Pitahayas: introduction, agrotechniques and breeding

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Geographic distribution

***Hylocereus* species**

Known as Pitahayas, Vine cacti, Dragon fruits

Species native to Central and South America

Mexico

Costa Rica

Panama

Colombia

Venezuela

Etc.

Plant characteristics

Fruit with scales (few of them with spiny peel)

Triangular stem

Wax in few species

Climbing plants, roots can be detached from soil

Spine shape

Nocturnal flowers

Open only one night – receptive 1 day

Bat feeding on nectar and pollinating

Pollination by bees

Genetic variability

Why Pitahayas as a fruit crop?

1. Water use efficiency (WUE) - one order of magnitude higher than other crops (CAM plants)

2. Many uses: food (exotic and beautiful fruits), industrial, ornamental products and more

3. Exotic fruit in world markets – high value crop

Agrotechniques

1- **Manual pollination due to self-incompatibility and lack of natural pollinators**

2- **Acclimation to arid and semi-arid conditions**

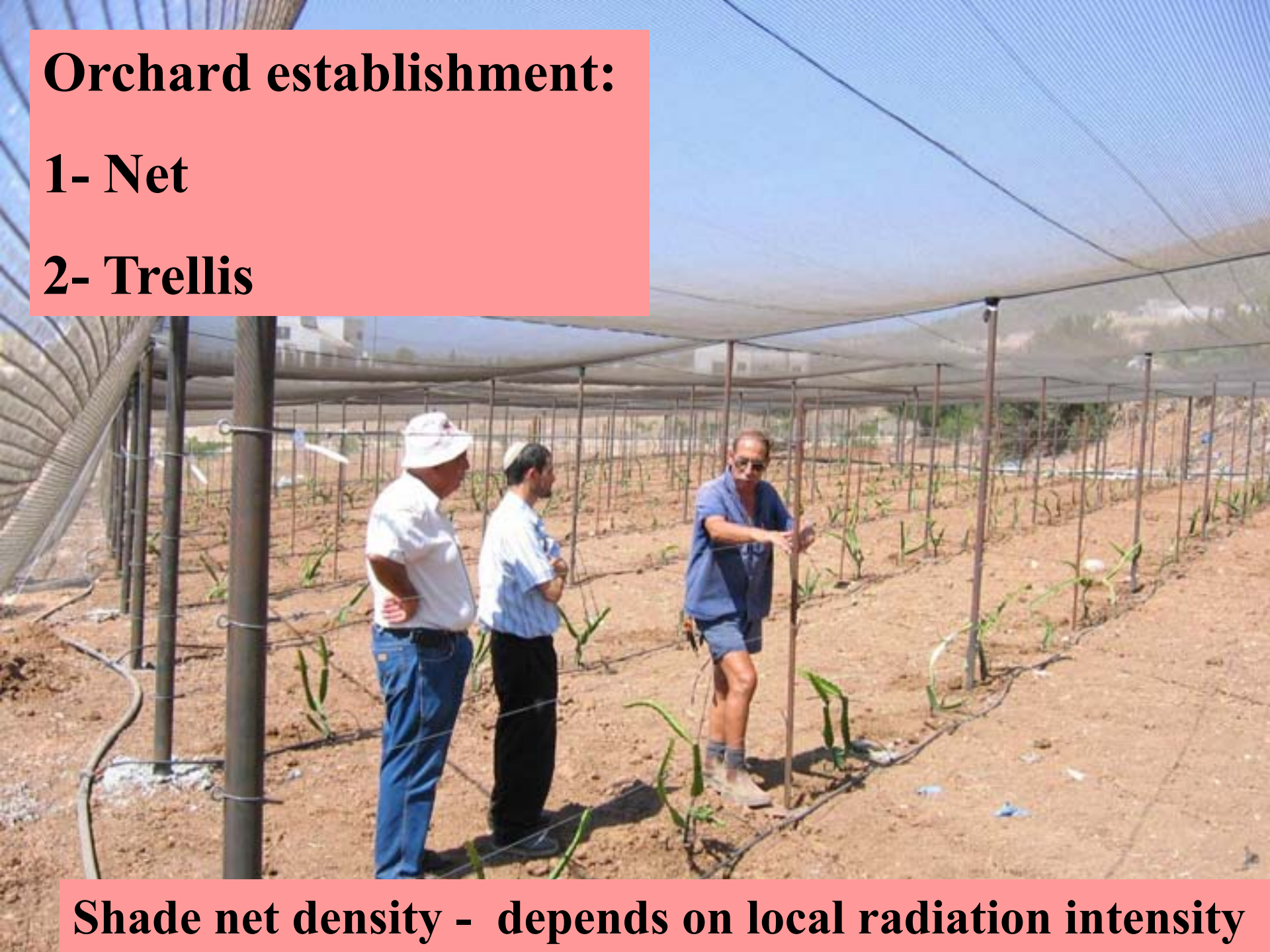
3- **Trellising climbing plants**

4- **Mechanization for removing spiny peel from yellow pitahaya**

<u>Others issues to solve</u>:

Irrigation, fertilization, pruning, short shelf-live

Hand-cross pollination



Orchard establishment:

1- Net

2- Trellis

Shade net density - depends on local radiation intensity

Heat damage, 90% yield reduction

Chilling injury 4-5 °C

Nematode damage

Excellent start, good yield and fruit size.

Destroyed the plants in years 4 & 5.

תוספת אקזוטית לקערת הפירות על שולחנך

פיטאיה צהובה

ממעגן מיכאל

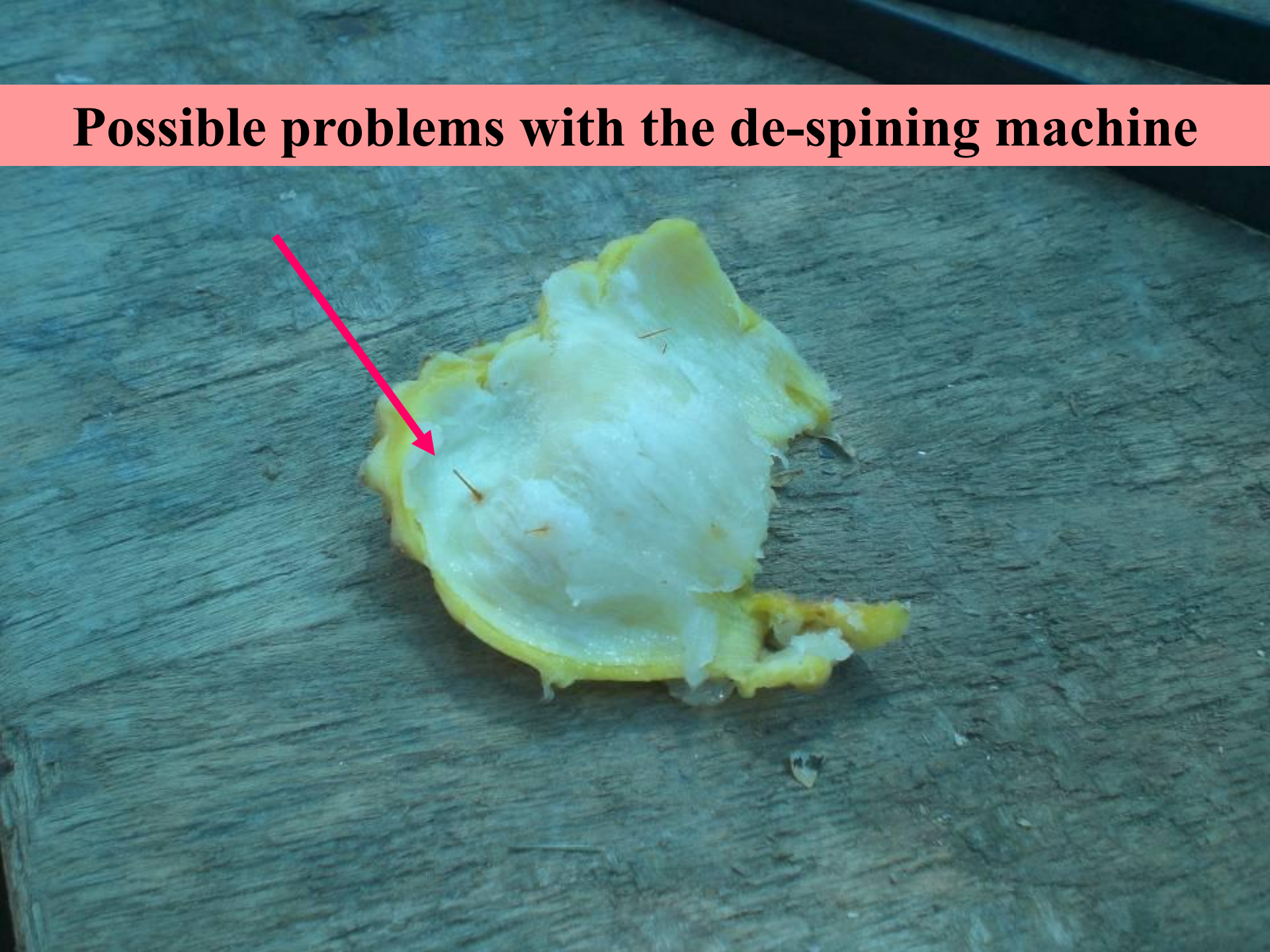
הפיטאיה הצהובה הוא פרי אשר מקורו במרכז אמריקה והינו חדש בארצנו. צמח הפיטאיה הוא קקטוס הגדל בשולי הג'ונגל הטרופי. פריחת הפיטאיה מתרחשת בלילות הסתיו ומוכרת בשם "מלכת הלילה". בארץ גדלה הפיטאיה במורדות הכרמל במעגל מיכאל בבתי רשת.

- טעמה של הפיטאיה משובח ובין תכונותיה המעולות גם:
  - בעלת מרקם קטיפתי עשיר ועסיסי.
  - עשירה בויטמין C (7.5 mg ל-100 גרם).
  - עוזרת בהסדרת פעילות המעיים והקיבה.

- את הפיטאיה ניתן להגיש ולאכול במגוון דרכים:
  - לחתוך לחצאים ולאכול בעזרת כפית.
  - לחרוץ חריץ בקליפה לאורך ולהוציא את הפרי בשלמותו.
  - להוסיף קוביות פיטאיה לסלט הפירות.
  - פיטאיה היא תוספת משובחת לגלידות ושייקים.
  - מומלץ להגיש קר.

מידע על החנות הקרובה לביתך בטלפון: 053-737635

Possible problems with the de-spining machine



Red pitahaya orchard: 35 ton/ha

Yellow pitahaya orchard: 15 ton/ha

not profitable

First introductions

- ✓ ***Hylocereus* spp.:** "red pitahaya" large and attractive fruit but lack taste, ripens in summer

H. monacanthus

- ✓ ***Hylocereus megalanthus*:** "yellow pitahaya" delicious but spiny peel, fruit inferior in size and yield, ripens in winter

H. undatus

H. megalanthus

Breeding program

F_1

Goals : taste, size, yield, spineless, self-compatible, prolonged shelf-life

- ***Hylocereus*** **spp.: "red pitahaya" - <u>diploid species</u>**
- ***H. megalanthus*****: "yellow pitahaya" - <u>tetraploid</u>**

Breeding and selection


Gregor Mendel

Grow out progeny

Evaluate progeny

Select parents

Recombine parents

Long and arduous process

Red pitahaya hybrids - one day in the lab!

Large variability in almost every aspect!

Improved “summer” hybrids

Red-yellow pitahaya hybrids (F_1)

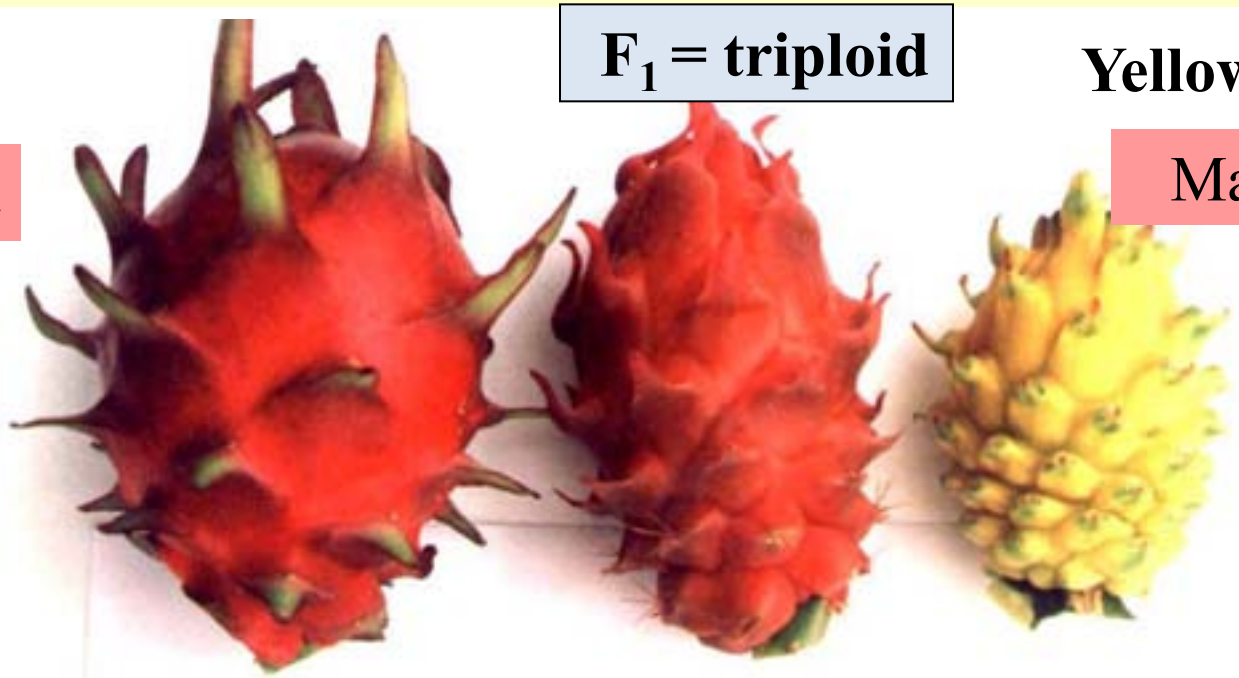
Red pitahaya

Female parent

F_1 = triploid

Yellow pitahaya

Male parent



Excellent in taste but spiny peel and low yields – "Autumn" cultivars

New orchards with F_1 hybrids

"Autumn" cultivars

triploids

"Summer" cultivars

diploids

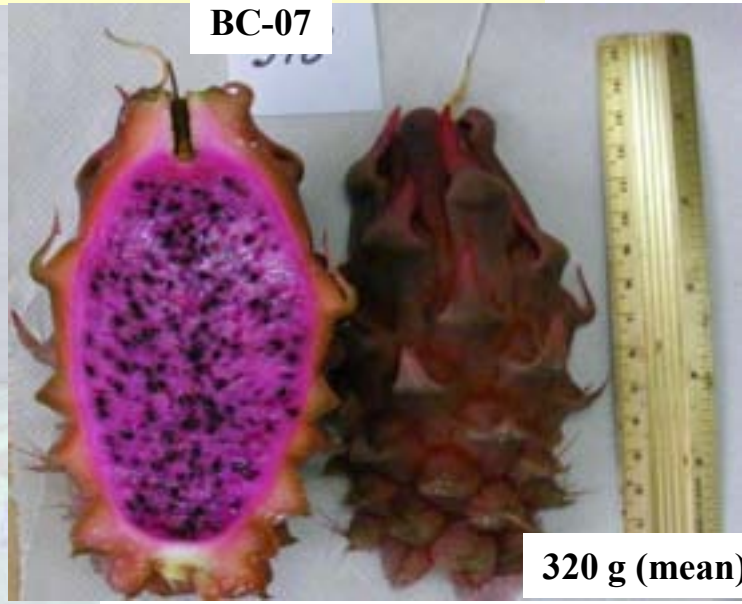
Yields: 25-35 ton/ha

500-1,000 m^3 water/ha/year

(about 10,000 m3 water/ha/year for other fruit crops)

Second generation of F_2 hybrids

Preliminary evaluation



Fruit morphology in hybrids

Other breeding projects

1. "*in situ*" polyploid induction

2. Production of homozygous Haploid-DH lines

3. Embryo rescue following interspecific-interploidy crosses

"*in situ*" polyploid induction

The goal : obtain artificial red and yellow polyploid plants

Treatments:

a- Vegetative lateral bud

b- Germinating seed

Red pitahaya 2n → 4n

1- Bigger flower buds

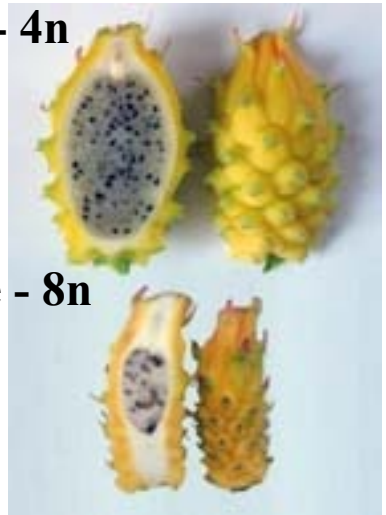
2- Breaks self-incompatibility system

3- About 25% decrease in fruit weight!!!

Yellow pitahaya 4n → 8n

Donor - 4n

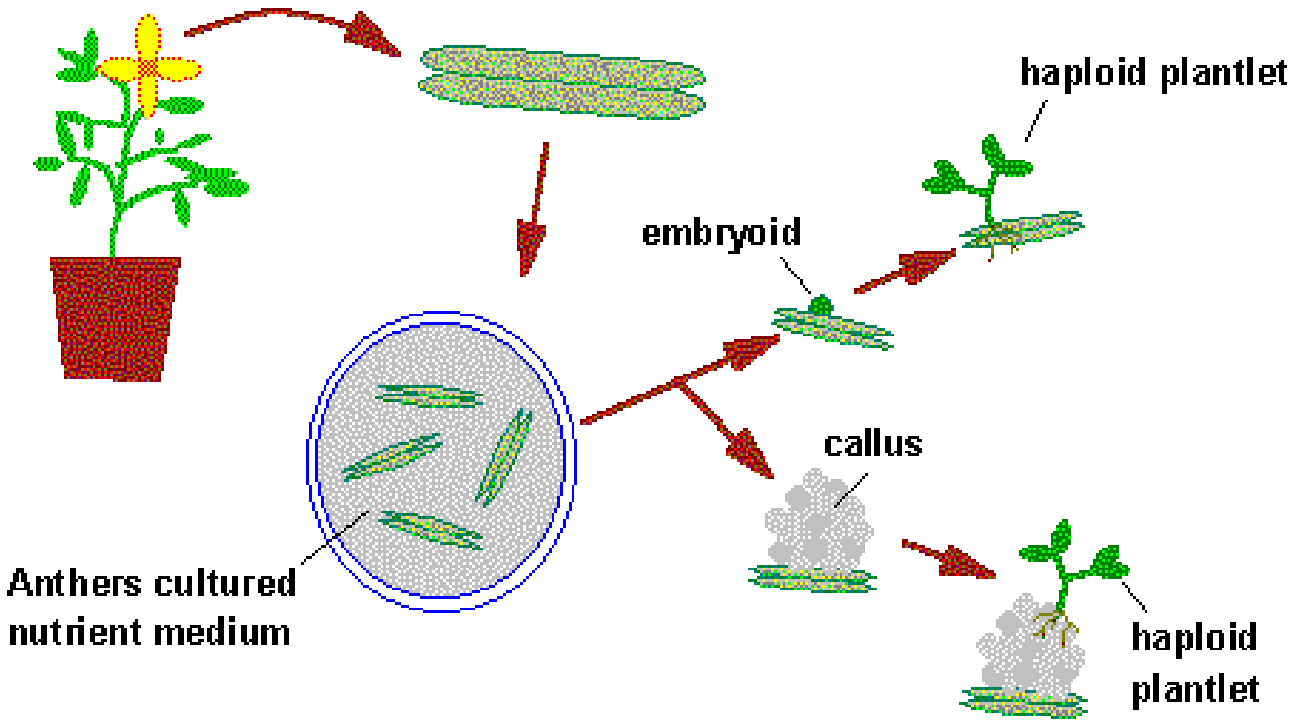
Double - 8n



1- Very small fruits – lacking commercial value

Production of homozygous Haploid-DH lines

Technique

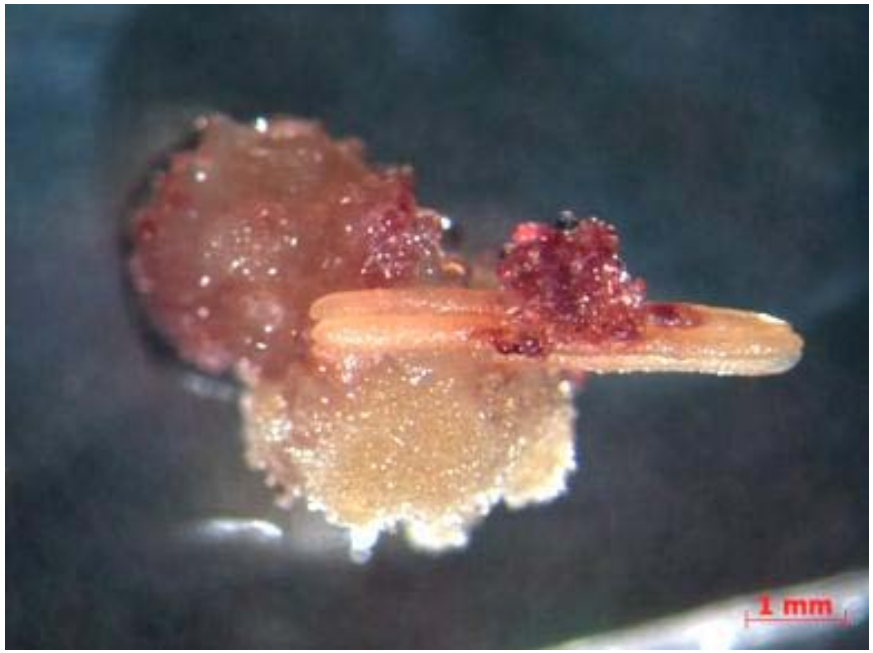


This approach allows the production of haploid plants.

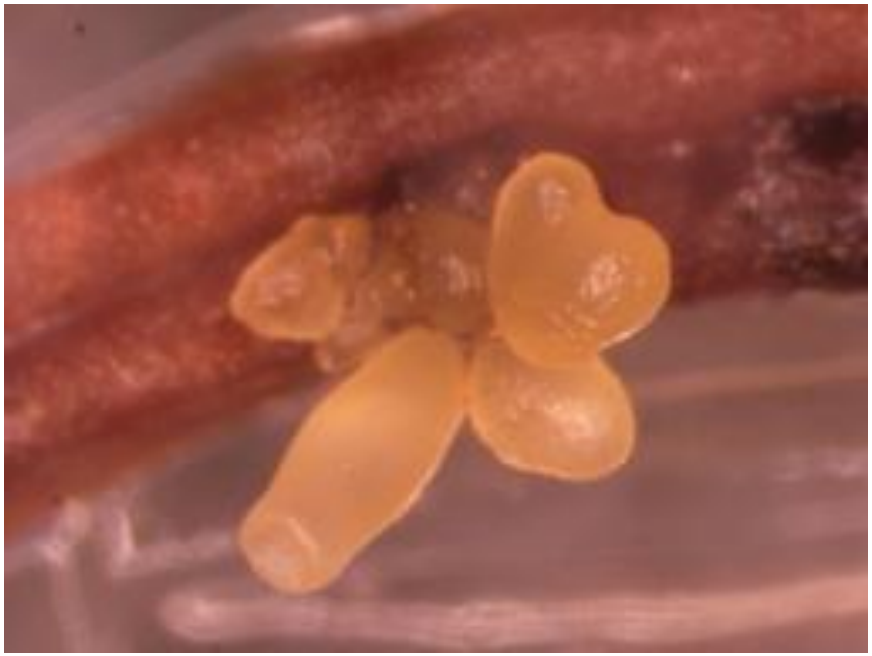
Homozygous lines from heterozygous donors could be obtained through a single-step

Anther culture

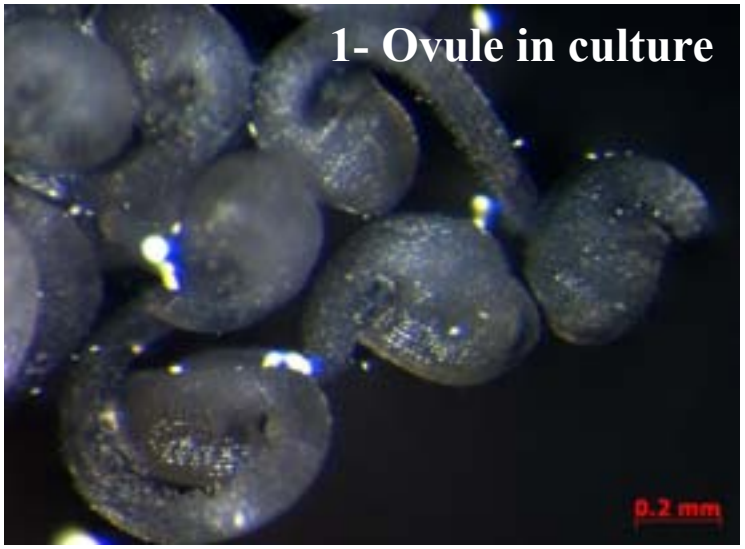
Callus formation

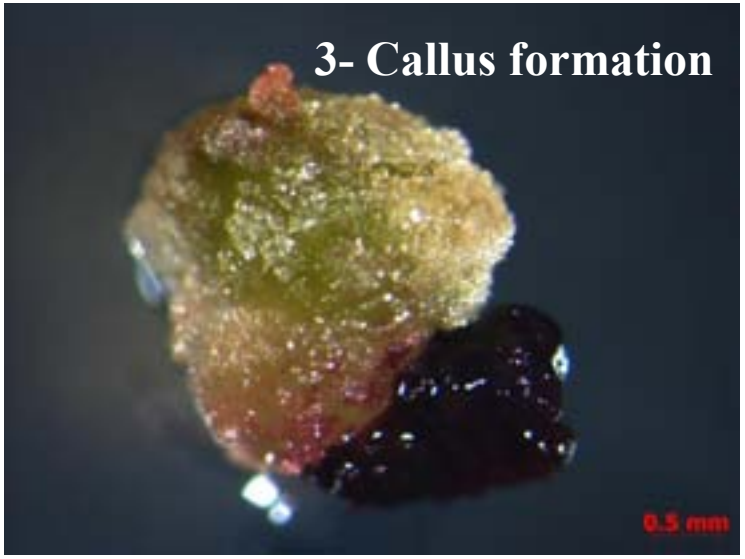


Embryoids formation



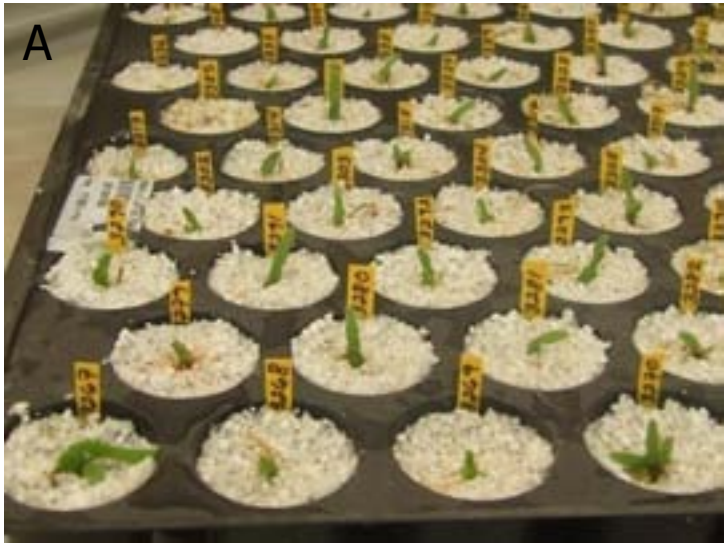
Ovule culture



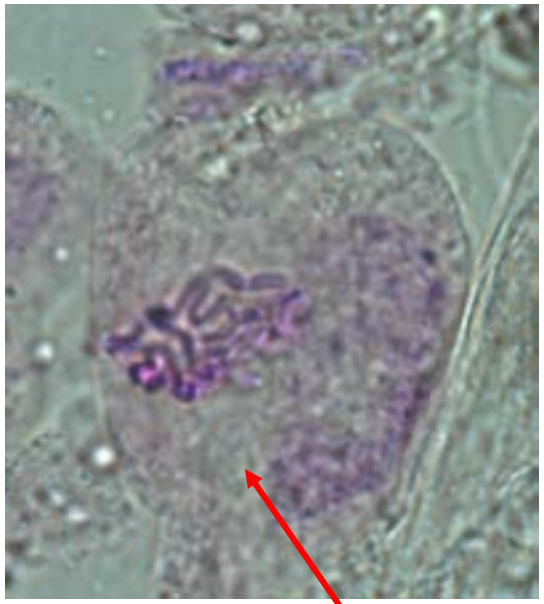


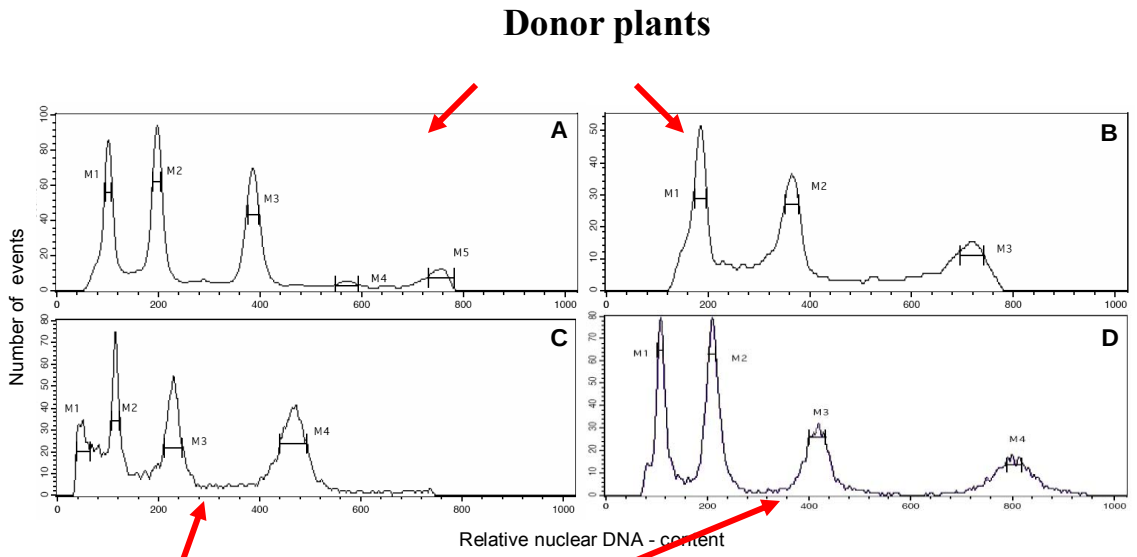
Abnormal plants - up to 5%

Hardening-off



Chromosome counts and FACS





Haploid plant with half number of

chromosomes / total DNA per cell

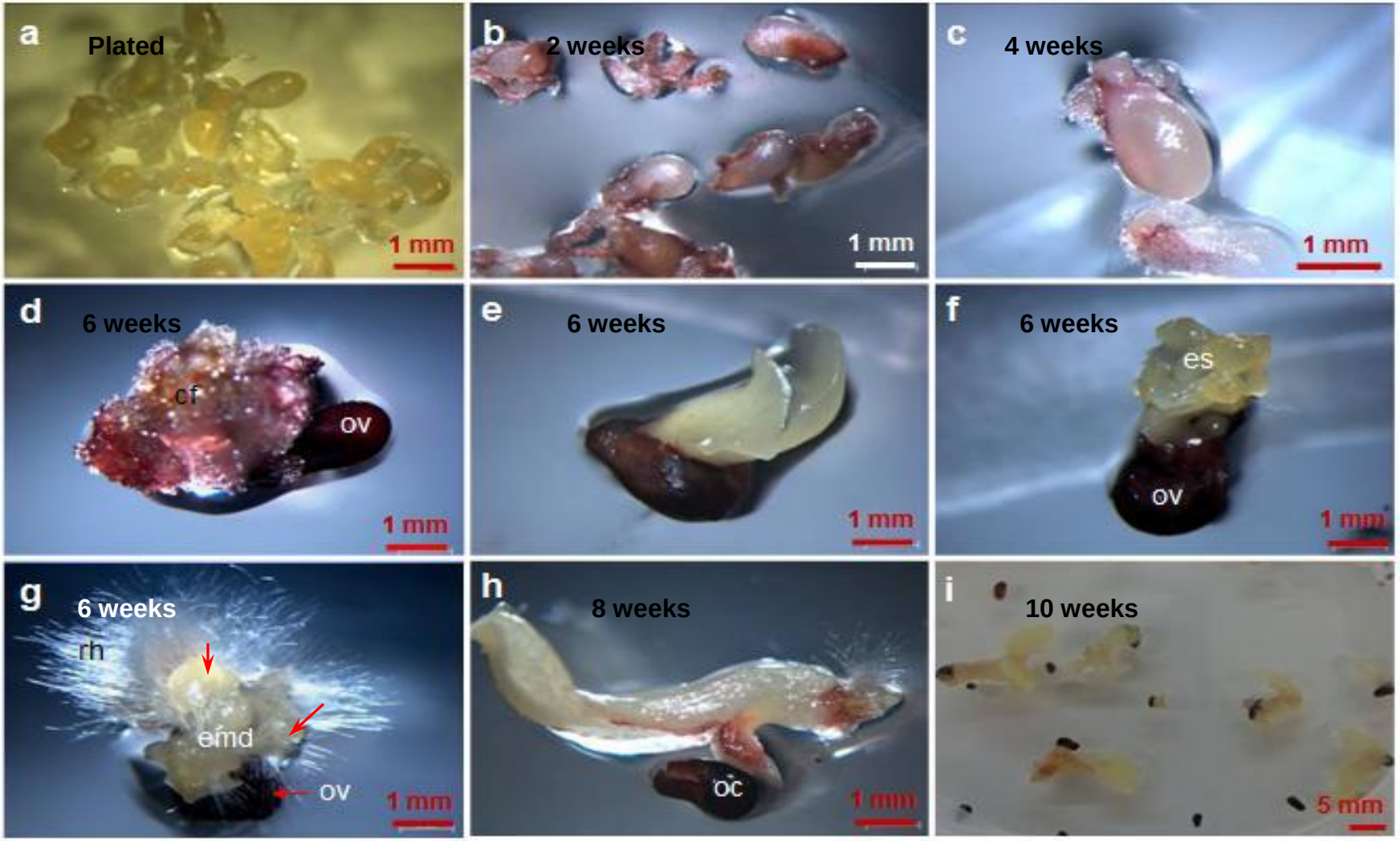
We obtained haploid plants from anther and ovule culture in red and yellow pitahayas

Few samples…..

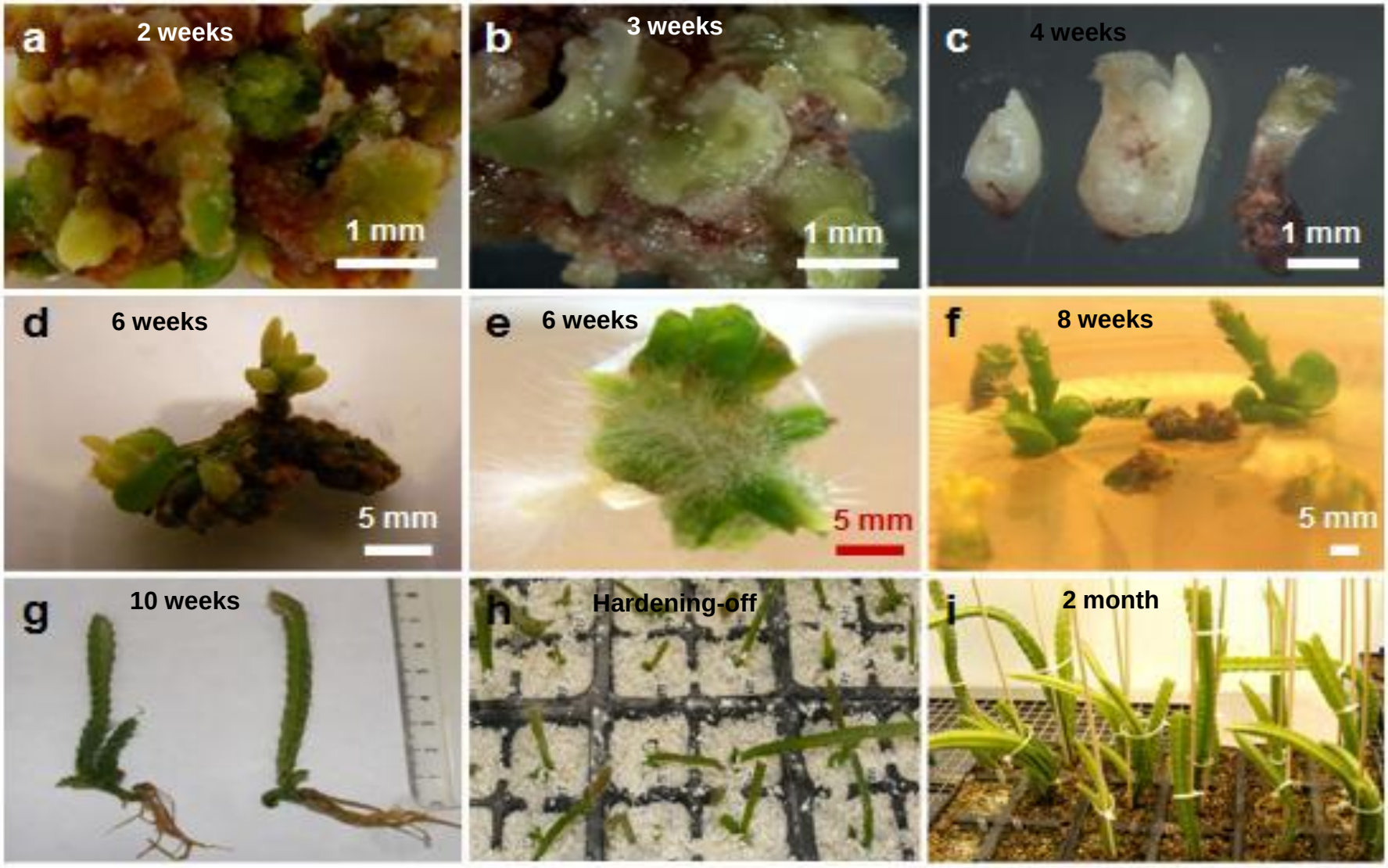
More than 2,000 plants for evaluation

Yellow pitahaya “haploid” plants start to bloom

Embryo rescue



Embryo rescue



This unique plant material offers us an opportunity

to identify elite lines in terms of yield, fruit quality,

resistance to disease, and drought tolerance,

enhances our potential to improve breeding efficiency

Perspectives

Thousands of plant for selection.

Improved cultivars for GROWERS?

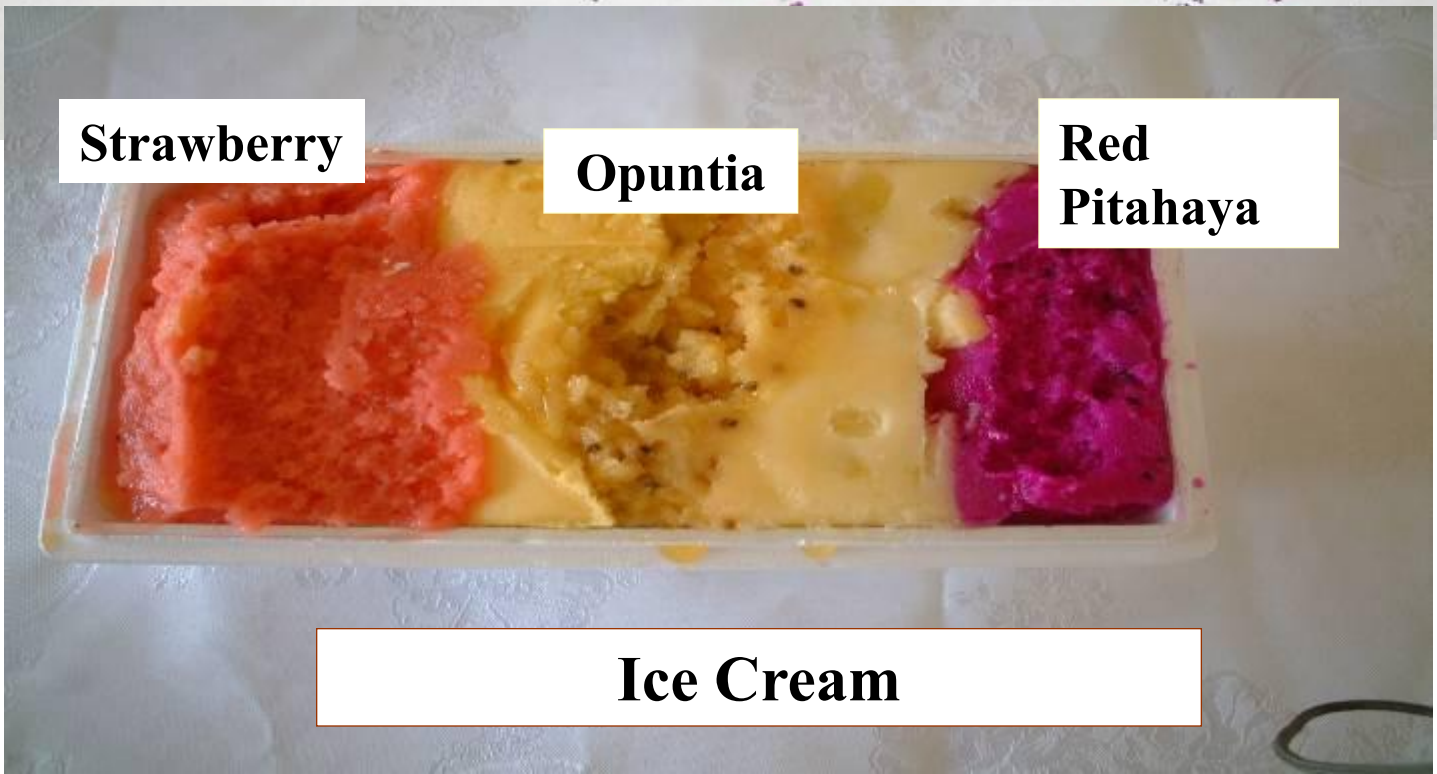
QTL's to map genome/ secondary metabolites

Elucidating genetic relationships among vine cactus species

Development of new additional products

- **Natural food colors**
- **Ornamental**

Hylocerenin Tolerant to Pasteurization



Ornamental uses

Next morning 6 am

withered

Midnight

In summary, there is a wealth of genetic variability in vine cacti waiting for us in the wild. These plants have inherent High Water Use Efficiency (WUE) with tolerance to other stresses

These plants in addition to providing food and feed, have industrial and medicinal uses

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BGU internal found


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