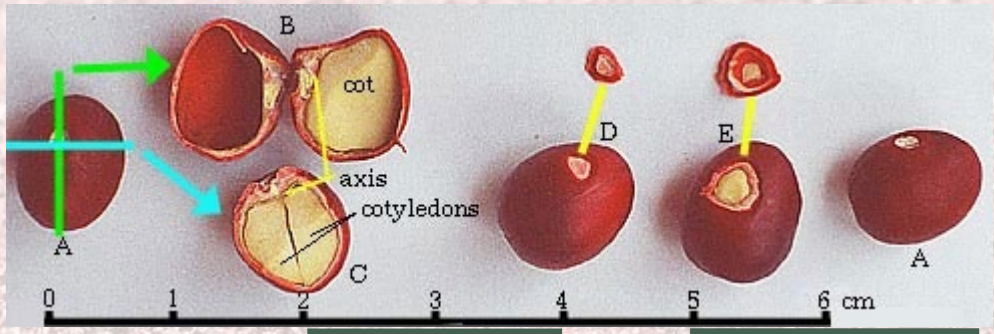
Stratification

- Storing the seeds in a cold, moist environment to meet their requirements for sprouting.

Tell your loved ones that this isn't taco meat! Millie Burrell

Scarification

- The process of penetrating or cracking the seed coat barrier.



Just Right

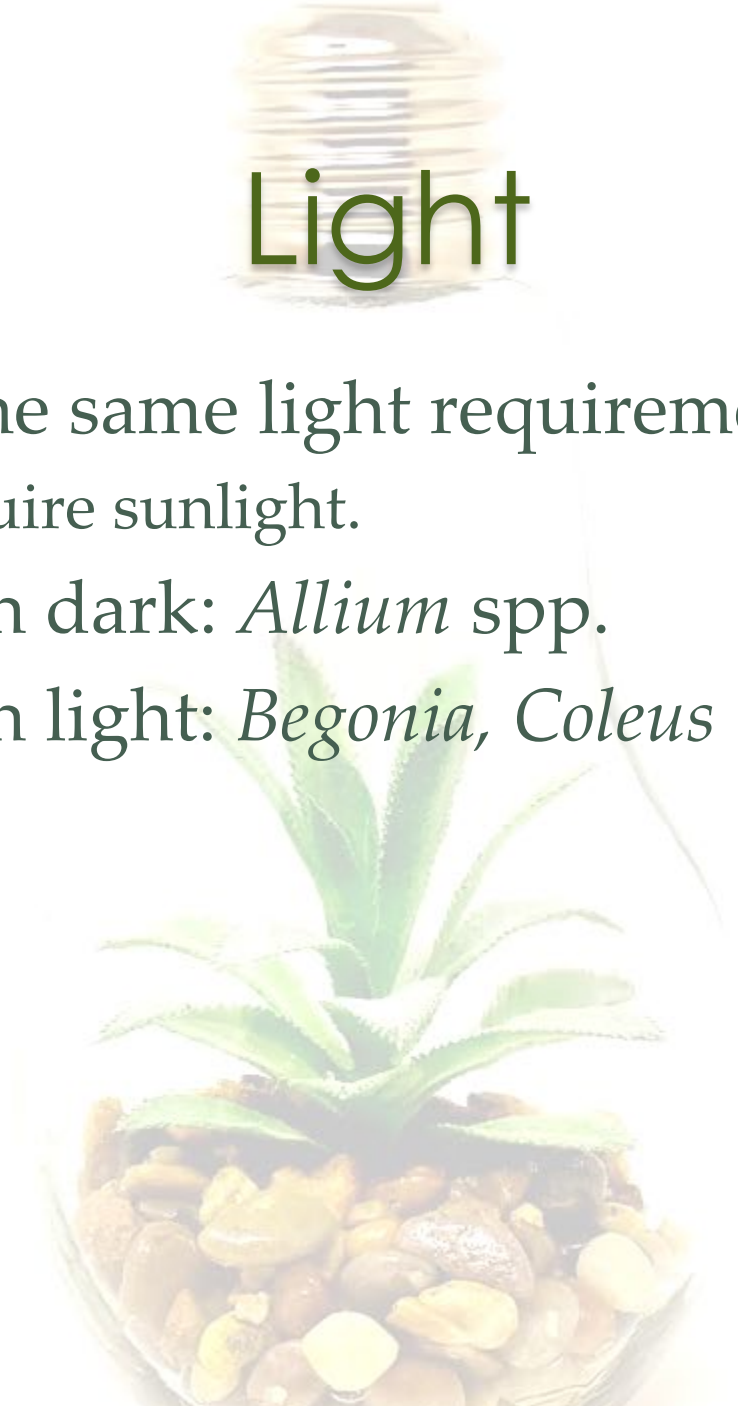
Too Deep

Soaking/Leaching

- Seeds may contain chemicals that inhibit germination

Light

- Not all seeds have the same light requirements.
  - But all seedlings require sunlight.
- Need to germinate in dark: *Allium* spp.
- Need to germinate in light: *Begonia, Coleus*

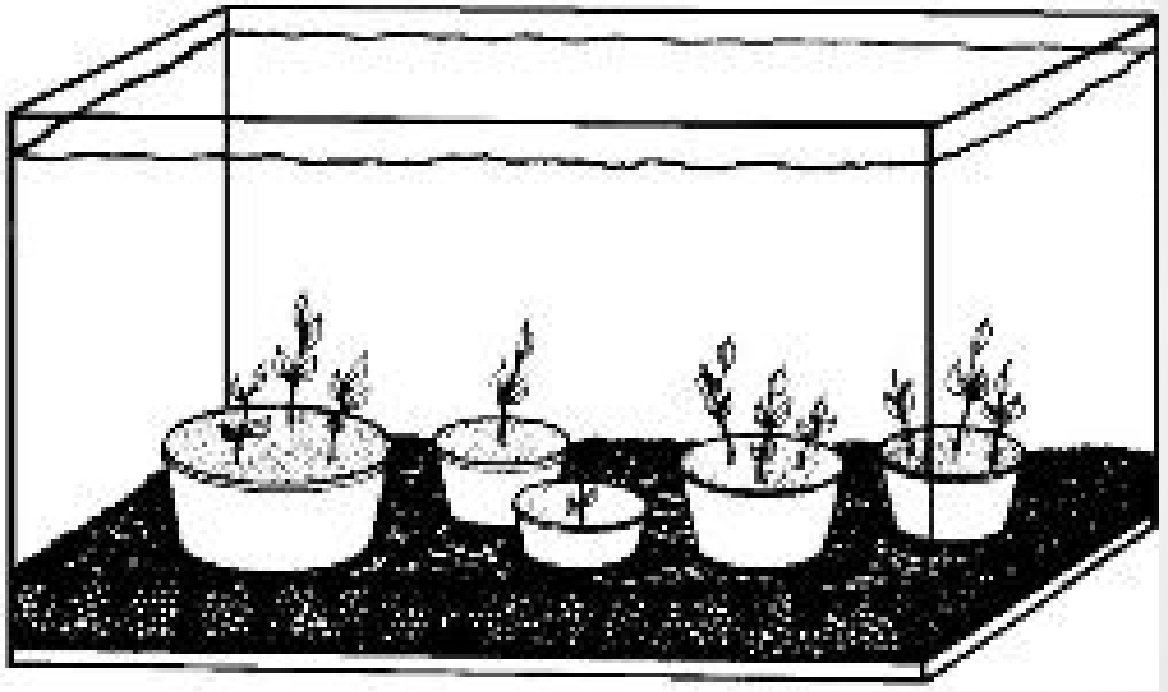


Depth

- Seed should be planted no deeper than 1 to 2 times their diameter.

Care

- Keep moist
  - relative humidity near 100 percent
- Moderate temperatures
  - between 70°F to 80°F for most seeds



Common Problems with Seeds

- Poor or Erratic Germination
- Tall, Spindly Growth
- Collapse and Death of Seedlings
- Discolored Seedlings

Poor or Erratic Germination

- Weak Seeds
- Poor Conditions
- Fungus, Bugs, or Animals
- Seed Coat
- Allelopathy

Tall, Spindly Growth

- Tall, spindly growth is a common problem when growing transplants indoors. Poor (insufficient) light, excessive watering, high temperatures, excessive fertilization, and crowded conditions are factors that contribute to spindly growth.

Collapse and Death of Seedlings

- "Damping Off": The fungi, *Rhizoctonia* spp. and *Fusarium* spp., along with the water mold *Pythium* spp. are the most common pathogens responsible for damping off

Discolored Seedlings

- A nutrient deficiency is likely responsible for the sickly yellow-green or purple color.

QUESTIONS?

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