



# Saffron:

From Production to Processing

Friday, March 16, 2018

Burlington, VT



*North American Center for  
Saffron Research and Development*





**BBC News**

6 hrs · 🌐



Could saffron save the agriculture industry in the US state of Vermont?



**Most expensive spice could help farmers in Vermont**

[bbc.com](https://bbc.com)

👍 🤔 ❤️ 2.3K

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**Yasmin Hyder**

Ghalehgolabbahani has to be the longest surname I've heard! What a mouthful. Lol

6 hours ago · Like · 👍 17 · Reply

# What is Saffron?

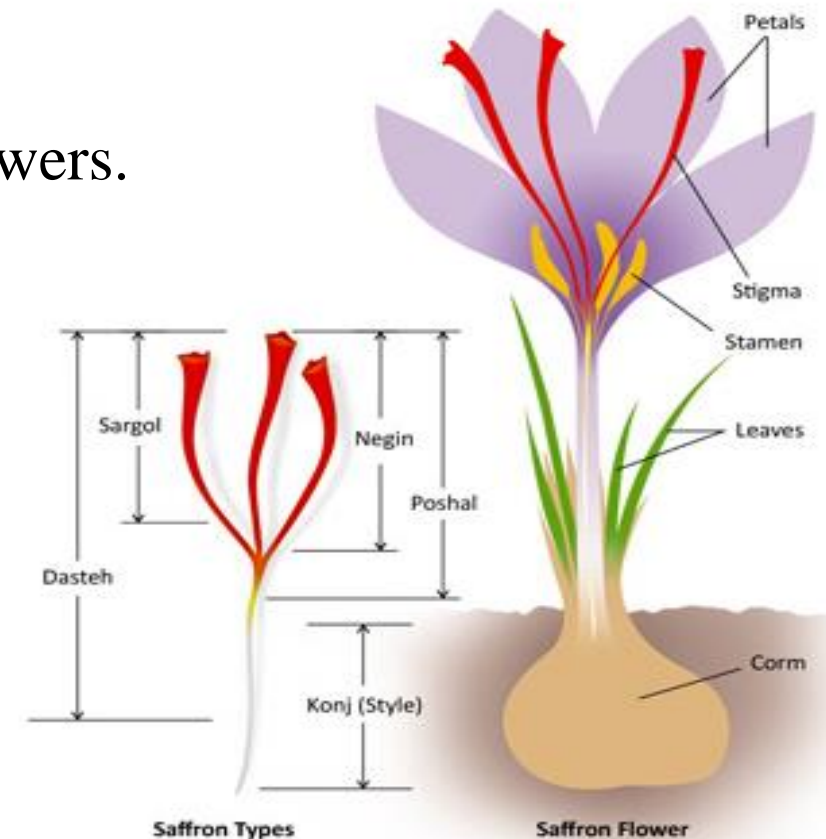
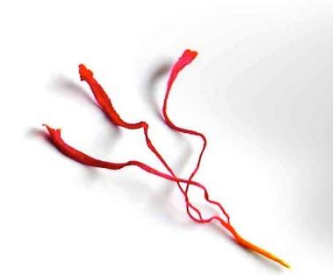
The most expensive spice in the world over  
**\$3,000-9,000/lb!**

**Saffron** is the dry stigma of *Crocus sativus* L. flowers.

**Flowering: autumn**

**In cultivation for over 3,500 yr**

**Origin: Probably Greece or Crete**





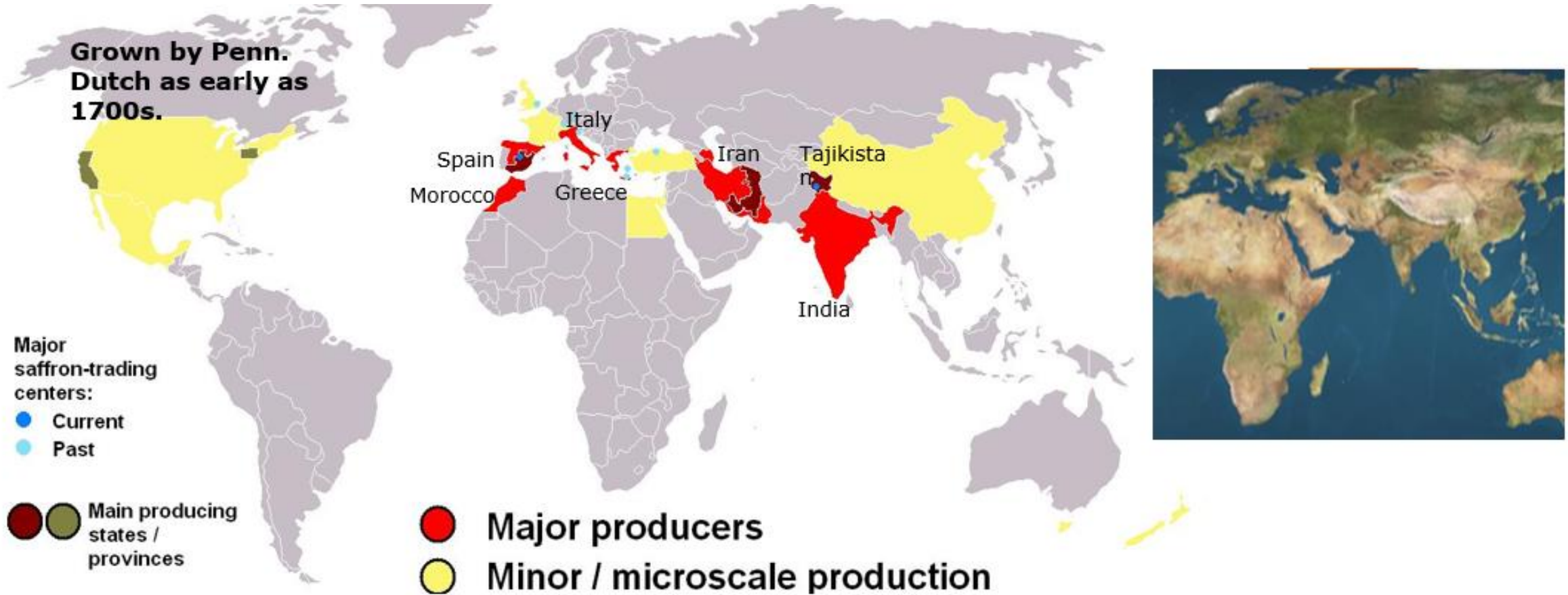
# What is Saffron good for?



- Culinary spice
- Medicinal herb
- Medicinal extract
- Perfume
- Ornamental plant
- Fabric dye
- Liqueur



# World Saffron Cultivation



**In 2016 the US imported 46 tons of saffron!  
Imports are estimated to triple by 2025.**

# Why is Saffron so expensive?

Currently all processing is done by hand

4,000 blooms = 1 oz of saffron



The average saffron yield is about **8 lb./ha (less than 4 lb./acre).**

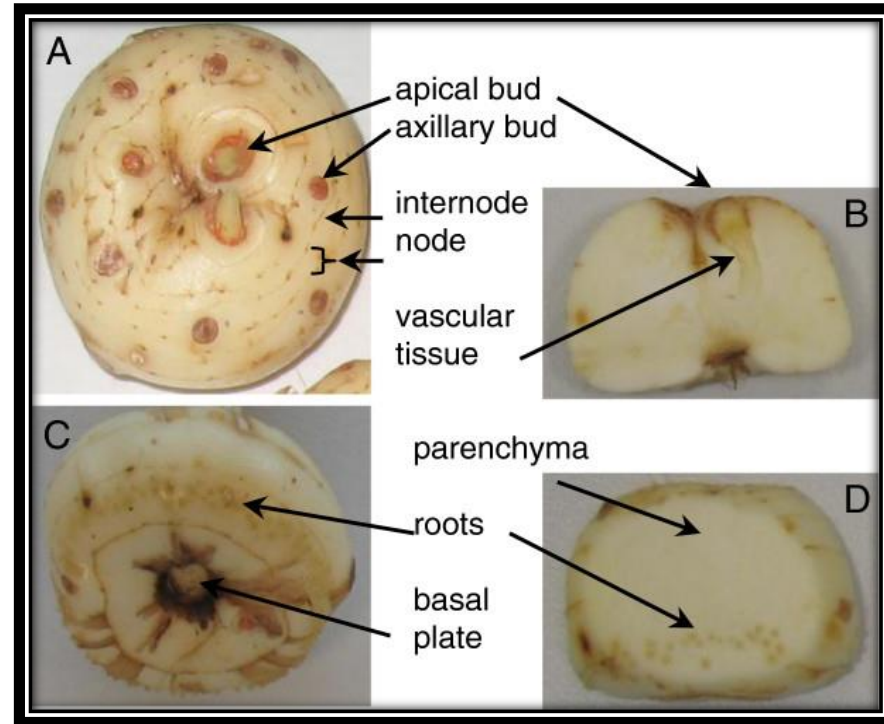


Saffron is adapted to **dry regions**

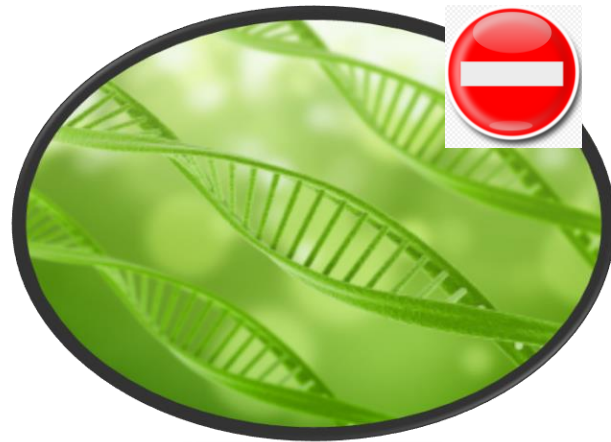
tolerates a low temperature of around **0 to -4 °F**

accumulation of reactive oxygen species (**ROS**) that can disturb plant cell metabolism.

Saffron is a triploid sterile plant and thus propagation is only by clonal **corm** multiplication



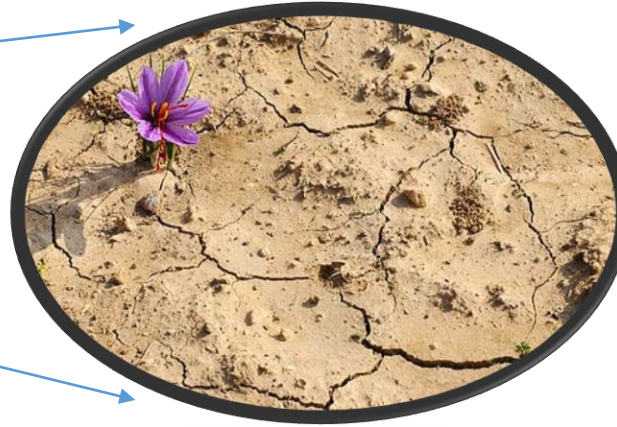
As the *Crocus sativus* doesn't set viable seed,  
the conventional breeding studies have not been success yet.



Therefore, the most recent studies on saffron production emphasize on new  
methods of cultivations,  
soil properties and water demands.



More than 110,000 acres of the saffron cultivated area which is more than 80% of the whole area, are located in Khorasan province, northeast Iran



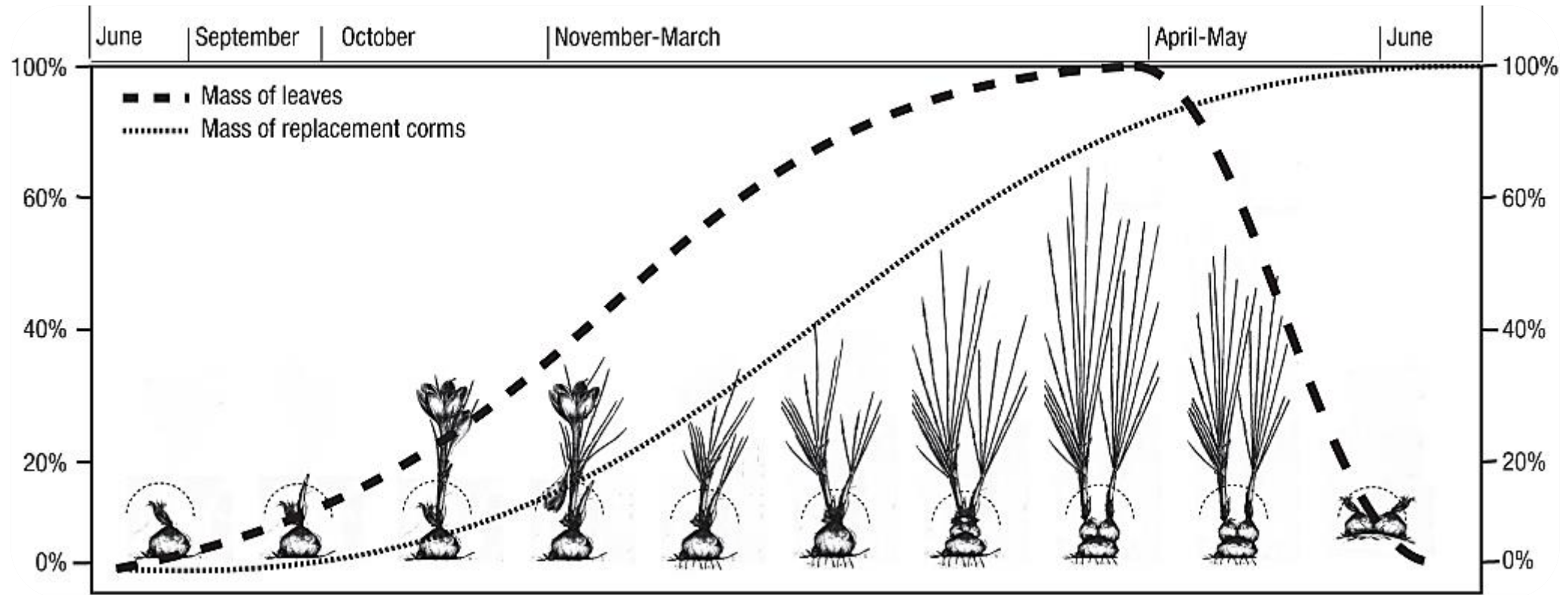
Low soil organic matter (less than 1%) is the characteristic of the soil in this region

The humic acid that is released from the organic matter and compost, can increase the saffron productivity up to 50%

The high level of organic matter in Vermont and northern New England (more than 5%), potentially, makes this area as a productive region for saffron

The life cycle of saffron is similar in all producing regions

The timing is related to the **air and soil temperature and also moisture**



# Saffron Production Cycle



Flowering/  
harvesting/drying  
Oct.-Nov.



Vegetative stage  
Dec. – Mar.



Corm development  
Apr. – June.



Dormancy  
July-Aug.



Plant corms  
Aug.



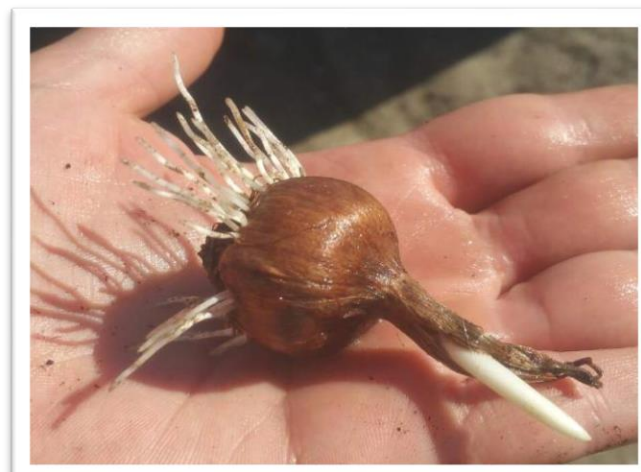
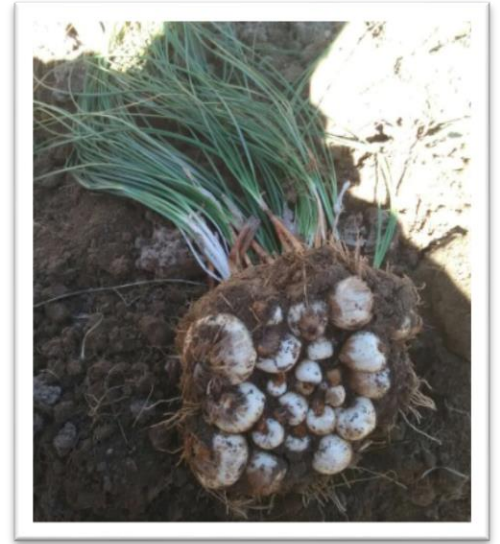
Sprouting  
Sept.

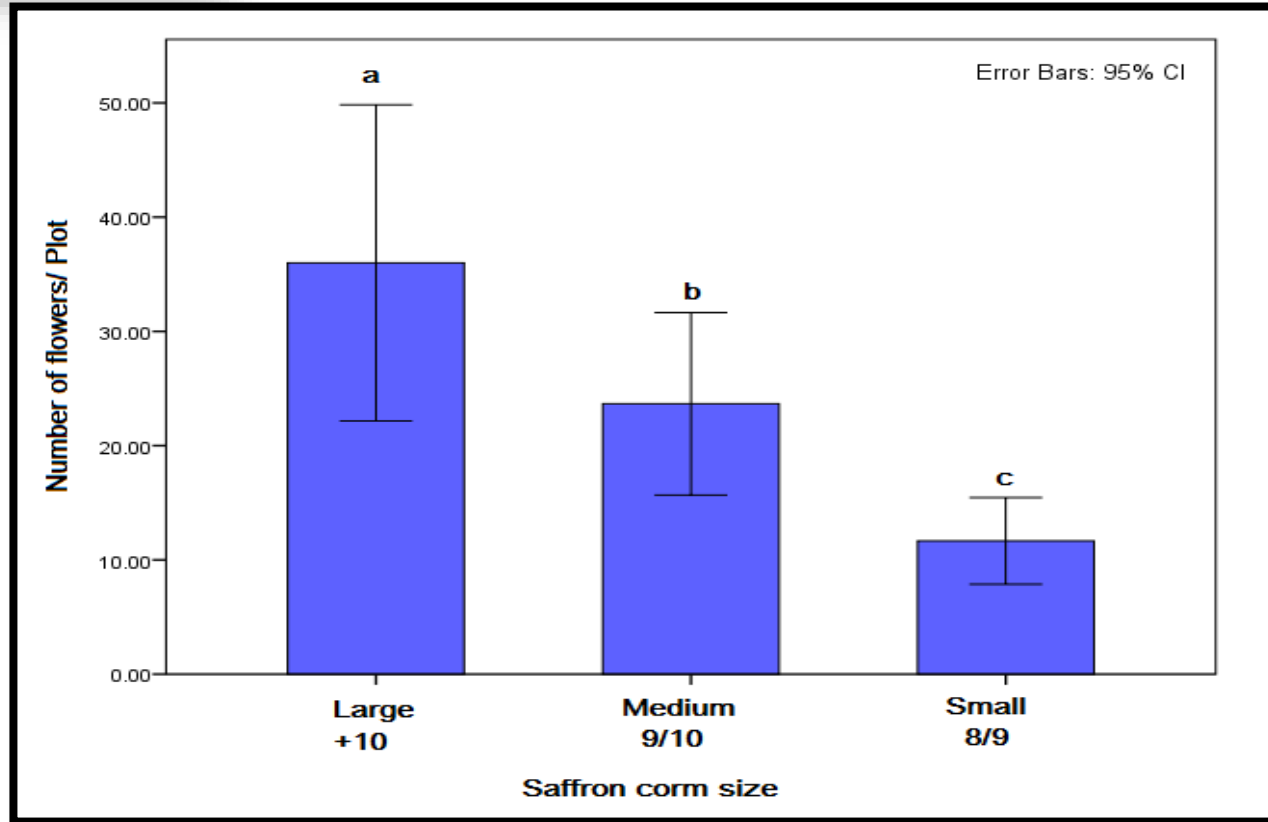


# Saffron Corm Properties

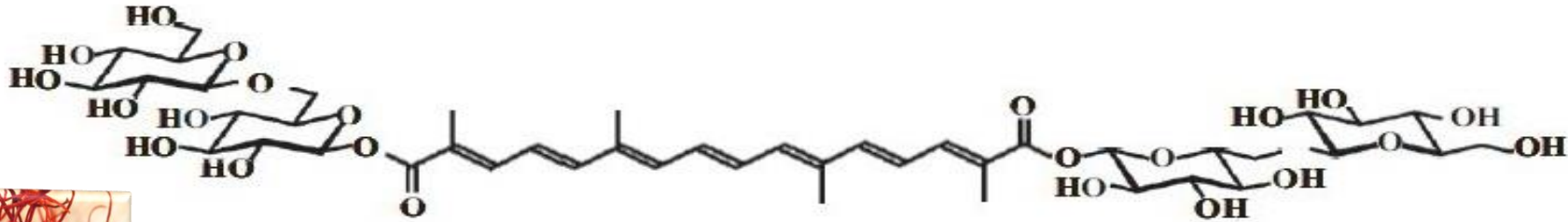
**Heavier and bigger** corms produce more flowers and stigmas.

**Bigger corms can generate better secondary corms**



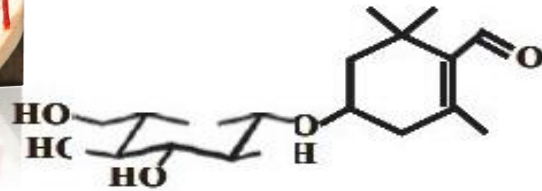


# Saffron quality

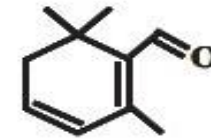


**Crocin**

color



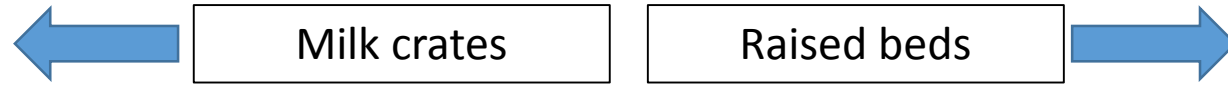
**Picrocrocin** taste



**Safranal** smell

**Picrocrocin** is an important component which **safranal** is a derivative from that during the dehydration of stigmas.

# High Tunnel Growing Methods Tested 2015-2016



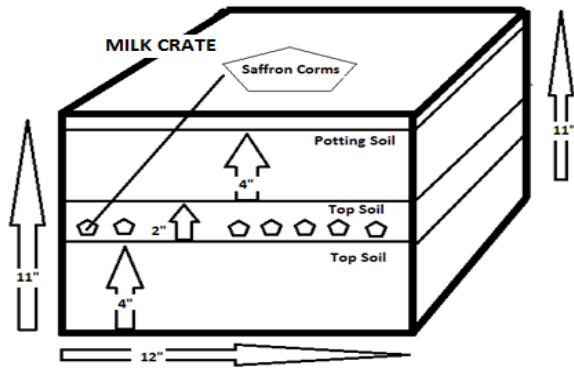
This project is conducted at an organic farm, in northern Vermont (St. Albans (USDA plant cold hardiness zone 5a [-20 to -15 °F])).

# Why Milk Crates?

- ✓ Easy to move so growers can start other high-value crops like tomatoes in spring
- ✓ Inexpensive (often free) and readily available
- ✓ Suitable depth for growing saffron
- ✓ Light weight but sturdy and durable
- ✓ Protect corms from rodent predation





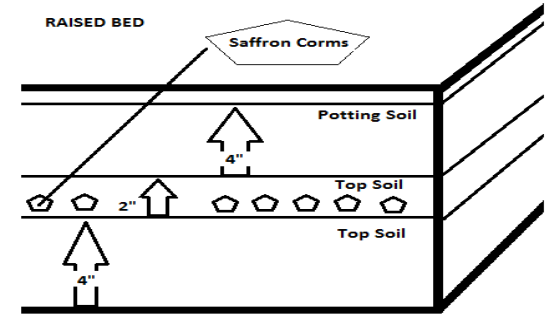


### MILK CRATES

- ✓ Milk crates (11 in. tall) covered inside with 2 strips of weed cloth.
- ✓ Crate filled with 4 in. top soil.
- ✓ Corms placed tip end up on top soil, covered with 2 in. of top soil and 4 in. perennial potting mix with compost.
- ✓ 11 corms planted/crate (=118 corms/m<sup>2</sup>)

# Production Methods

**Source of Corms:** PA (2015); Holland (2016)  
**Corm size:** 9-10 cm circumference  
**Planting date:** Aug. 25-Sept. 1  
**Irrigation:** top watering

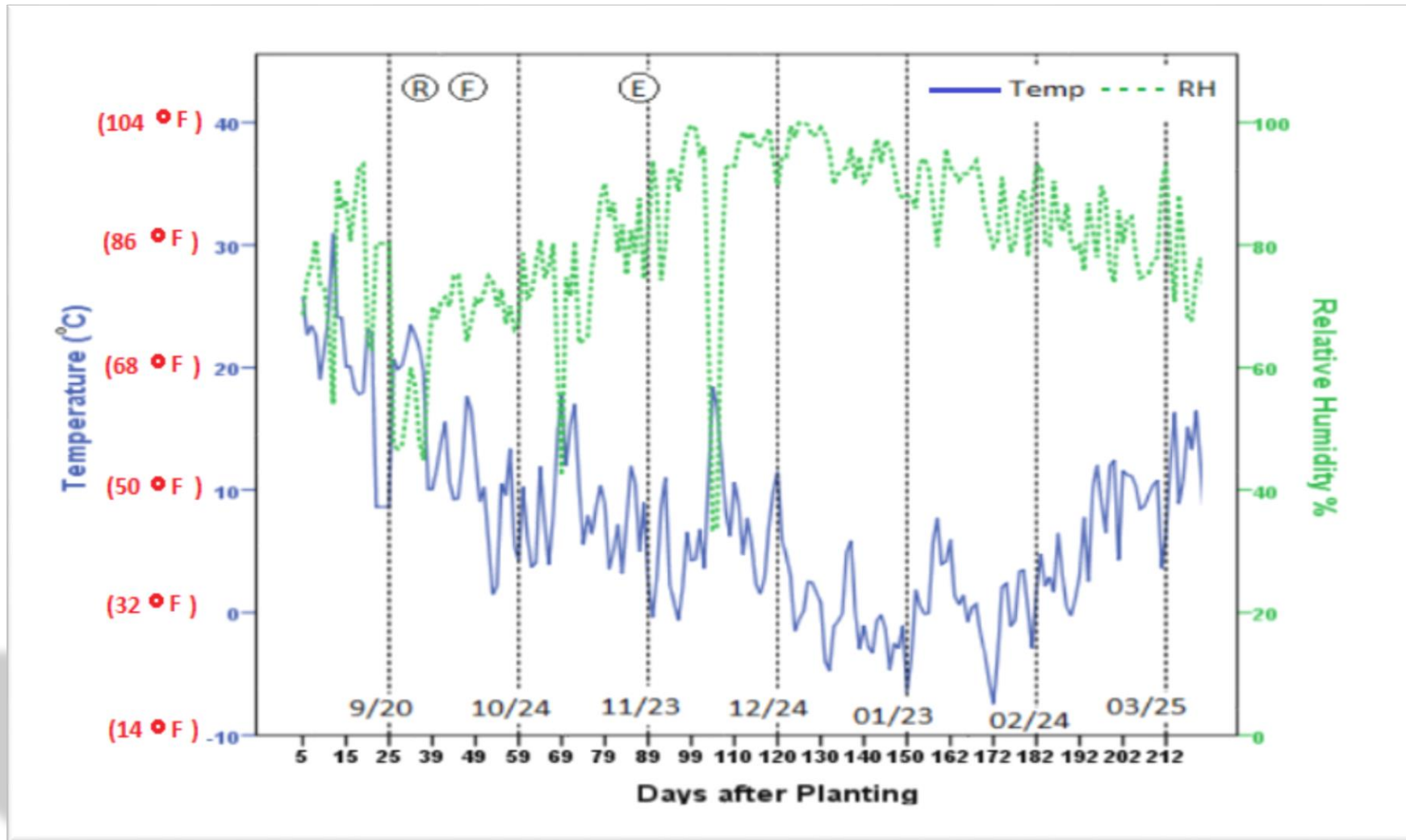


### RAISED BEDS

- ✓ Raised beds (12 in. tall), bottom covered with hardware cloth (2016 only)
- ✓ Corms planted 2 in. deep in top soil covered with 4 in potting mix
- ✓ Planting density: 118 corms/m<sup>2</sup>



**R:** Emergence of root,  
**F:** Start of flowering,  
**E:** End of flowering period



# Harvesting and Drying Methods

**Harvest Period ~35 days: October 12-November 20**

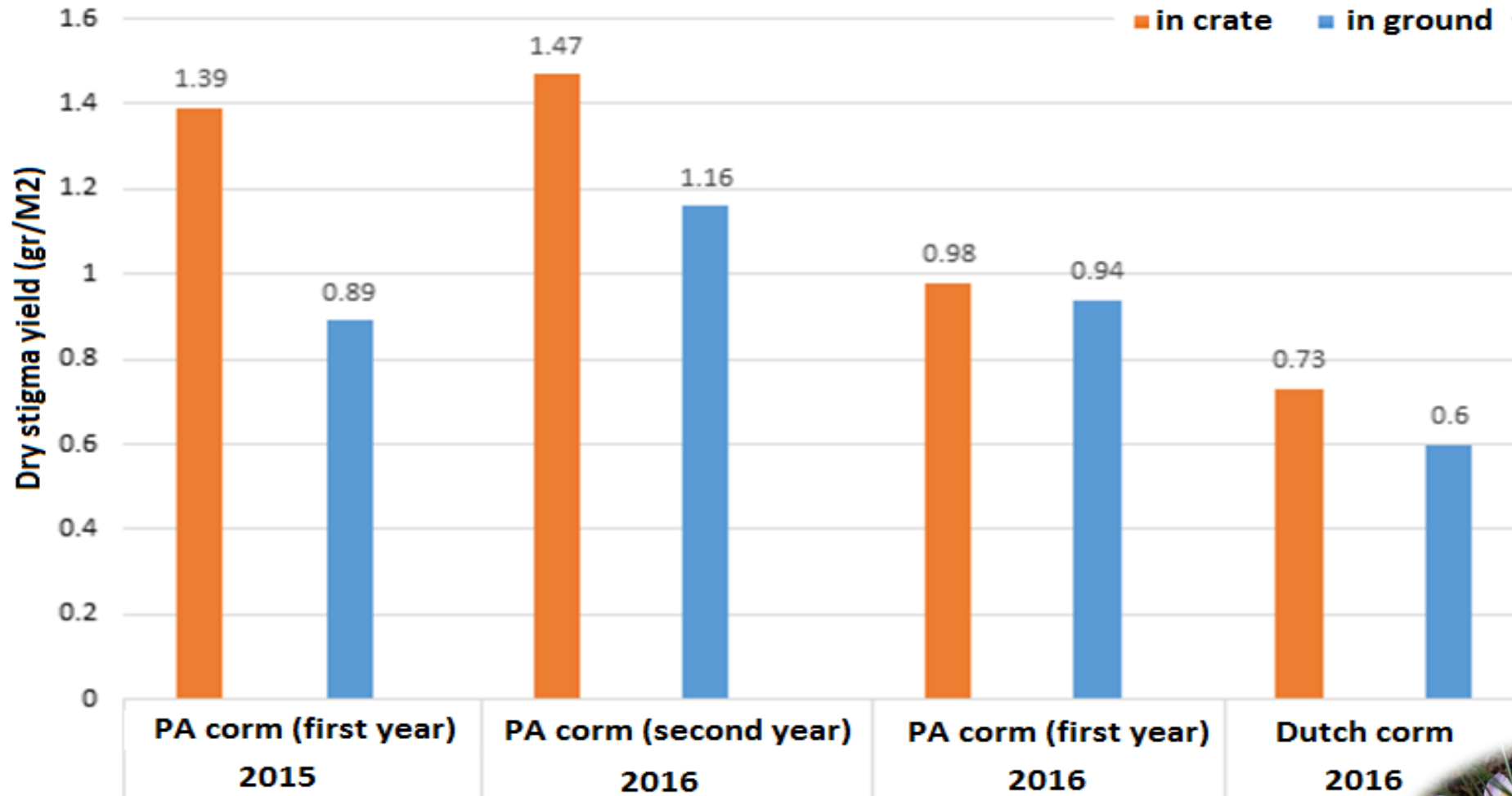
- ✓ Harvested by hand every 2 days.
- ✓ Stigmas, stamens and petals separated and dried.
- ✓ Fresh and dry weight of each part recorded.
- ✓ Drying



# Factors We Assessed

- ✓ Saffron yield
- ✓ Saffron quality
- ✓ Corm yield/survival

# 2015 & 2016 Stigma Yield



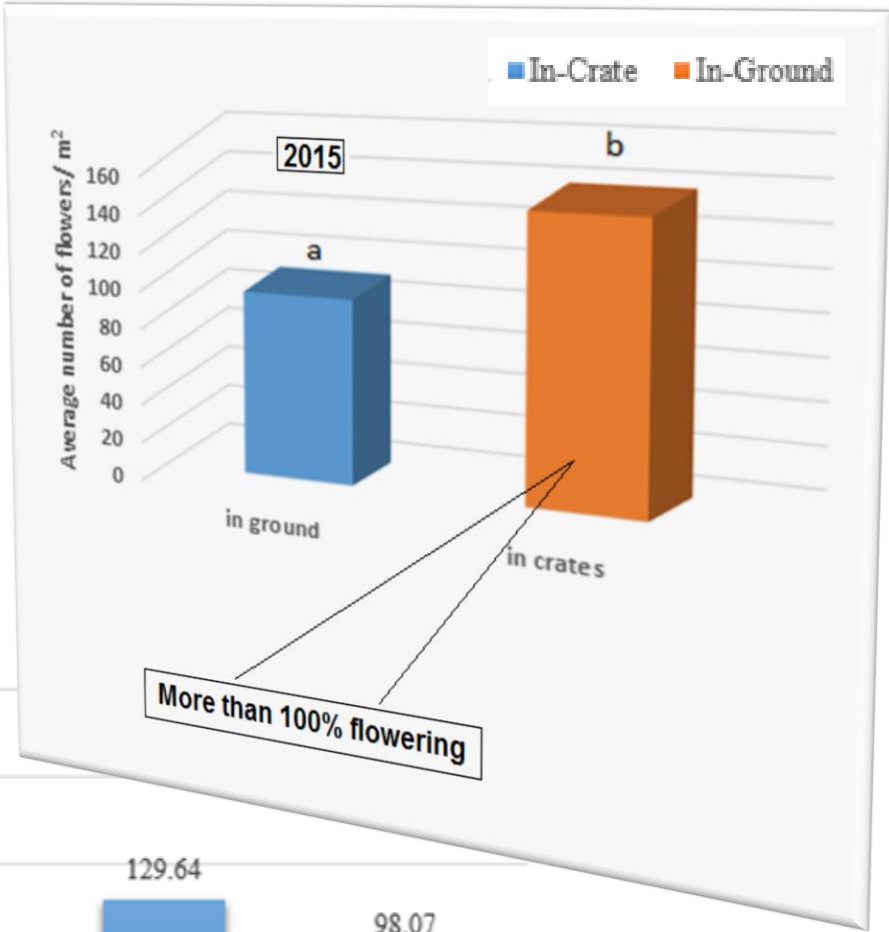
- Greater yield in crates than in raised beds (rodent damage)
- Yield increased in Year 2



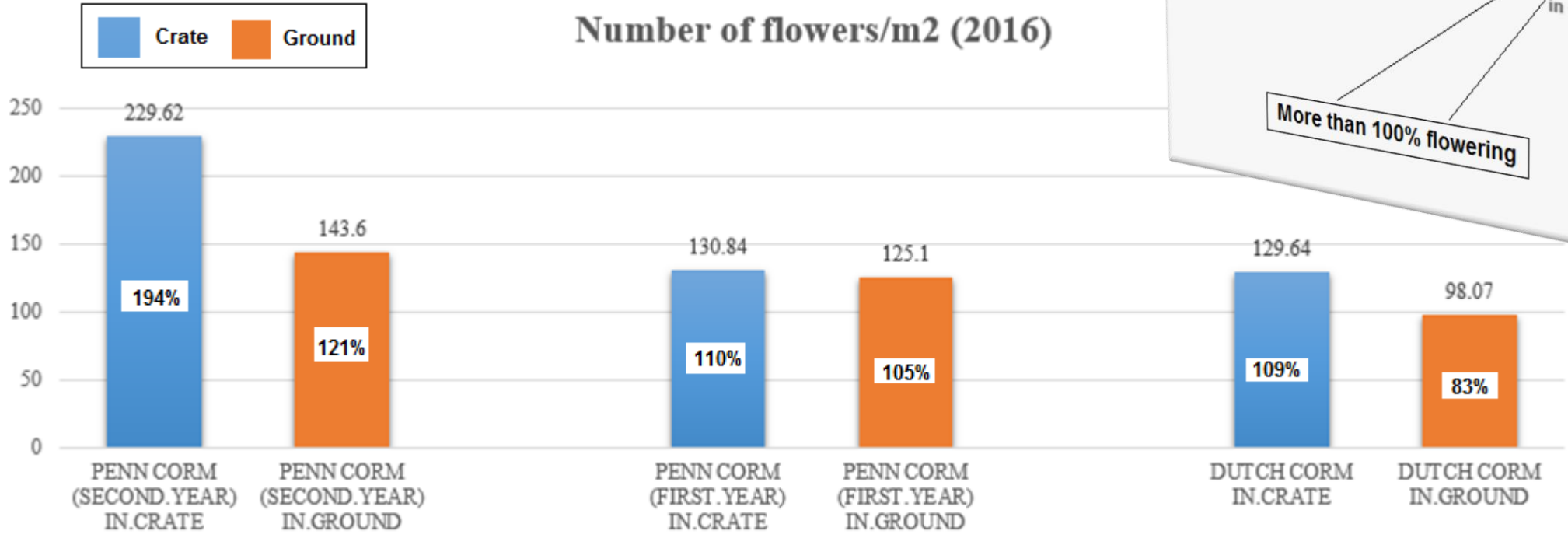
## Why was our yield higher than Iran and Spain?

- Soil fertility
- Soil moisture
- Protection from rain and wind damage

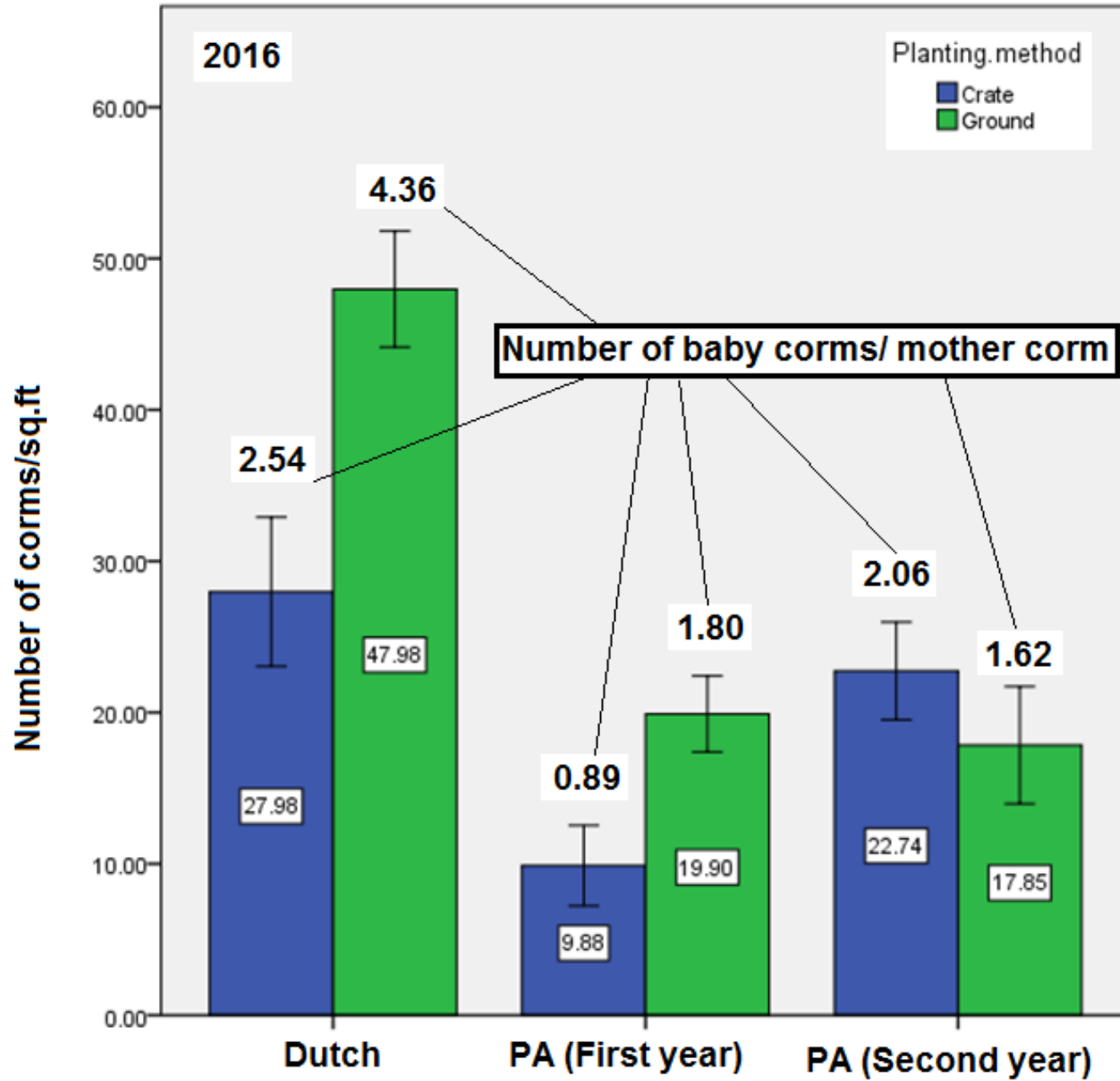




**Number of flowers/m2 (2016)**



# Corm Yield



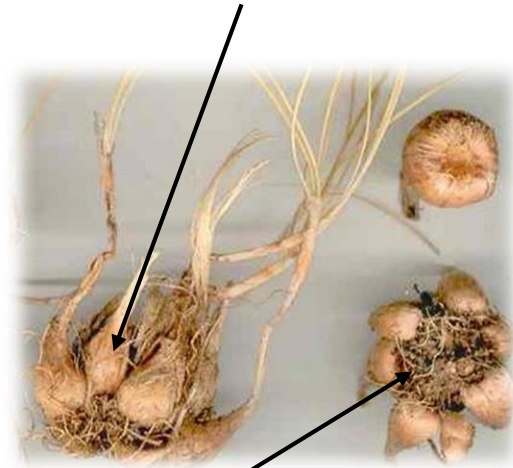


Major factor: rodent feeding in raised beds

- Corms from raised beds were 1/3 heavier than those from crates.

Major factor: soil moisture deficit in crates

Secondary corm



Primary corm

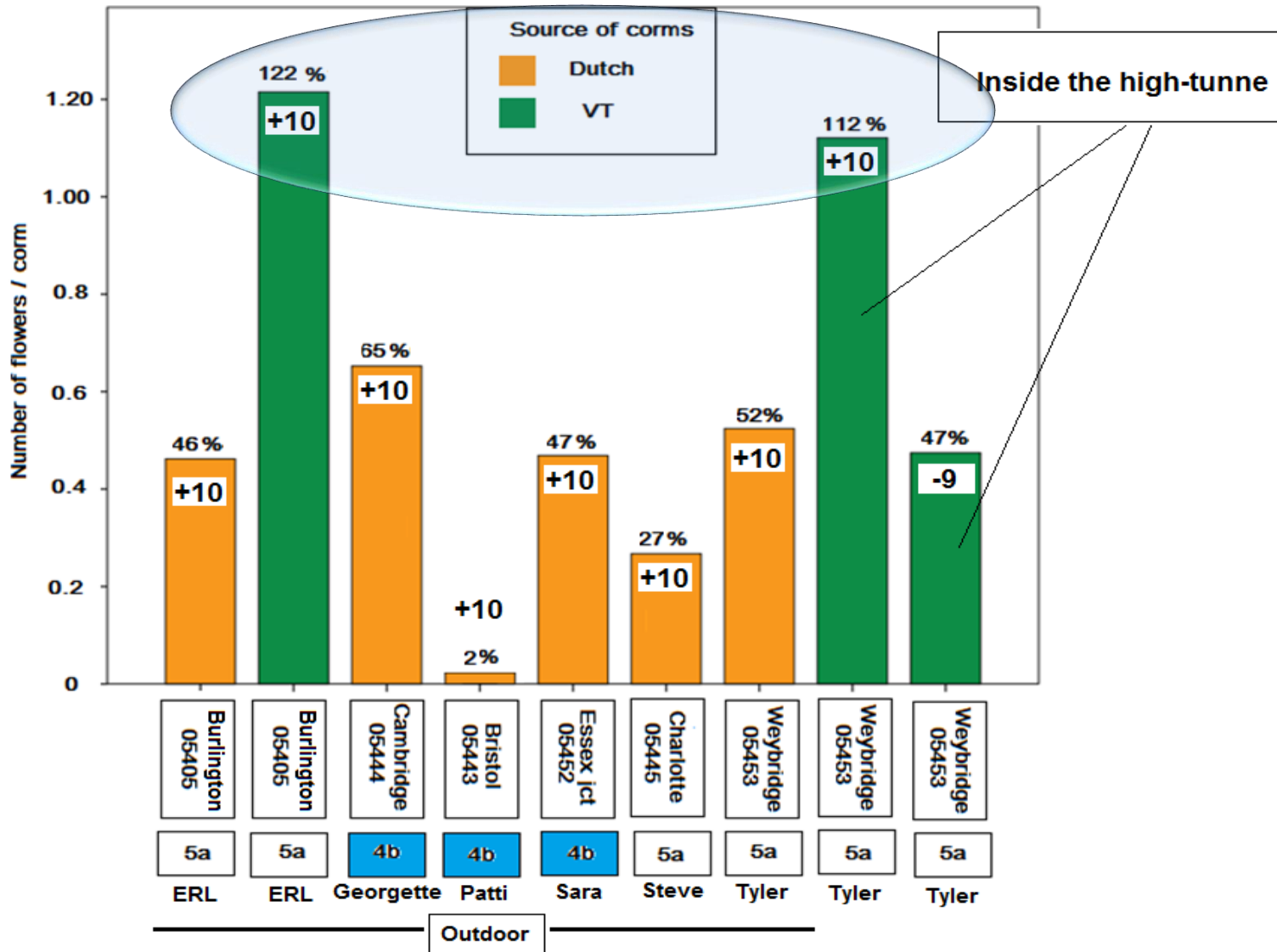


## Rodent Damage




# Outdoor Saffron Production & Participatory Research





Cobble Creek Nursery LLC: John & Patti Padua





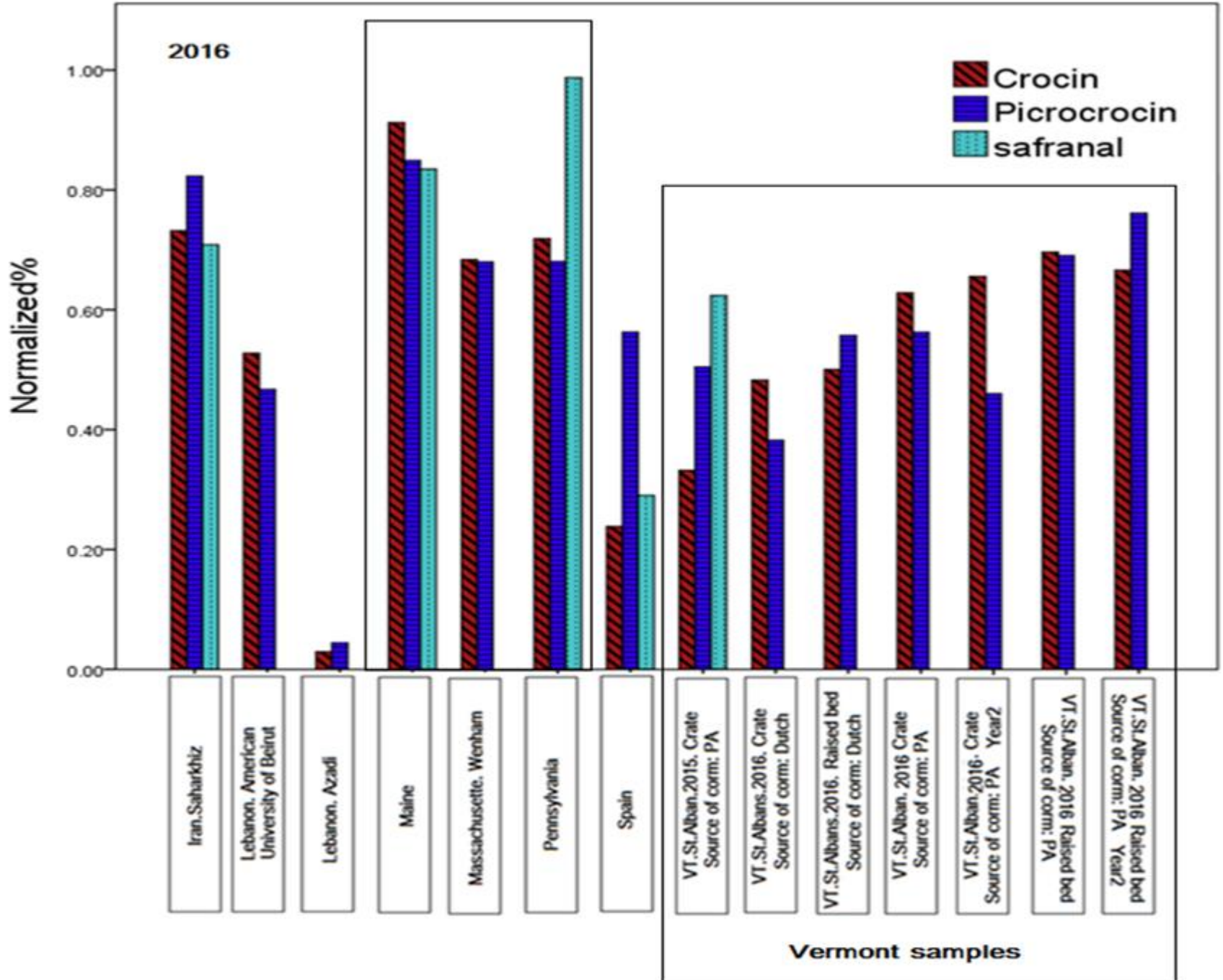
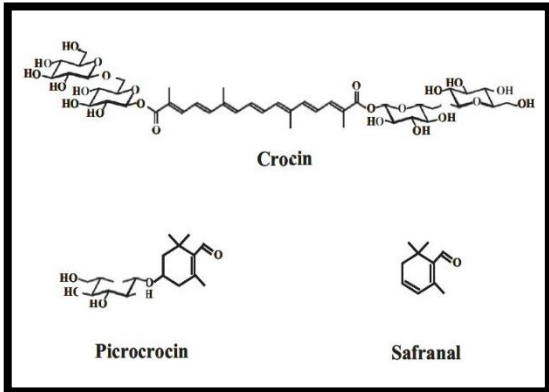
# All that Glitters is NOT Gold!

- Mexican Saffron is not the real thing.
- It is safflower (*Carthamus tinctorius*), a frequent filler or fraudulent product.



Saffron is the most frequently adulterated spice in the world.

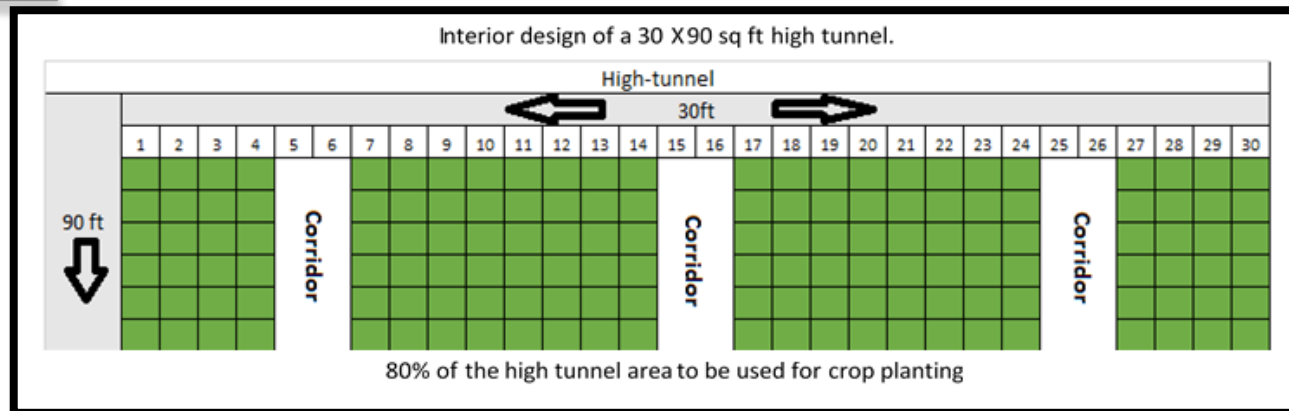
# QUALITY





## Preliminary Market Analysis

There are several commodities that can be generated from one crop





The estimated cost per corm is \$0.20-1.20 each.

Mother corms generally produce **2-8 new corms** every year, depending on growing conditions.

Projected gross revenue from corms @ \$0.30/corm: **\$14,256 (in the high tunnel)**



The highest yield we obtained I year 1 of production was

Dry saffron yield:  $1.39 \text{ g/m}^2 = 0.13 \text{ g/ft}^2$  (~280 g in the high tunnel, 5,624 g/acre)

The estimated retail price for dry saffron is ~\$20/g or \$794/oz

We checked locally and found the retail price ranged from \$10 - \$36/gram

Projected gross revenue from dry saffron (\$15/g): **\$4,480 in the high tunnel**



The estimated price for dry petals is \$0.33/g

**Dry petal yield: 1,585 g (in the high tunnel); 31,963 g/acre**

Projected gross revenue from dry petals:

**\$523 (in the high tunnel); \$10,548/acre**



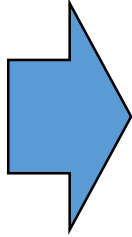
## Gross Revenue \$19,259/ high-tunnel

Approximate costs for producing saffron in a 30 x 90 ft high tunnel in milk crates.

Expense	Unit Cost	Amount needed	Total cost
Crates	\$4.00/crate	1,920	\$7,680
Compost	166/cubic yard	8.13	\$1,500
Corms	0.3/corm	21,600	\$7,128
Weed cloth	\$60/roll	4	\$240
Labor for bed and crate prep	\$12/hr	79.75	\$957
Labor for general management	\$12/hr	11.25	\$135
Labor for harvesting	\$12/hr	155.25	\$1,863
<b>Total</b>			<b>\$19,503</b>



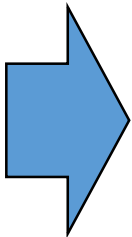
First year



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<b>Total</b>			<b>~ \$4,500</b>

Second year



**Net Revenue  
~ \$15,029**

## Current Research & Outreach

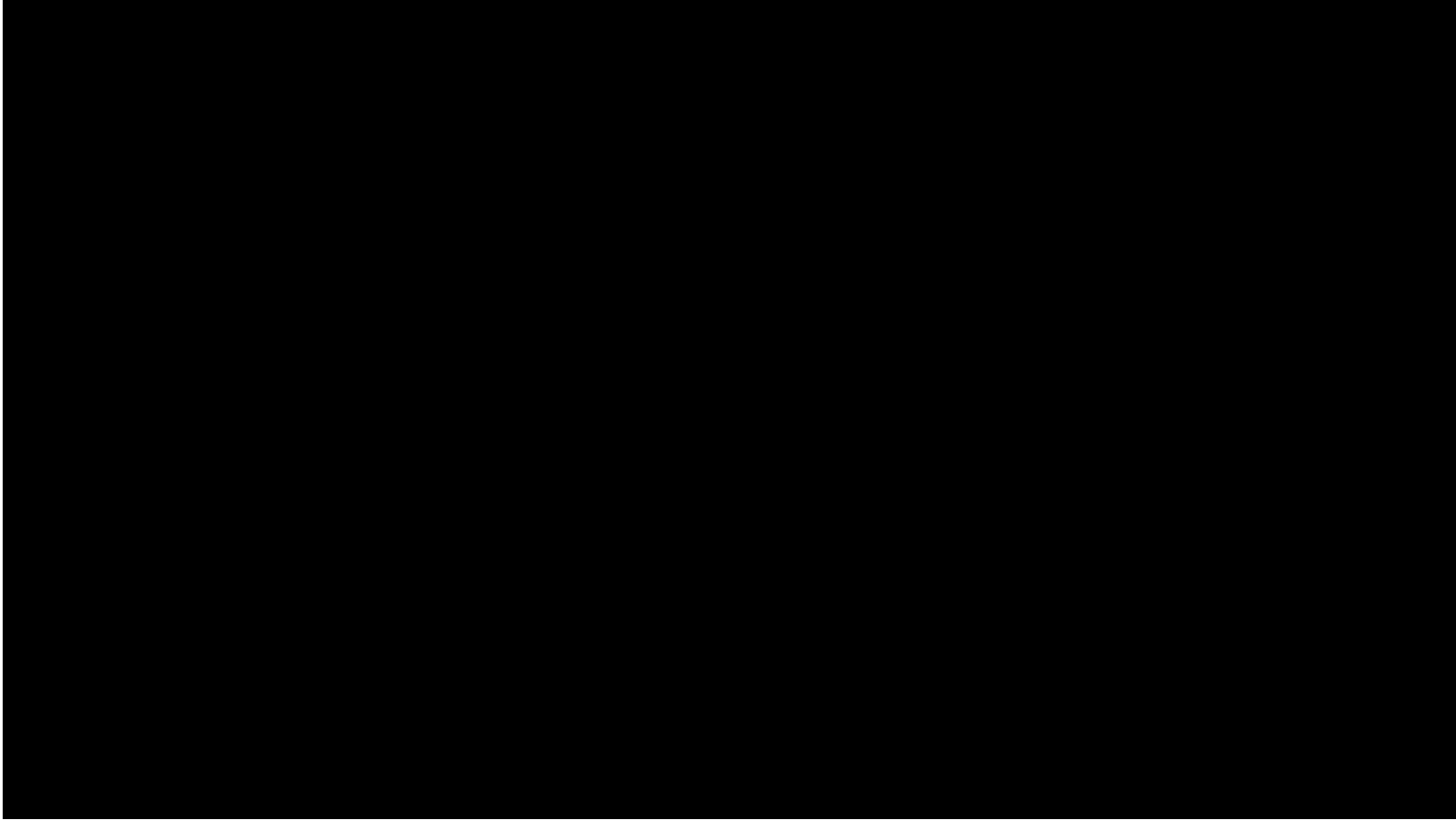
- **Field production in different VT coldhardiness zones.**
- **Assessing the effect of different corm sizes on the saffron yield .**
- Compare saffron yield over time (years).
- Assess saffron quality relative to coldhardiness zones.
- Test different ways to minimize rodent and bulb mite damage.



## Future Research

- Field vs high tunnel vs low tunnel production in different coldhardiness zones.
- Market analysis and production cost study.
- Determine factors affecting saffron quality.







# Thanks for the Support!



This research was supported by the University of Vermont College of Agriculture & Life Sciences, USDA Hatch Program, Herb Society of America and the VT Specialty Crop Block Grant Program.