

Developing Plant and Soil Skills: One Tomato at a time

*Phil Reilly,
(gphilreilly@gmail.com)
April 14, 2017*



**See “Worlds Healthiest Foods” site:
<http://www.whfoods.com/genpage.php?tname=foodspice&dbid=44>**

About this presentation ...

April 16, 2017

A new gardening season has begun in the Ottawa area. Pre-starting one's own favoured varieties of vegetables, to obtain an earlier harvest of a that enjoyed produce, is a time-honoured practice that many gardeners undertake with joy and anticipation. While the seeds of most tomato varieties planted directly in a sun-filled garden can yield a harvestable crop by fall, the satisfaction of an early harvest of favourite produce drives many of us.

With 25 of years experience growing and marketing experience while operating our home-based ornamental plant nursery, tomatoes have always been grown amongst our gardens for our family's seasonal consumption and processed for off-season consumption.

Now that our ornamental nursery is closed (for retirement reasons), we have undertaken, in earnest, a quest to produce, process and/or store not just tomatoes, but many other fruits and root crops, to make ourselves less dependent on foods' just-in-time costly fossil fuel-delivery (with its exhaust gas negativity) to local retailers. Our motivation is to reduce our 'plant-to-plate' costs and to have knowledge that what we eat is healthily grown and managed without reliance on herbicides, fungicides, and pesticides. The developed survival skills, during severe drought and storms brought on by Climate Change, will be welcomed in the years ahead.

Yes, this involves daily oversight, in our 144 square-foot indoor greenhouse, 320 square-foot outdoor hightunnel, and numerous gardens on our one-acre property. Timely identification and management of pest and disease outbreaks, more common than we would like, includes interventions such as aquatic soap and oil sprays, hand picking, use of insect-attracting yellow sticky cards, attention to watering regimes to keep soils 'not too wet ... not too dry', and seasonal use of floating row covers over plants of concern, to minimize insect damage, to give us a bounty of quality foods by seasons' end. As a bonus, our plant-rich home during winter months provides a visually-delightful way to have plants' photosynthetic process consume some of our home's available carbon dioxide to give us an oxygen-enhanced, moist, and sometimes fragrant, environment in which to while away winter's miseries. And, back to tomatoes, we delight in being able to harvest cherry tomatoes from our indoor greenhouse beginning about February 15 each year!

Concern for the continuation of pollination insects in our environment stimulated us to develop and maintain our ornamental gardens with the aim to have them approved (done!) as a Monarch Way Station (by Monarch Watch) Monarch and Backyard Habitat (by the Canadian Wildlife Federation). We encourage all gardeners to include native plants in their gardens to serve our broader environmental needs.

I hope that this presentation offers readers useful insights and tips to successfully grow, on balconies and in gardens, a few tomatoes that are not not bred to withstand transportation rigours but have the array of heirloom varieties mouth-watering sweetness and flavours.

Tomato plants are ...

**Vines originating from a cranberry-sized fruiting plant found in Peru
(*Solanum pimpinellifolium* = currant tomato)**

- *See link for excellent background info on historical and nutritional info of tomatoes (<http://www.whfoods.com/genpage.php?tname=foodspice&dbid=44>)*
- **health benefits (antioxidant effect of lycopenes) on bone health and heart and blood health (cholesterol), and phytonutrients on overall health.**

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Heirloom defined ...

Commercial Heirlooms:

Open-pollinated varieties introduced before 1940, or tomato varieties more than 50 years in circulation.

Family Heirlooms:

Seeds that have been passed down for several generations through a family.

Created Heirlooms:

Crossing two known parents (either two heirlooms or an heirloom and a hybrid) and dehybridizing the resulting seeds for how ever many years/generations it takes to eliminate the undesirable characteristics and stabilize the desired characteristics, perhaps as many as 8 years or more.

Mystery Heirlooms:

Varieties that are a product of natural cross-pollination with other heirloom varieties.

**(Note: All heirloom varieties are open-pollinated ...
but not all open-pollinated varieties are heirloom varieties.)**

Tomato Basics (for the home gardener!)

Vine Types:

Determinate (Bush-type) Good for containers. Supports not needed.

(e.g. Roma, San Marzano paste, Sweet 'n Neat Cherry, Bush Beefsteak)

- * **Grow to a maximum height (about 4' tall) ... then flower and set fruit.**
- * **Fruit ripening happens over about a two week period.**
- * **Should not prune/remove suckers.**

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Indeterminate: most Heirlooms (Both cherry and slicing) **Supports needed.**

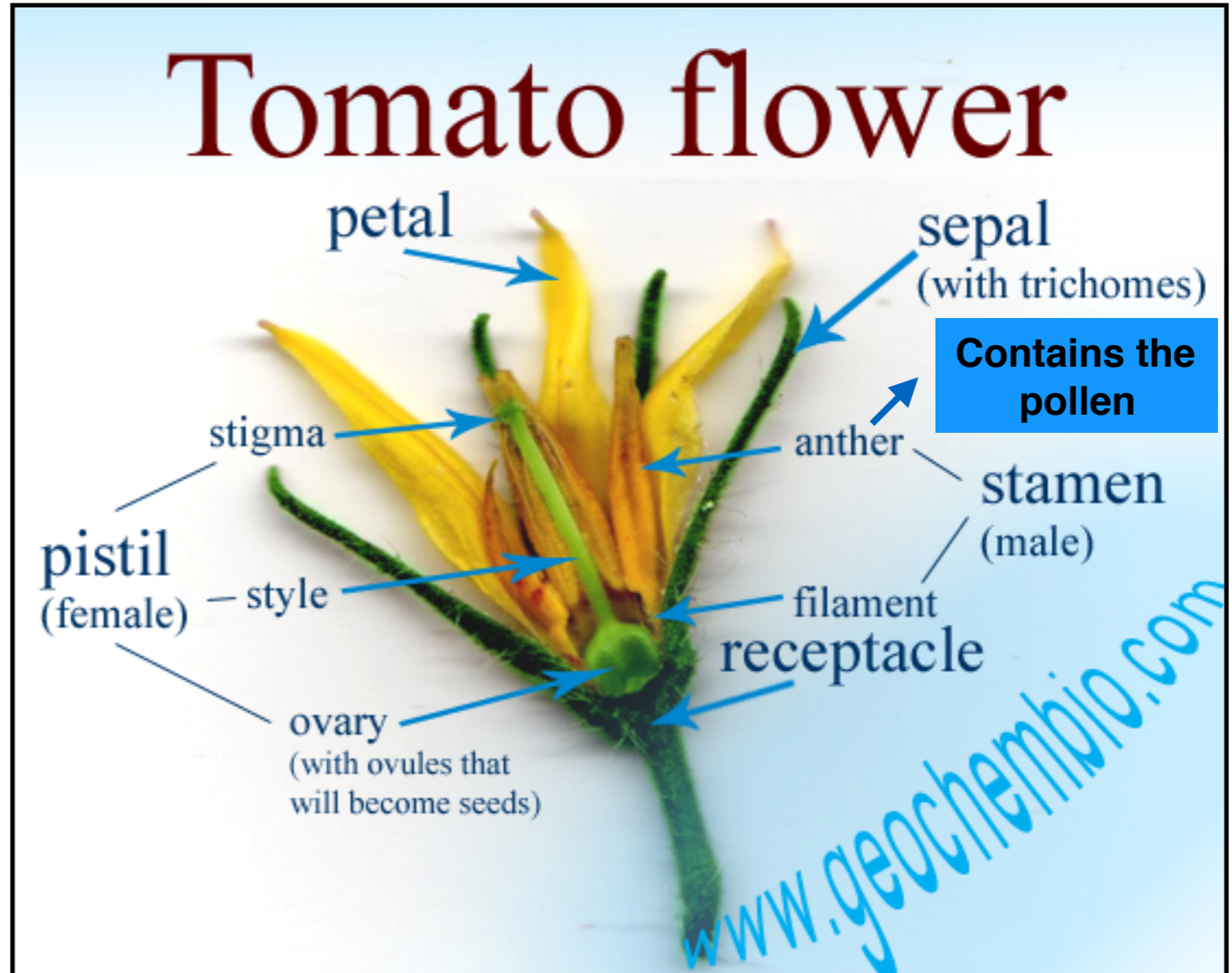
- * **Grow to 6'- 10' (even to 16' tall!).**
- * **Fruit ripening happens over a prolonged time.**
- * **Heirlooms are lower yielding and more prone to diseases.**
- * **Prune out some laterals for maximum photosynthesis.**

Five-foot sections of salvaged farm-field page wire fencing make sturdy tomato cages. We bury the bottom row of wire in the ground to give fruit-laden plants great stability.



Tomato Basics

Flower anatomy



Tomato Basics

Flower anatomy

Tomatoes are Self-fertile

(Also called 'Open Pollination')

- wind, vibration, and insects can cause pollen to be transferred to the stigma.

Cross Pollination

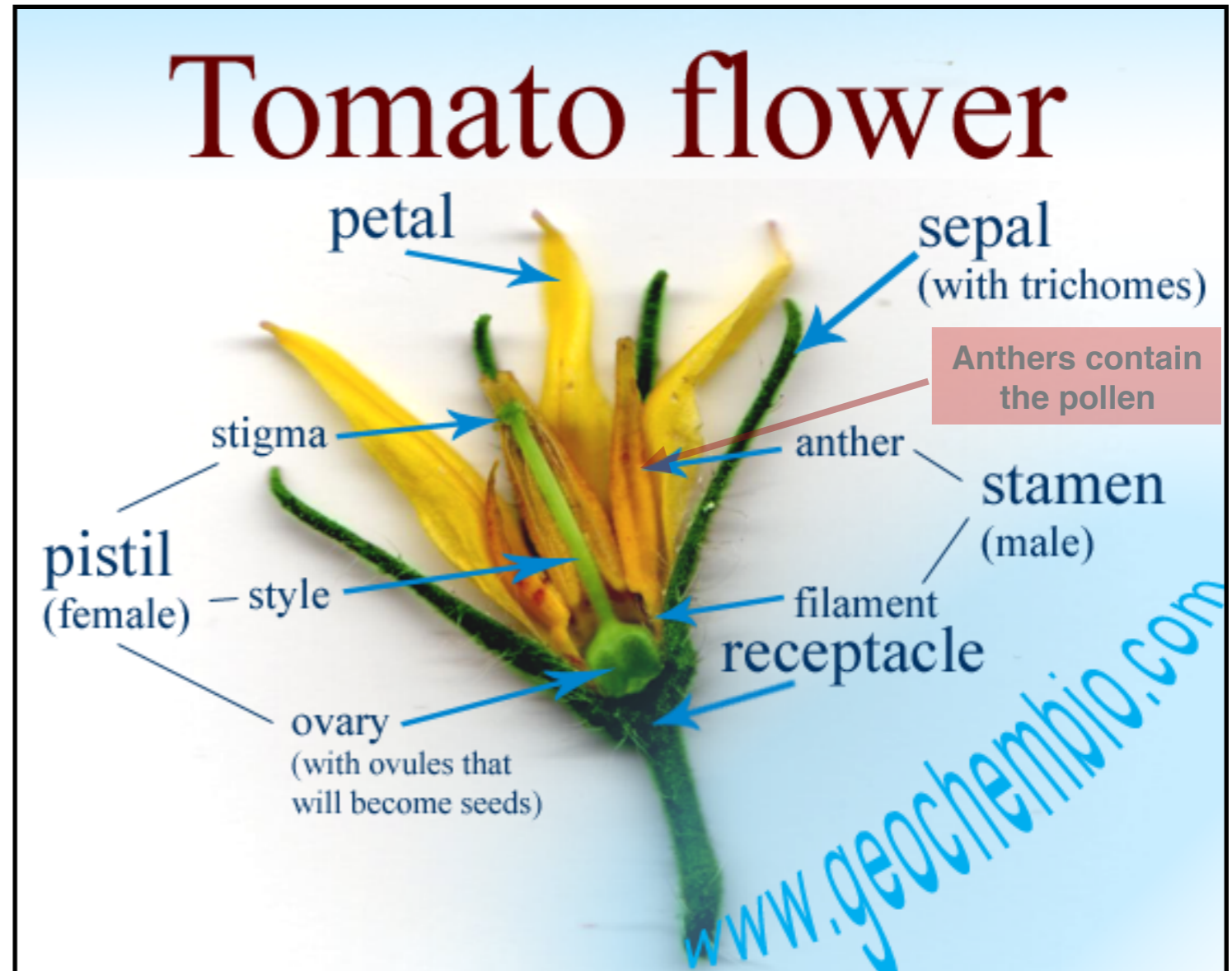
Happens naturally by insects or by

Human practices

(must physically remove anthers to prevent self-fertilizing)

There are no GMO tomatoes!

Hybrid varieties (F1, F2,) depends on continual manual cross-breeding of specific male and female parents. This requires removal of male anthers, then manually applying pollen from desired variety to the stigma (and pollen then naturally migrates to ovules to produce viable seed).



Tomato Basics

Flower anatomy

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Cross Pollination

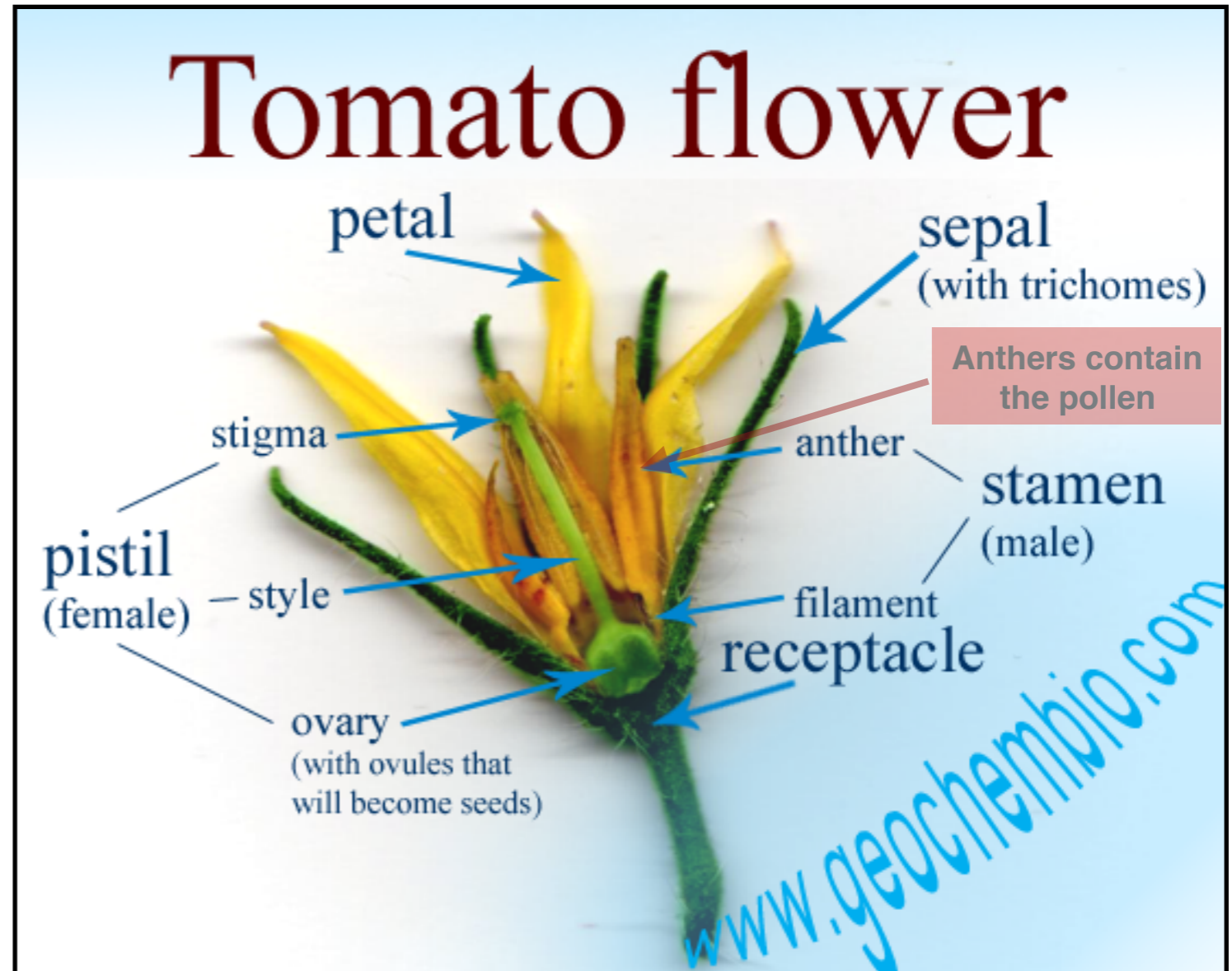
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Note: Gene editing technology, reported in March 2017, has resulted in a non-transgenic tomato, named Tomelo, which is resistant to Powdery Mildew. Researchers have removed a gene from the DNA of a strain of tomato called Heinz 1706 to achieve this result. See: [Rapid generation of a transgene-free powdery mildew resistant tomato by genome deletion](http://www.nature.com/articles/s41598-017-00578-x). <http://www.nature.com/articles/s41598-017-00578-x>

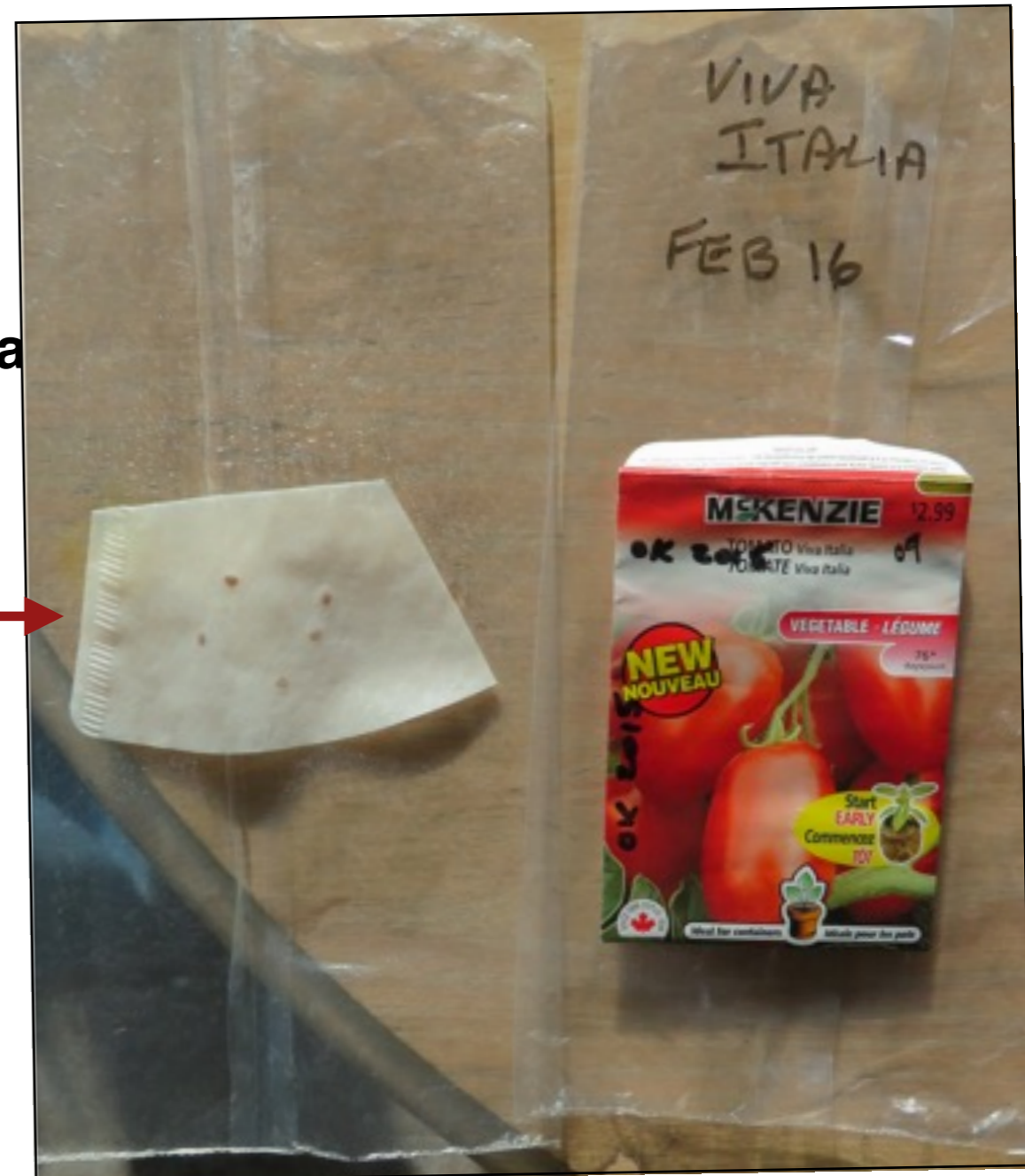


Beginning Plants

Seeds

- * Begin seeds 6-8 weeks before date of last frost.
- * 75 F - 85 F usually gives one-week germination.
- * Start seeds in coffee filters placed plastic baggies or
 - seed directly into Pro-Mix BX (good drainage characteristic).
- * Keep seed mix moist, but not soaking wet.
- * **Got old seeds?**
 - Placed in jar of water, viable seeds sink and can be retrieved for germination!

My method using pieces of coffee filter inserted in a milk bag. Within a couple of days of germination root hairs develop on the primary root. It is then time to place seedlings in potting soil. If root hairs are anchored in the paper, I rip the paper to isolate each seedling, with its roots intact, and place paper and seedling, root pointing downwards, into the soil.



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- * Old seeds? In water, viable seeds sink!

Stem Cuttings

- * **Box cutter used for cutting stem tip.**
- * **Place in tap water in bright light (but not in direct sun).**
- * **When well-rooted, place in ProMix BX and place under lights or harden off and transplant in garden.**



Stem showing root initiation.

“Well-rooted” will see the cuttings with copious roots with developed root hairs.



Beginning Plants (3-5 plants/person for eating, 5-10 for preserving)

When purchasing plants: examine and reject plants with flowers and insects!

Home Growing Conditions:

Seedlings:

- * **Soil conditions**

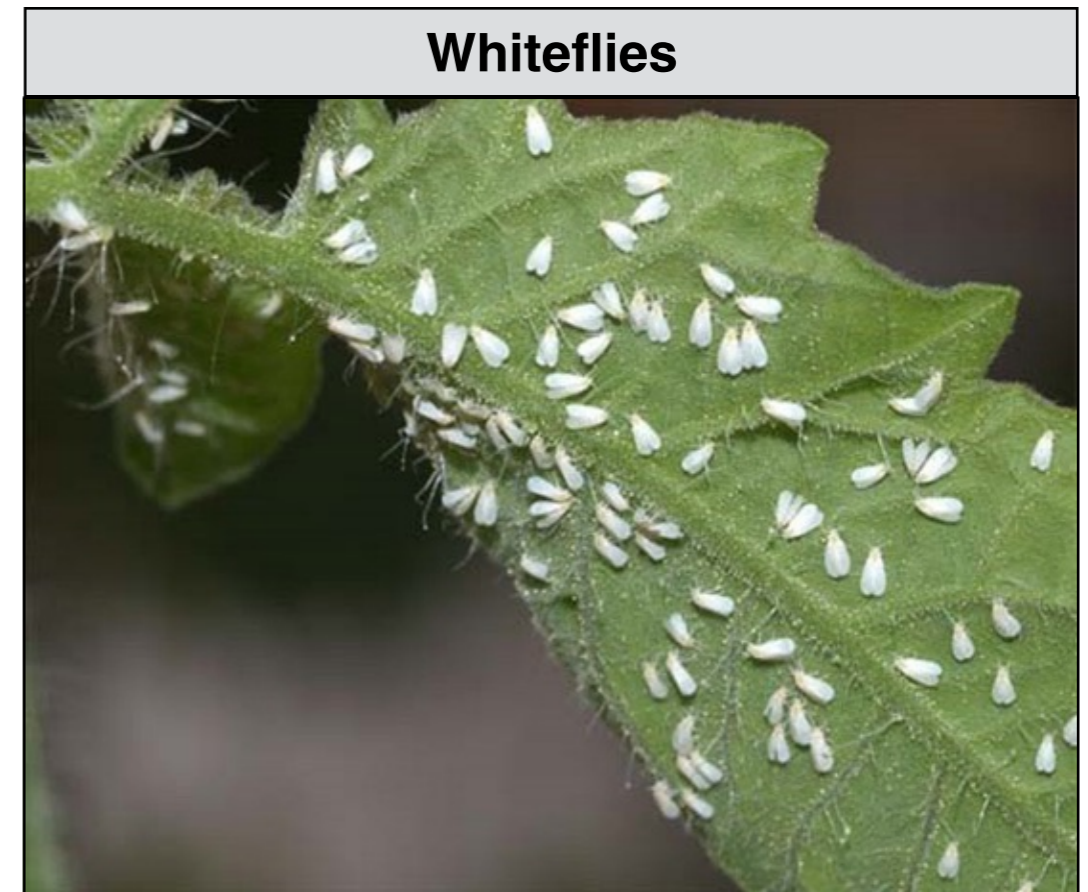
- **(ideal pH of water & soil: pH 6.8 - 7.0)**
- **soak then let dry to about one-inch depth to encourage deeper root growth.**

- * **Soil temperature: Cooler (70 F).**

- * **Lighting: 14 - 16 hours a day.**

- **Young plants want light with more blue spectrum.**

Rotate daily if light is only from window sill placemetn!



Beginning Plants (3-5 plants/person for eating, 5-10 for preserving)

Home Growing Conditions:

Seedlings:

- * After 2 weeks ... fertilize weekly with balanced formulation (e.g. 10:10:10 / 3:3:4) soluble or slow release pellets dilute to 1/4 recommended strength.
- * Check daily for Damping Off Disease (a soil fungus enabled by moist soil surfaces). Maintenance of dry soil surface while keeping bottom soil moist is best done using bottom watering. Quickly discard diseased plants to minimize fungal spread.
- * Control fungus gnats & white flies
 - let soil surface dry.
 - use yellow cards to trap adults.



Growing Conditions

Harden Off Seedlings Before Transplanting

- Begin when + 4 C (+ 40 F) outdoor temperatures arrive.
- Increase sun & wind exposure over 10 - 14 days.

Transplanting

- * Well-drained soil with pH 6 to 6.8 (slightly acidic). *Ours is pH 7.(2)*
- * Best done on cloudy day or in evening.
- * Full sun location best. *(our experience: part shade is tolerable)*
- * Best done when soil warms to daytime 15 C (60 F) & cools to night time 13 C (55 F) . **(i.e. does not need cold covering!)**
- * Leggy plants: lay down @ 30° with 4-5" of stem exposed.
- * Cutworm protection with toilet rolls.
- * Best growth and fruit set occurs with air temperature between 65 and 85 degrees F.
 - above 90 degrees F cause water stress, fruit damage from sun scald and slow ripening.

Fertilizer for flowering and onwards: 9:15:30



8-32-16
or
6-24-24



Growing Conditions ... to Maturity

Soil moisture:

- normally watering: 1 inch/week is enough ...

Note: Be aware of your water's pH and negative effect of salt content from softened water!

- allow soil surface to dry out before re-watering (roots grow deeper).
 - tomatoes' root environment requires air for nutrient uptake.
- in high temperatures & drying soils periods water 2" per week.
- **Note:** mulch heavily (3 inches) ... especially over black landscape cloth.

Growing Conditions ... to Maturity

Soil moisture:

Training plants

- trim the bottom 16" of each plant of all stems and suckers (other than 4-5 main stems) to reduce the relative humidity around the base of the plants.
 - this also helps prevent septoria leaf spot (a fungal disease).
- prune plants to 4-5 main stems.

Note 1: Stop liquid fertilizing in periods of high temperature (90 F).

Note 2: Common media advice to add light shade cloth to plants in high temperature not relevant to our latitude.

Tomato problems:

* Yellowing leaves

- likely due to overly moist soils (e.g clayey soils!)
- **epsom salt remedy** (for magnesium deficiency)
 - not likely ... See: (<https://puyallup.wsu.edu/wp-content/uploads/sites/403/2015/03/epsom-salts.pdf>)
- may be a problem in sandy soil
- do a soil test ([Exova laboratory, 146 Colonnade](#))
- deficiency really only possible in intensive crop production where magnesium is known to be deficient.



Tomato problems:

- * Yellowing leaves
- * **Leaf Roll**

http://www.clemson.edu/extension/hgic/hot_topics/2008/05tomato_leaf_roll.html

- **physiological causes**
 - moisture, heat, transplant shock, etc.
 - lower leaves affect first (inward roll to mid-vein) and they stay green

- **Viral causes (whitefly issue!)**
 - Leaves cup-shaped and turn yellow with purplish veins.

Most plants will continue to set fruit and provide ripe tomatoes late into the growing season.



Tomato problems:

- * Yellowing leaves

- * Leaf Roll

- * **Blossom End Rot:** *(not a disease!)*

- Calcium unavailability ... not deficiency.
- Can be more of a problem in heavy clay soils.
- Setting out in cold soil can lead to the problem on first fruits.
- Set out in early to mid June when soils are warmer!



- * **Growth cracks:**

- Drought followed by heavy rain or watering gives rapid growth during fruit ripening.

http://www.clemson.edu/extension/hgic/hot_topics/2008/05tomato_leaf_roll.html



Tomato problems:

Septoria Leaf Spot

- small spots on the lower leaves (after the first fruit sets).
- spots spread upwards from oldest to youngest growth.
- leaves turn slightly yellow, then brown, and then wither and fall off.
- Fruit infection is rare.
- fungus overwinters on infected tomato debris or on weeds in the nightshade family.

Prevention

- clean up debris at season's end.
- no overhead watering.
- mulch after the soil has warmed.
- two-year crop rotation.



<http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/help-for-the-home-gardener/advice-tips-resources/pests-and-problems/diseases/fungal-spots/septoria-leaf-spot-of-tomato.aspx>

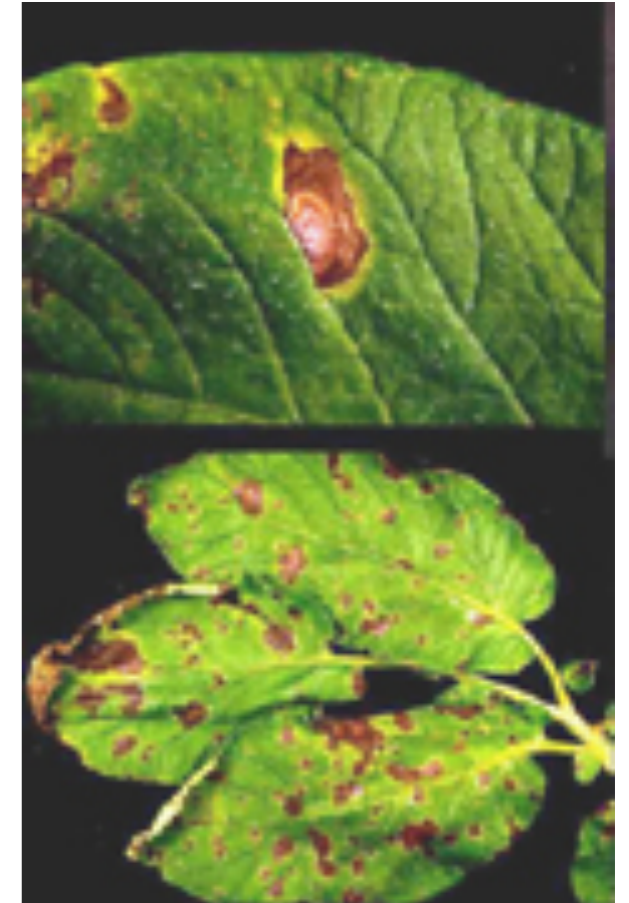
Tomato problems

Early Blight:

- * Primarily a fungal disease of aging plant tissue.
- * Fungal spread of the disease results from conidia being dispersed mainly by wind and occasionally by splashing rain or overhead irrigation.
- * Production of fungal spores is during wet nights. The following day light and dryness induce them to produce spores, which emerge on the second wet night.
- * Lesions generally appear quickly under warm, moist conditions and are usually visible within 5-7 days after infection.
- * Spots on fruit near stem end.
- * The pathogen overwinters on living infected crop debris.

Control:

- * Remove plant debris ... **send to municipal compost.**



Tomato problems

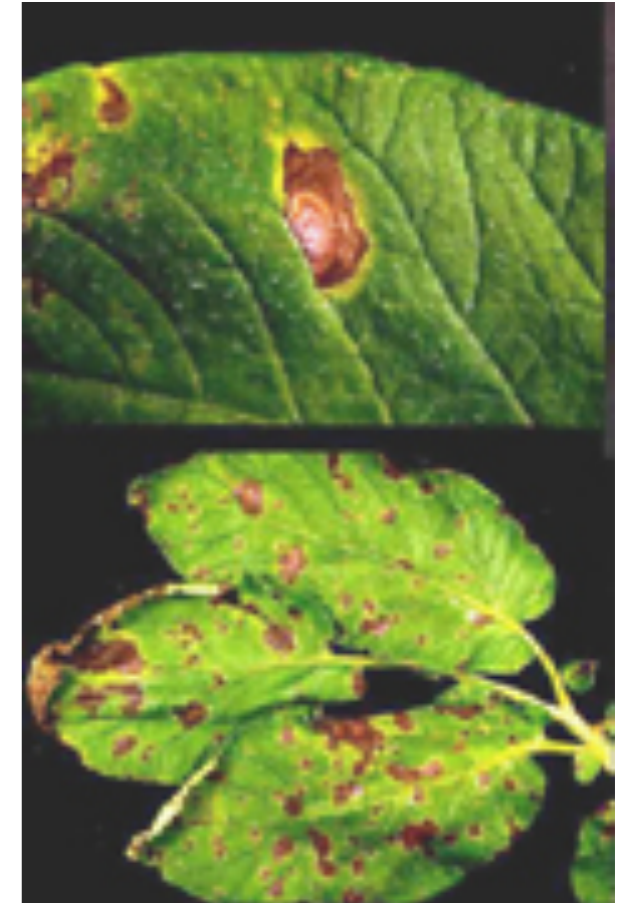
Late Blight:

- * Primarily a fungal disease of aging plant tissue.
- * Fungal spread of the disease results from conidia being dispersed mainly by wind and occasionally by splashing rain or overhead irrigation.
- * Production of fungal spores is during wet nights. The following day light and dryness induce them to produce spores, which emerge on the second wet night.
- * Lesions generally appear quickly under warm, moist conditions are usually visible within 5-7 days after infection.
- * The pathogen over winters on living infected crop debris.

Control:

- * Remove plant debris ... **send to municipal compost.**

Video: <http://articles.extension.org/pages/68599/video:-identifying-and-scouting-for-late-blight-on-organic-farms>

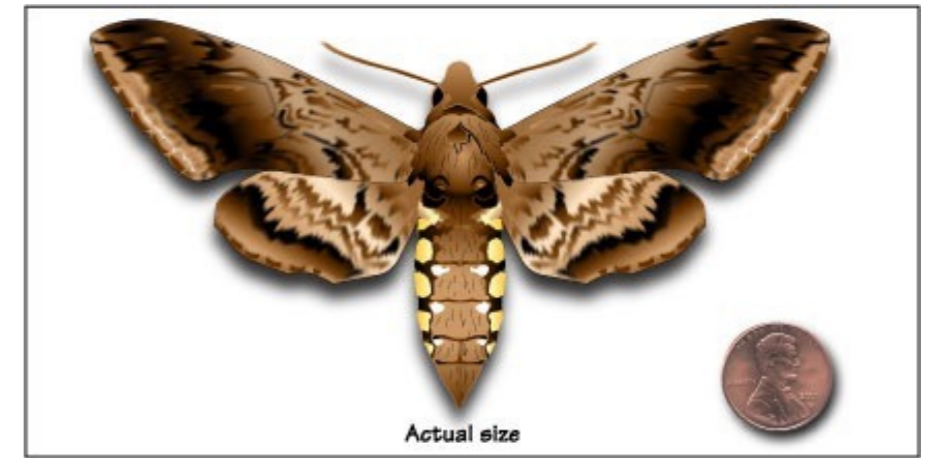


Tomato problems:

Horn worms

Adult stage is Five-spotted hawk moth
(also feed on peppers, potatoes and eggplant)

- Eggs found on underside of leaves
- Larvae fall to ground where they pupate
- control: fall clean-up important



8 white lines



Plants That Attract Beneficial Insects

http://www.farmerfred.com/plants_that_attract_benefi.html

Brachonid wasp



Brachonid wasp cocoons



Tomato problems:

Two-spotted Spider mites

- Scan for mites in early season.
- Feed on juices of leaves.
- Start on lower leaf surface but can move to upper surface.
- Disposal of infected leaves!
- Control using horticultural oil sprays.
 - Spray in evening!
 - 10 mls/l = 1% solution.
 - repeat at 5-7 days



Cutworms

- Problem at transplanting time.
- Instal paper/cardboard collars.
- Delay spring planting until soil warms up.



Tomato problems:

White Flies

- Whiteflies suck plant juices.
- Produce honeydew ... a sticky substance which can cause fungal diseases to form on leaves.
- Leaves will wilt, turn pale or yellow, and growth will be stunted.
- Control/monitor with yellow sticky cards.
- Control with Insecticidal soap control.
 - Spray when temperatures are lowest.



Fungus Gnats

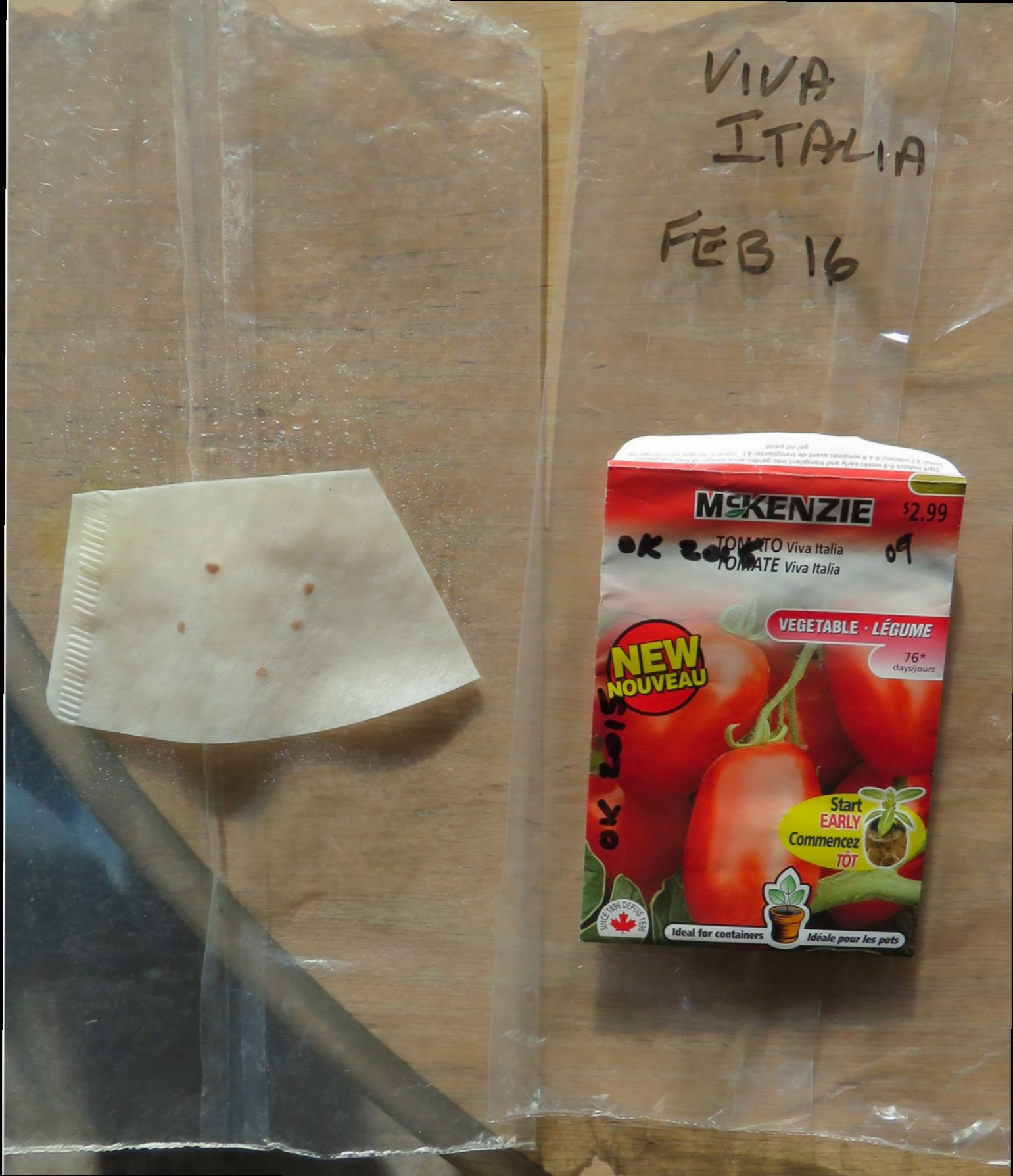
- Mostly problem with seedlings.
- Larvae feeding on roots reduces plant growth and vigour.
- Prevention by allowing top 2" of soil to dry out before re-watering.
- Control using yellow sticky cards.



Harvest and Storage

- * Pick when vine ripened and firm.**
- * Some green tomatoes may be picked before the first killing frost and stored in a cool (55 °F), moist (90-percent relative humidity) place.**
- * Green tomatoes can be stored at 50 to 70 °F for one to three weeks.**
- * Ripen green fruits indoors at 70 °F.**
- * Do not store green tomatoes in the refrigerator since red color will not develop at less than 50 °F.**
- * Ripened tomatoes should be stored at 45 to 50 °F for four to seven days.**

Tomato Varieties 'Viva Italia' Paste



Tomato Varieties

'Red & Yellow Pear'

Red & Yellow Pear Tomatoes

SOW SEEDS INDOORS Feb. - March

DAYS TO GERMINATE 7 - 14 days

TRANSPLANT OUTDOORS IN FULL SUN April - June

MATURE HEIGHT 5 - 7 feet

TRANSPLANT TO HARVEST Approx. 75 days

✿ ✿ ✿ ✿ ✿ ✿ ✿ ✿ ✿ ✿

An old-fashioned treat. Our mixed seed packet offers an easy way to grow plants of both crimson-red and sunny yellow little pear-shaped tomatoes that ripen like delectable drops of flavor in luscious long clusters. You'll find their bright colors, appealing shapes and mild sweet taste truly irresistible.

Seeds are color coded with USDA food grade stain to distinguish varieties. Be sure to plant some of each for colorful harvests!

Pink seeds = Red Pear
Undyed seeds = Yellow Pear

NOTES
Well with aged compost. Plant

✿ Renee's Garden ✿

Ph: 888-880-7228 • reneesgarden.com

Visit reneesgarden.com \$2.79 US/\$2.99 CAN
Net Wt. 100 mg PACKED FOR 2015 LOT B
Not treated or genetically engineered Sell by 12/15

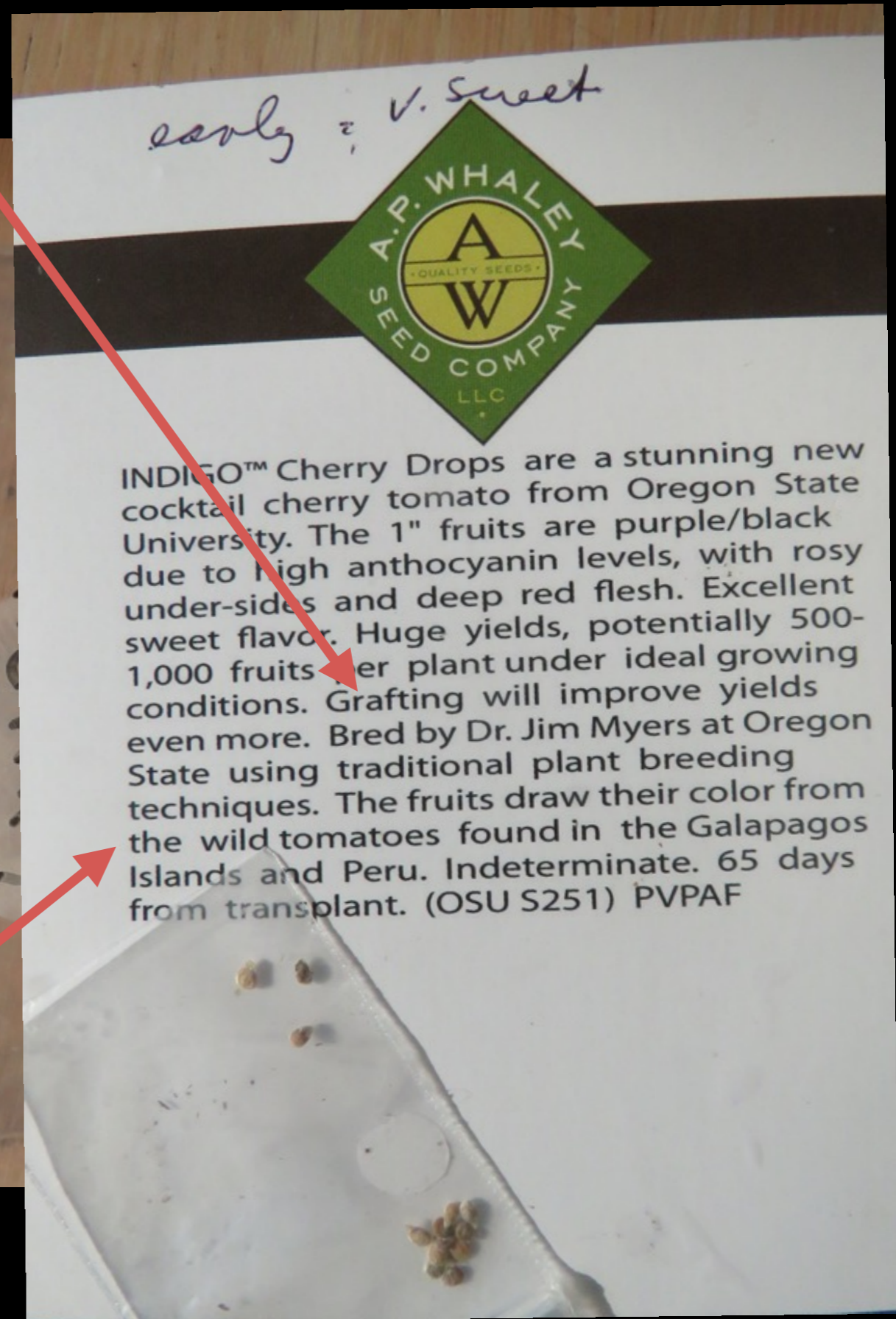
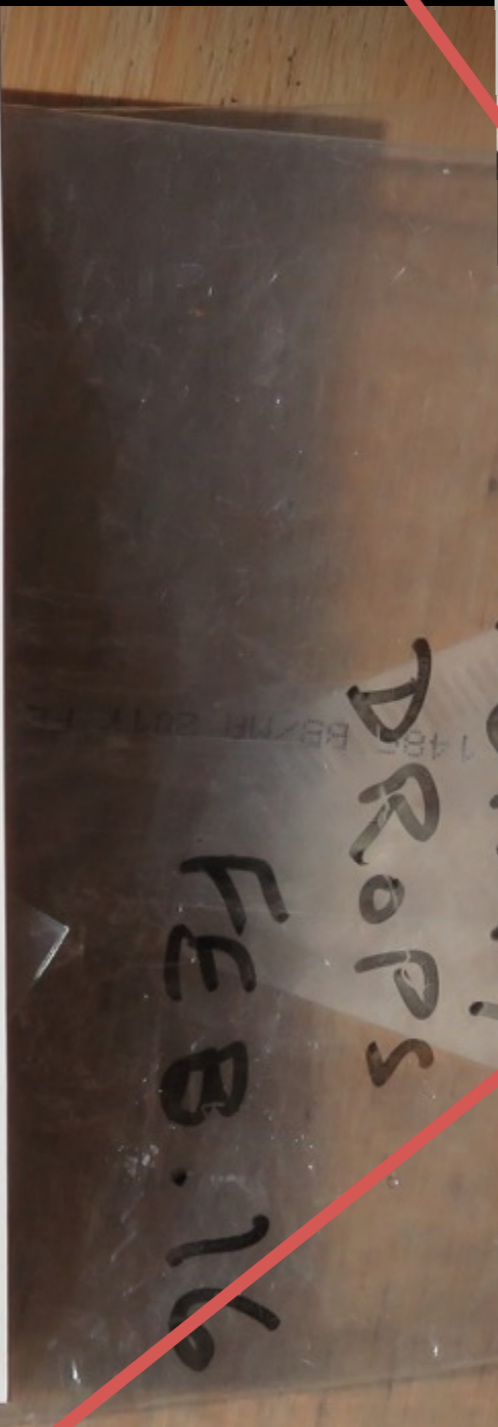
Yellow
100% in 4 days

RED PEAR
FEB 16



YELLOW PEAR
FEB. 16

Tomato Varieties 'Cherry Drops'



Tomato Varieties

'Big Beef'

TO HARVEST Approx. 75 days

HEIGHT 5 - 7 feet

IN FULL SUN April - June

GERMINATE 7 - 14 days

INDOORS Feb - March

Big Beef Beefsteak Tomato

✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

If you yearn for old-fashioned beefsteak tomato taste, size, and quality, this All-America winner is our hands-down favorite, combining delicious full flavor, heavy yields, wide adaptability and truly superior disease resistance (V-1, F-1, F-2, ASC, St.N, ToMV).

The huge globe-shaped fruits size up about 10-12 oz each, without the cracked tops or fibrous interiors of older beefsteak varieties. Best of all, these scrumptious giant slicers are heavy with sweet flesh and lots of juice — perfect for "BLT" sandwiches.


NOTES
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all by themselv
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Beefsteak Tomato Big Beef



The best juicy beefsteak for flavor, size and quality. All-America winner.

Visit reneesgarden.com \$2.99 US/\$3.19 CAN
Net Wt. 70 mg PAKED FOR 2014 LOT A
Not treated or genetically engineered Sell by 12/14

Tomato Varieties 'Black Krim'

SOW SEEDS INDOORS Feb. - March
DAYS TO GERMINATE 7 - 14 days
TRANSPLANT OUTDOORS IN FULL SUN May - June
MATURE HEIGHT 5-7 feet
TRANSPLANT TO HARVEST Approx. 80 days

Black Krim Heirloom Tomato

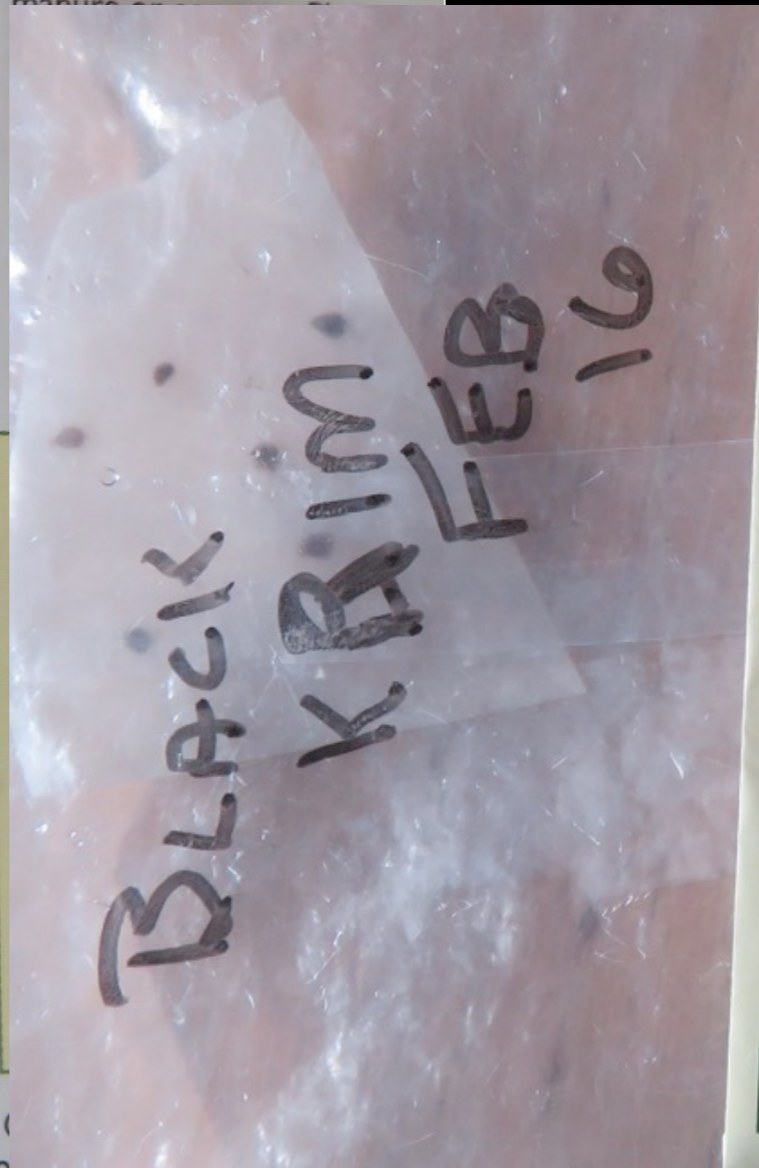
STARTING SEEDLINGS

In early spring, start indoors about 6 to 8 weeks before outdoor night temperatures are reliably in the 50-55°F (10-13°C). Sow seeds 1/4 inch deep and 1 inch apart in a container of seed starting mix. Keep moist but not soggy, and very warm, 80°F(27°C). Provide a strong light source until seedlings are ready to plant outside.

When seedlings are 2 inches tall, transplant into individual 4 inch pots. Maintain at 70°F (21°C). Feed with half-strength fertilizer every 2 weeks until ready to plant. When nights reach 55°F(13°C), gradually acclimate to outdoor conditions. Plant these vigorous indeterminate climbers 3 feet apart into rich soil in full sun.

GROWING NOTES

Prepare soil well with aged manure...



✧ Renee's Garden ✧

ORGANIC  **SEEDS**

Heirloom Tomato
Black Krim



Tall vigorous vines offer mouthwatering fruits with unique dark purple/black skins.

✧ Renee's Garden ✧

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Net wt. 125 mg **\$3.79 US / \$3.99 CA**
 Packed for 2015 Sell by 12/15 LOT B
Certified Organic by the CO Dept of Agricu

Tomato Varieties

'Sweet Treats' Cherry

A new one-of-a-kind cherry tomato, with an excellent flavor experience. The fruits are rich and flavorful with a beautiful deep pinkish tone.

*Indeterminate type
105-120 days to harvest
Average fruit size 20-30 grams*

Transplant anytime after danger of frost has passed. Sweet Treats produces a large bush and should be staked and tied.



Roasted Cherry Tomatoes

Source: Bon Appetit Magazine

Makes 25 servings

Preparation:



Collecting seeds:

- * Tomato to be paste ripe —just before rotting stage.
- * Mash tomato, thoroughly wash the pulp, then dry quickly out of direct sunlight.
- * Store

Good description of fermentation and storage process:
<http://permaculturenews.org/2014/07/08/save-tomato-seeds/>

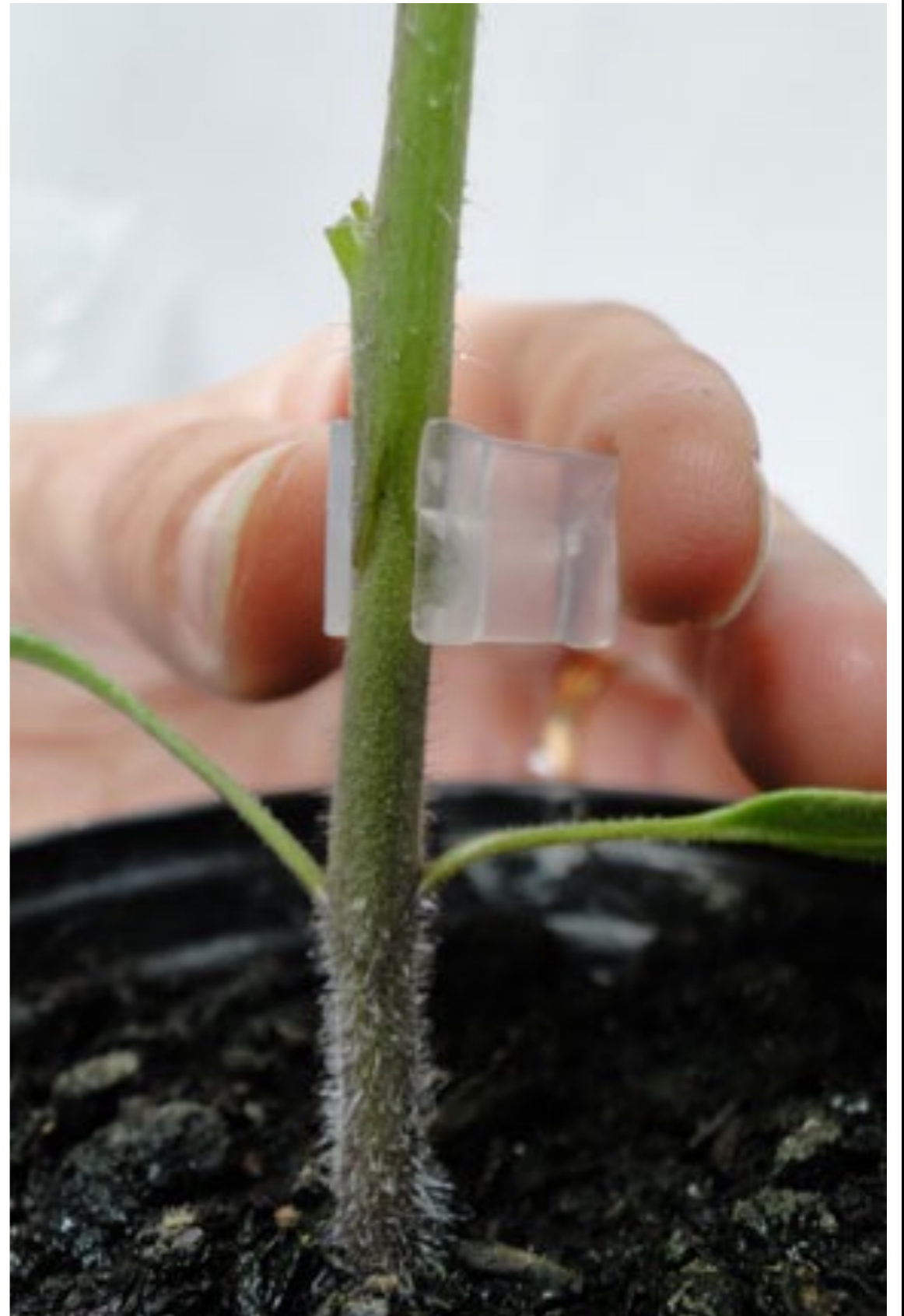
Grafted Tomatoes

* Grafted tomatoes bring together the best of both worlds: excellent production and disease resistance, ...

* Grafting is simply taking the top—scion—of any tomato variety seedling that's the same stem size as the rootstock, and attaching it to a specialized hybrid rootstock grown specifically for its vigour and disease resistance.

Grafting vegetables:

<https://www.rhs.org.uk/advice/profile?PID=825>



References for Growing Tomatoes (gphilreilly@gmail.com)

What's New and Beneficial About Tomatoes (Worlds Healthiest Foods)

<http://www.whfoods.com/genpage.php?tname=foodspice&dbid=44>

Best LED Grow Lights:

<http://uponics.com/best-led-grow-lights/>

Epsom salt myth:

<https://puyallup.wsu.edu/wp-content/uploads/sites/403/2015/03/epsom-salts.pdf>

Tomatofest's & Tomatodirt's Information:

[https://store.tomatofest.com/Heirloom Tomato Seeds s/1.html](https://store.tomatofest.com/Heirloom_Tomato_Seeds_s/1.html)

<http://www.tomatodirt.com/potting-mix.html>



Clemson University Home and Garden Information Centre

* Excellent table on maturation dates and disease resistance.

http://www.clemson.edu/extension/hgic/hot_topics/2008/05tomato_leaf_roll.html

Grafting vegetables:

<https://www.rhs.org.uk/advice/profile?PID=825>

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