An Introduction on Conservation of Plant Genetic Resources and Operating A Genebank

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Genetic Resources and Seed Unit

World Vegetable Center

History of Plant Genetic Resources Conservation (1)

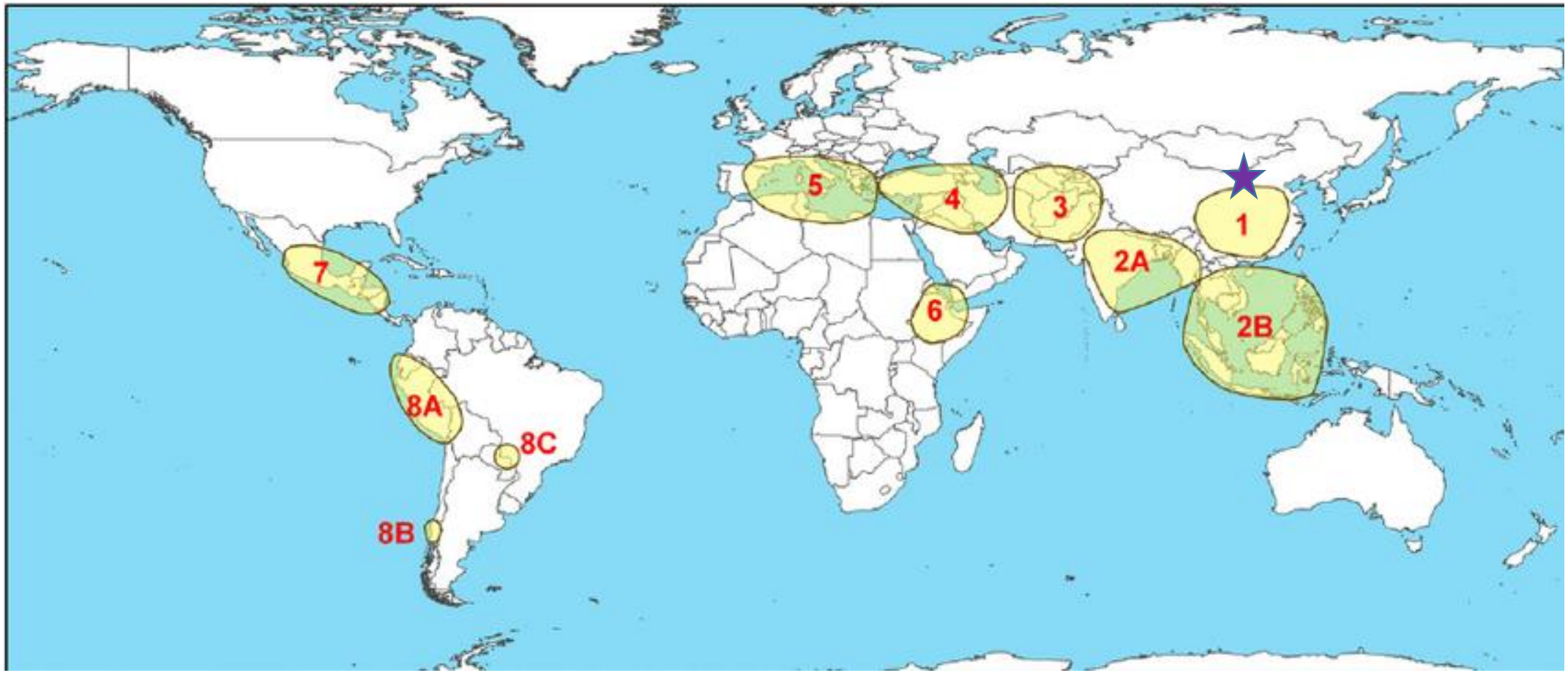
- **Key person: Nikolai Vavilov (1887-1943) – Father of plant genetic resources activities**
- **Before Vavilov: Crop genetic resources had collection but without conservation.**
- **1930's materials of "Green Revolution" replaced many traditional varieties and landrace cause quite serious genetic erosion.**
- **Vavilov's work: Reveal that genetic variation in cultivated was concentrated in certain region of the world which termed "Centers of Diversity"**

History of Plant Genetic Resources Conservation (2)

- 1961 - 1st international technical meet on plant exploration and introduction - organized by FAO of UN
- 1967-68 Crop Ecology and Genetic Resources Unit formed by FAO
- 1972 : Recommended by CGIAR – Create a network of nine regional genetic resources centres
- 1974 IBPGR(International Board for Plant Genetic Resources) established by CGIAR – real work began.

"IBPGR ---1991---> IPGRI ---2006---> Biodiversity International"

Vavilov's world center of origin of cultivated plants

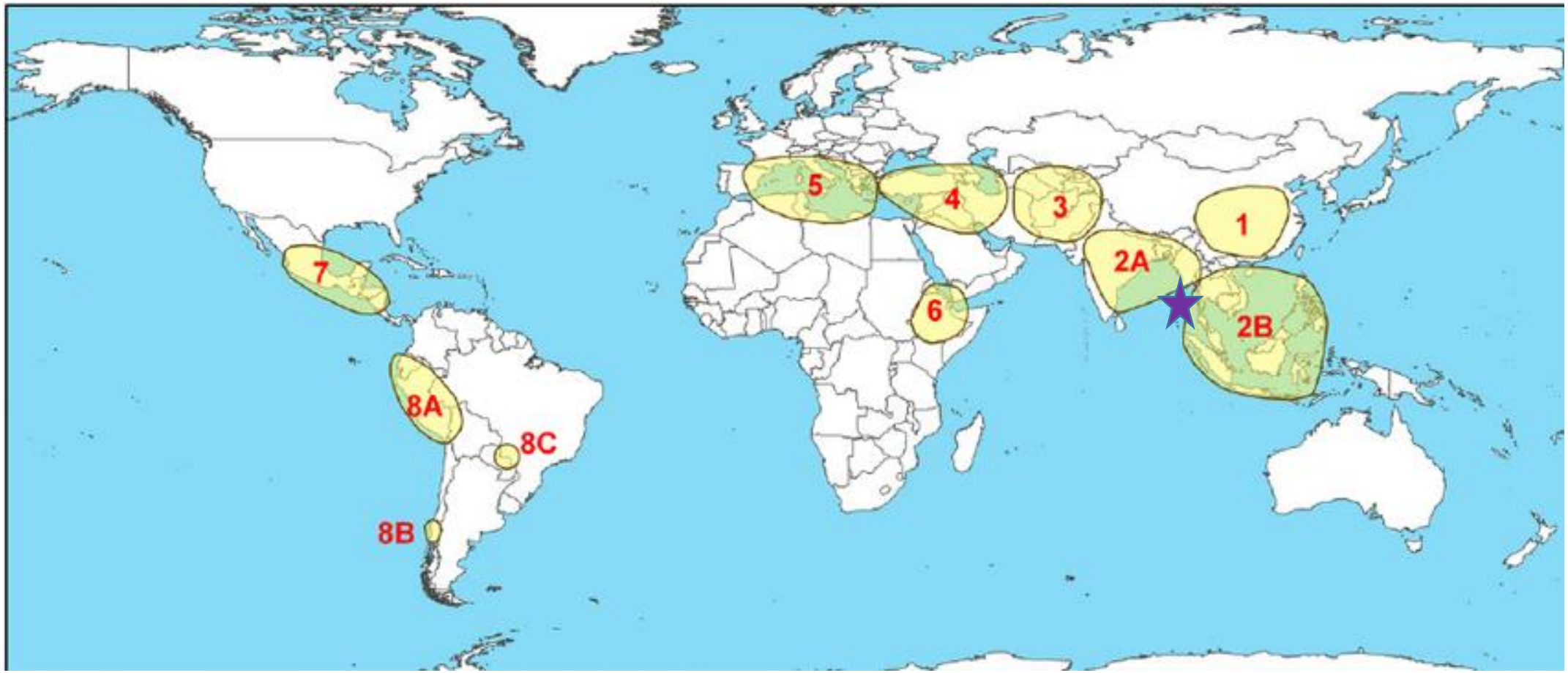


Vavilov's world center of origin of cultivated plants(1)

1. THE CHINESE CENTER

Naked oat, Soybean, Adzuki bean, snap bean, Small bamboo, Leaf mustard, Apricot, Peach, Sesame, Chinese tea

Vavilov's world center of origin of cultivated plants



Vavilov's world center of origin of cultivated plants(2)

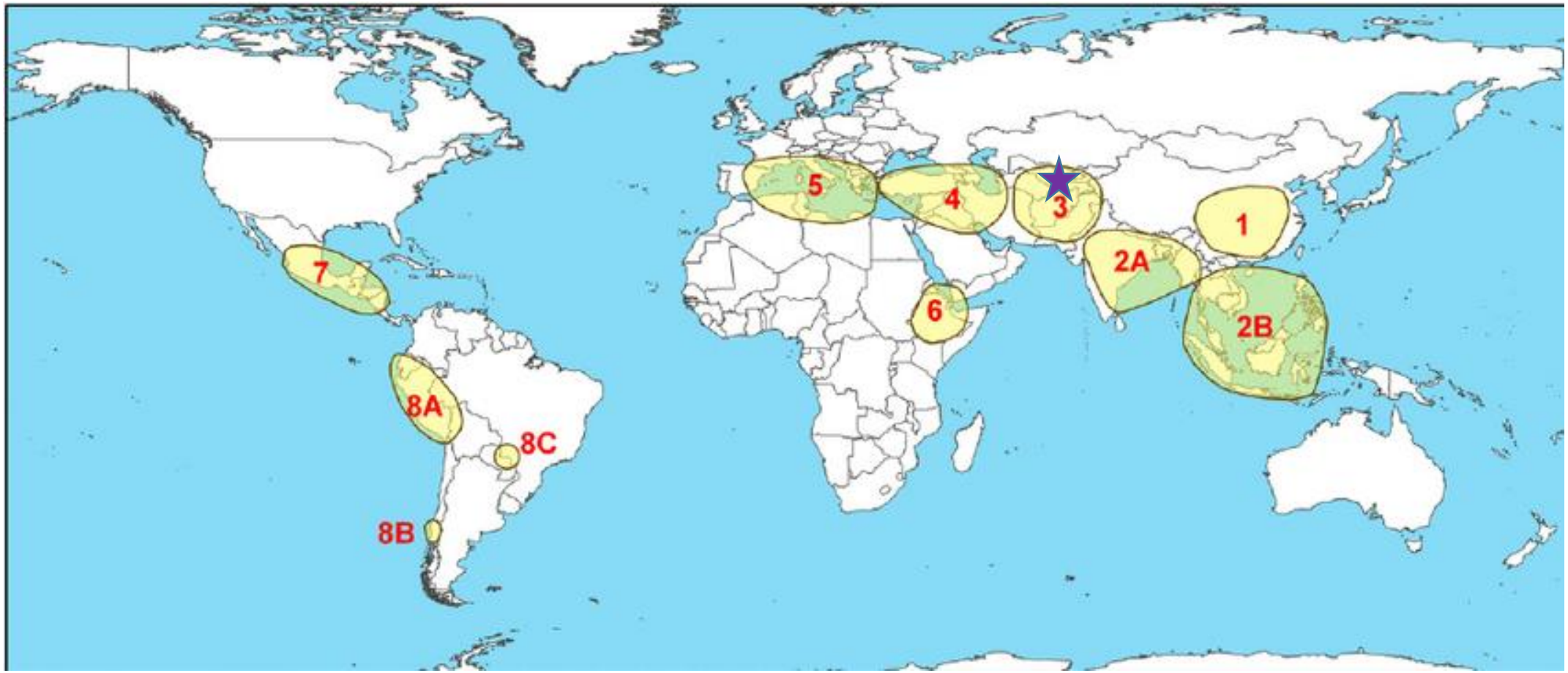
2a. THE INDIAN CENTER

Rice, Finger millet, Chickpea, Math bean, Rice bean, Horse bean, Asparagus(Yard-long) bean, Egg plant, Rat's tail radish, Taro, Cucumber, Tree cotton, Jute, Pepper, Indigo

2b. THE INDO-MALAYAN CENTER

Yam, Pomelo, Banana, Coconut

Vavilov's world center of origin of cultivated plants

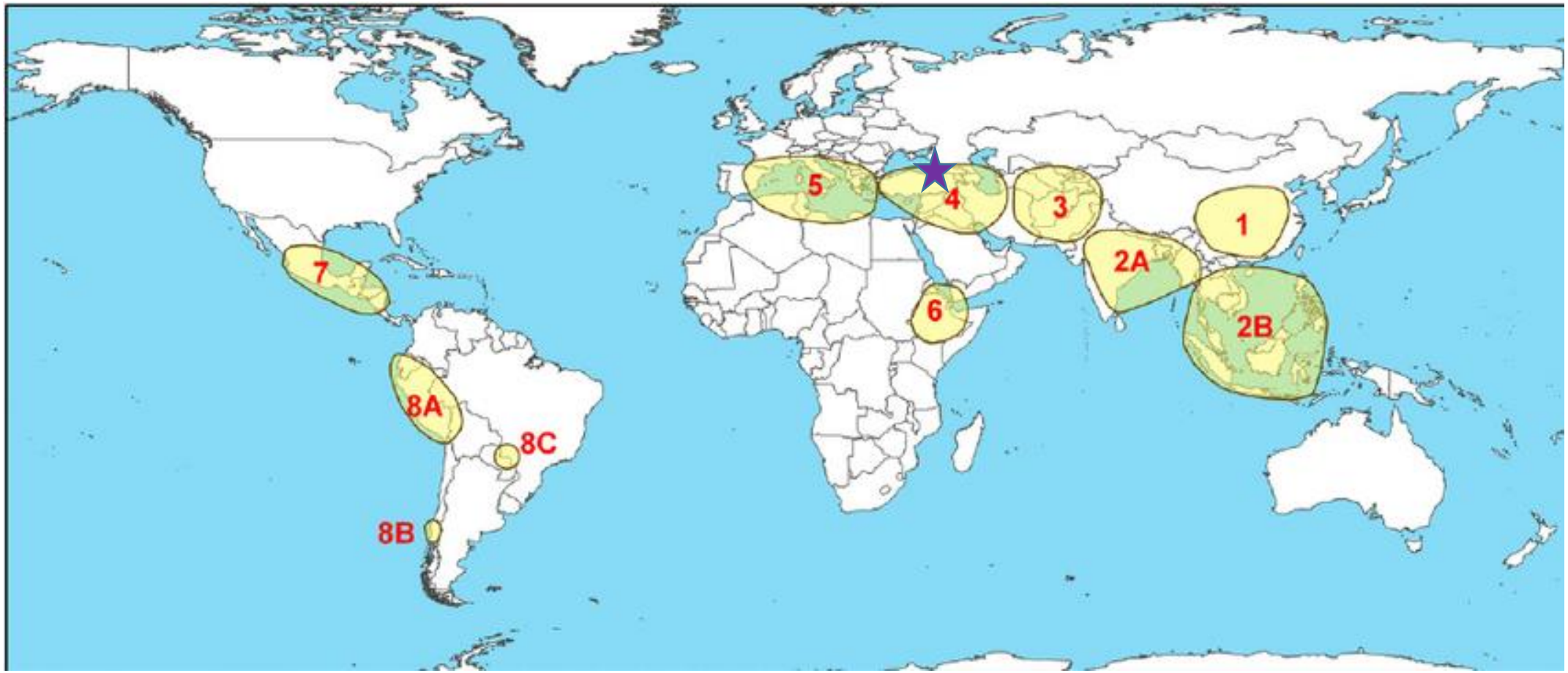


Vavilov's world center of origin of cultivated plants(3)

3. THE CENTRAL ASIATIC CENTER

Bread wheat, Club wheat, Short wheat, Rye, Pea, Lentil, Chickpea, Sesame, Flax, Safflower, Carrot, Radish, Pear, Apple, Walnut

Vavilov's world center of origin of cultivated plants

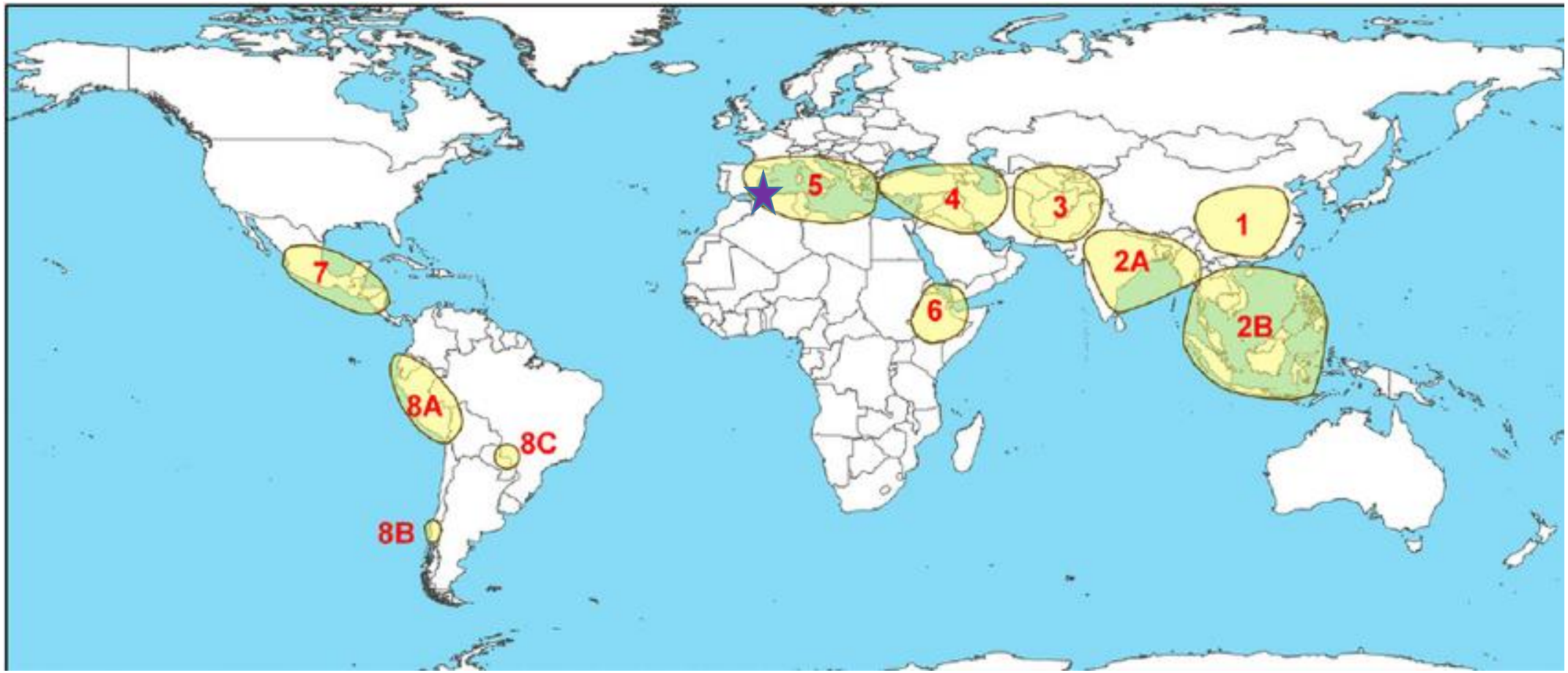


Vavilov's world center of origin of cultivated plants(4)

4. THE NEAR EASTERN CENTER

Einkorn wheat, Durum wheat, Poulard wheat, Bread wheat, Barleys, Rye, Red oat, Chickpea, Lentil, Pea, Blue alfalfa, Sesame, Flax, Melon, Almond, Fig, Pomegranate, Grape, Apricot, Pistachio

Vavilov's world center of origin of cultivated plants

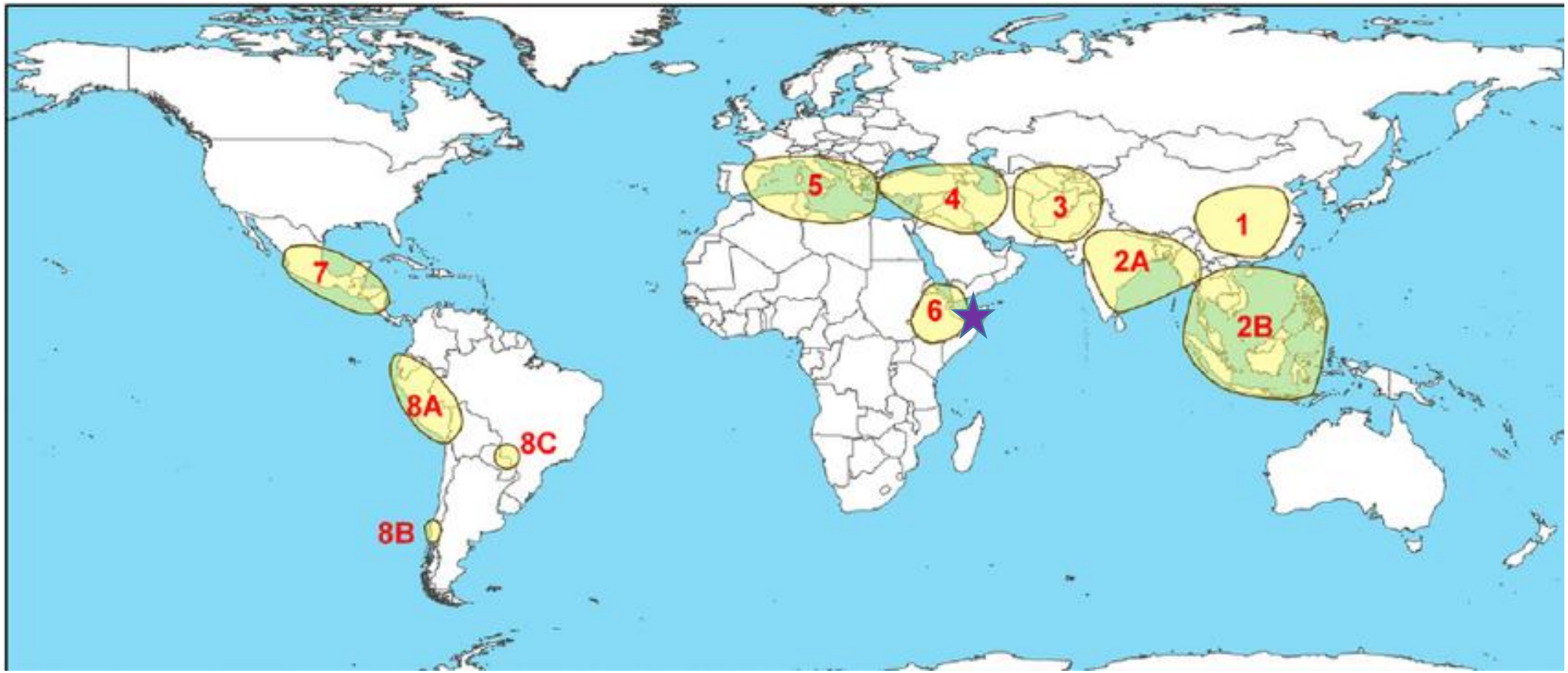


Vavilov's world center of origin of cultivated plants(5)

5. THE MEDITERRANEAN CENTER

Durum wheat, Hulled oats, Broad bean. Cabbage, Olive, Lettuce

Vavilov's world center of origin of cultivated plants

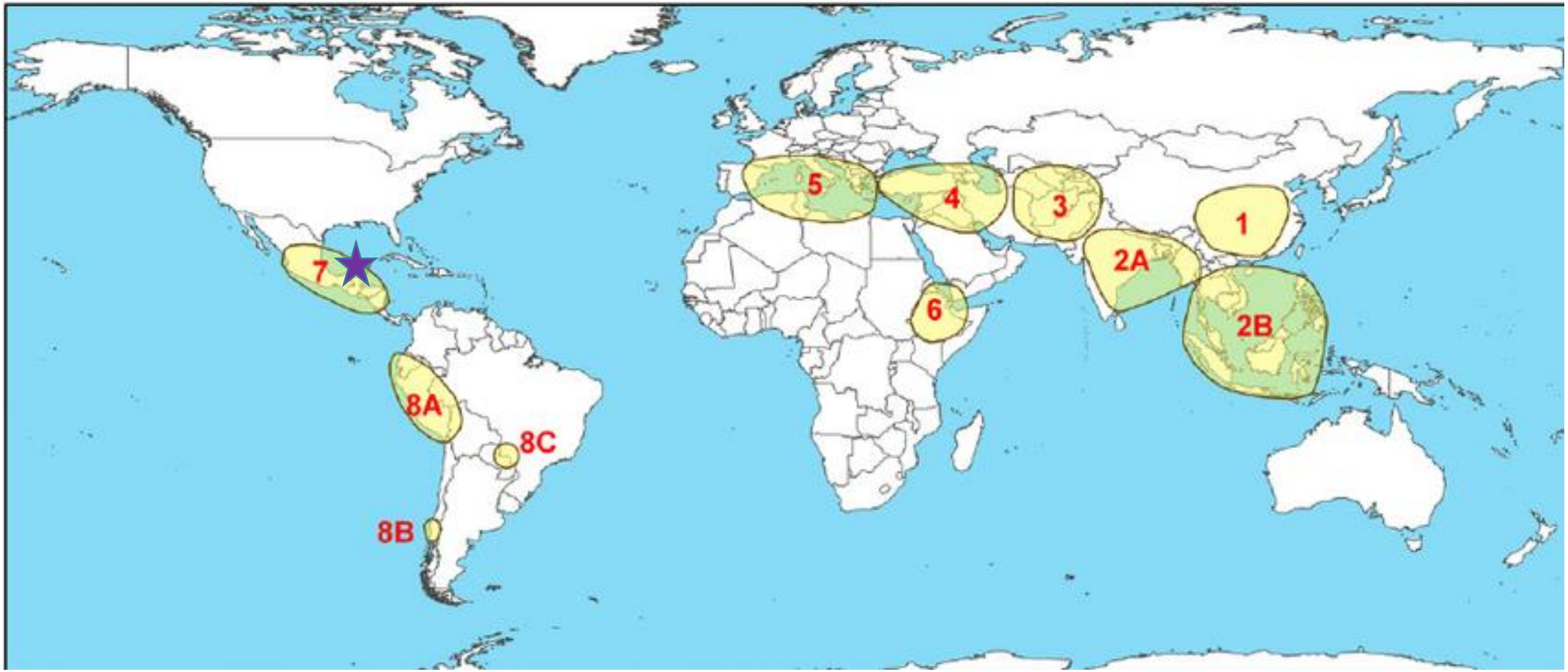


Vavilov's world center of origin of cultivated plants(6)

6. THE ABYSSINIAN CENTER

Durum wheat, Poulard wheat, Emmer, Barley, Chickpea, Lentil, Teff, Finger millet, Pea, Flax, Sesame, Castor bean, Coffee

Vavilov's world center of origin of cultivated plants



Vavilov's world center of origin of cultivated plants(7)

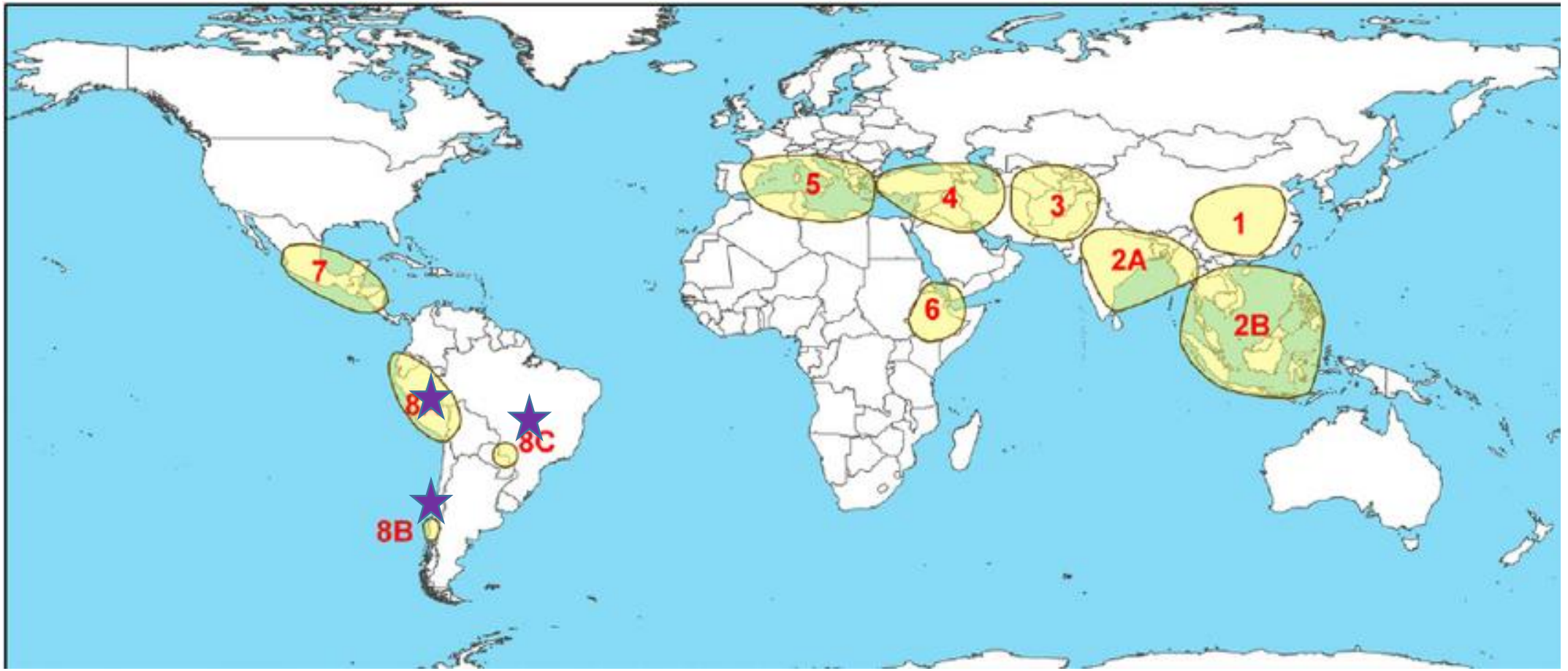
7. THE SOUTH MEXICAN AND CENTRAL AMERICAN CENTER

Corn, Common bean, Pepper,

Upland cotton, Sisal hemp,

Squash, Pumpkin, Gourd

Vavilov's world center of origin of cultivated plants



Vavilov's world center of origin of cultivated plants(8)

8a. SOUTH AMERICAN (PERUVIAN – ECUADOREAN – BOLIVIAN) CENTER

Sweet potato, Potato, Lima bean, Tomato, Sea island cotton, Papaya, Tobacco

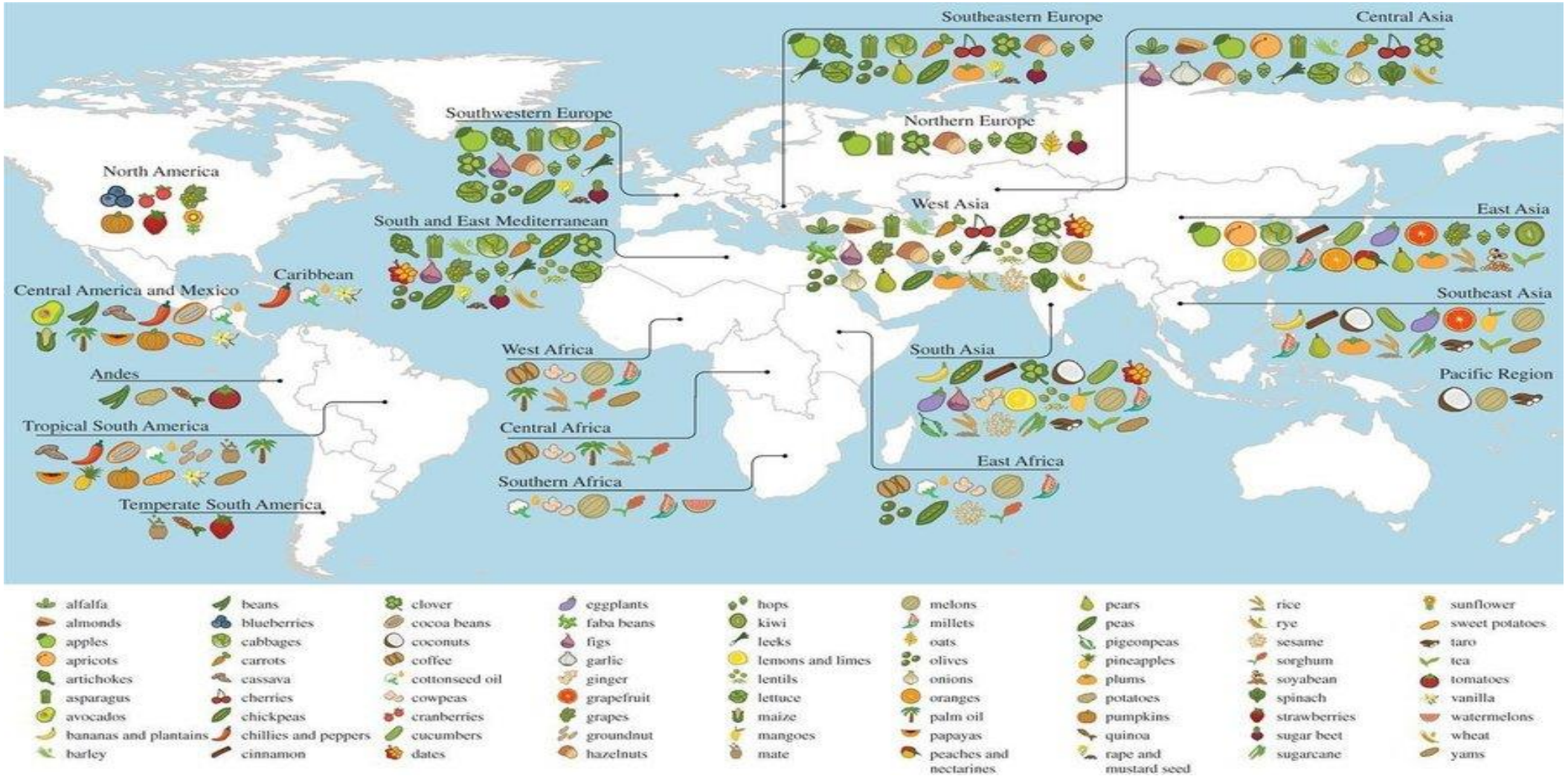
8b. THE CHILOE CENTER

Potato

8c. BRAZILIAN – PARAGUAYAN CENTER

Manioc(cassava), Peanut, Cacao, Rubber tree, Pineapple, Purple granadilla

Origin center of food crop plants



Where is Vegetable Crop Origin from?

ORIGIN OF OUR COMMON VEGETABLES

Plant Genetic Resources Conservation

In situ

- *In-situ* conservation, the conservation of species in their natural habitats or human made ecosystems
- Mainly to wild species related to crop plants, to forest and pasture species
- Need for continued evolution within natural environments.

Ex situ

- It is the process of conserving components of biological diversity by removing or restricting them from a natural habitat and then managing them in a controlled or modified environment.[1]
- a set of conservation techniques involving the transfer of a target species away from its native habitat to a place of safety

In situ conservation

***In situ* conservation** is the conservation of genetic resources in natural populations of plant species.

- **National Park**
- **Biosphere reserves**
- **Farmer's conservation**

Ex situ conservation

- ***Ex-situ* techniques include:** seed storage, captive breeding, slow-growth storage, DNA storage and cryopreservation.
- *Ex-situ* collections of plants are established by storing seeds, conserving pollen and through the storage of plant shoots in conditions of slow or suspended growth (in vitro conservation)
- **Gene banks, e.g. seed banks, field banks;**
- **In vitro plant tissue and microbial culture collections;**
- **Captive breeding of artificial propagation of plants, with possible reintroduction into the wild; and**
- **Collecting living organisms for botanic gardens for research and public awareness.**

Genetic Resources and Seed Unit
World Vegetable Center

Germplasm Collection in The World Vegetable Center

- Total Number：61,952 accessions
- Genera：173 Genera
- Species：442 Species
- Origin ：156 Countries

The World Vegetable Center

Top 10 Crops in Germplasm Collection (Totally41,060)

Soybean (*Glycine spp.*)	15,477 accessions
Tomato *(Solanum lycopersicon*)	8,566 accessions
Pepper *(Capsicum spp.)*	8,263 accessions
Mungbean *(Vigna Radiata)*	6,765 accessions
Eggplant (*Solanum*)	3,774 accessions
Adzuki bean*(Vigna angularis)*	2,377 accessions
Cabbage group(*Brassica spp.*)	1,948 accessions
Yardlong bean(*Vigna unguiculata*)	1,641 accessions
Bulb Allium (*Allium spp.*)	1,129 accessions
Pumpkin*(Cucurbita spp.)*	1,120 accessions

The World Vegetable Center
Vegetable germplasm Collection（Top11-20）

Top11-20 Crops(Okra-*Abelomschus,* Black gram-*Vigna mungo,* Amaranth-*Amaranthus,* Cucumber-*Cucumis,*Snap bean-*Phaseolus vulgaris,* Spongy gourd-*Luffa spp.,* Bitter gourd-*Momordica spp.,* Lablab bean-*Lablab purpureus,* Rice bean-*Vigna umbellata* , Roselle- *Hibiscus spp.*)

Totally 6,576 accessions

Other crops totally 4,316 accessions

History of GRSU/Worldveg(1)

- 1971 AVRDC (Asian Vegetable Research and Development Center) was established and was started operating in 1973. 570
- 1975 a new unit called “Seed Laboratory” was independent from Mungbean Breeding Unit, the unit head was Mr. Leonard Ho. 19,023
- 1983 Dr. Chong-chen Tay became Head of the Unit, some research staffs jointed the Unit. 21,445
- 1984 the Unit change its name to Genetic Resources and Seed Unit (GRSU) and be assigned as Global genetic center of mungbean and pepper 23,469

History of GRSU/Worldveg(2)

- 1985 New building of Genetic Resources and Seed Unit was completed. 25,379
- 1991 Dr. Liwayway Engle became Head of GRSU one year after Dr. Tay left AVRDC. 39,116
- 1992 GRSU start a safe duplicate preservation for its germplasm collection to National Plant Genetic Resources Center (NPGRC) of Taiwan ROC 35,950
- 1995-2003 Under Support of ADB, GRSU Executed indigenous vegetables project, cooperated with many South-East Asia countries in germplasm collection and conservation of IVs. 53,347

History of GRSU/Worldveg(3)

- 2007 GRSU start safety duplicated its germplasm collection to Global Crop Diversity Trust
- 2007 Dr. Andreas Ebert became Head of GRSU after Dr. Engle retired
- 2010 Expansion building of new cold storage was completed under support of MOFA, ROC
- 2011 Completed expansion and renovation of GRSU's main building under support of MOFA, ROC
- 2016 Dr. Solberg became GRSU's manager after Dr. Ebert retired

55,790

57,925

59,294

61,952

Operating a Genebank (Seed Bank)

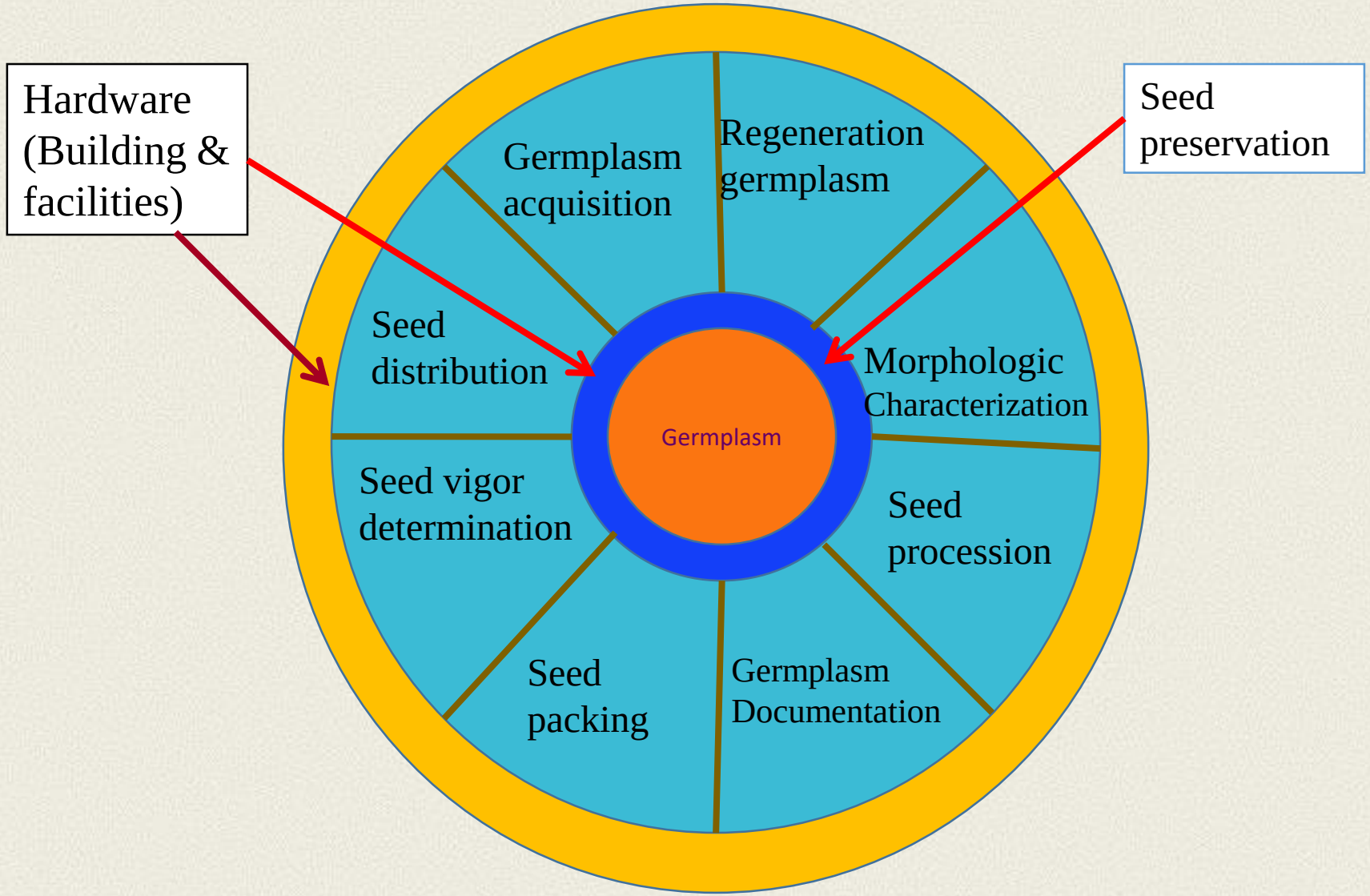
Hardware

- Building
- Cold storage
- Seed drying facility
- Facility of seed testing
- Green house
- Regeneration field
- Documentation facility

Technology

- Germplasm acquisition
- Germplasm Documentation
- Regeneration of germplasm
- Morphologic Characterization
- Seed procession
- Seed packing
- Seed vigor determination
- Seed distribution

GENE BANK


Hardware (Building & facilities)
Seed preservation
Germplasm acquisition
Regeneration germplasm
Seed distribution
Morphologic Characterization
Germplasm
Seed vigor determination
Seed procession
Seed packing
Germplasm Documentation

Operating a Genebank (H-1)

Building

GRSU/World Vegetable Center

- Office
- Packing room
- Storage
- Document
- Laboratory
- Seed processing

Operating a Genebank (H-2)

Cold storage

- Extending longevity of seed
- Short-term storage
- Medium-term storage
- Long-term storage

GRSU/World Vegetable Center

Operating a Genebank (H-3)

Seed drying facility

- Reduce seed moisture content
- Get a better seed storage situation
- Drying room
- Drying ground
- Desiccator with desiccant

GRSU/World Vegetable Center

Operating a Genebank (H-4)

Facility of seed testing

GRSU/World Vegetable Center

- Determine seed moisture content
- Determine seed viability (Germination rate)





Operating a Genebank (H-5)

Green house

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- Growing germplasm which in dangerous of loosing
- Be seedling nursery for regeneration

Operating a Genebank (H-6)

Regeneration field

GRSU/World Vegetable Center

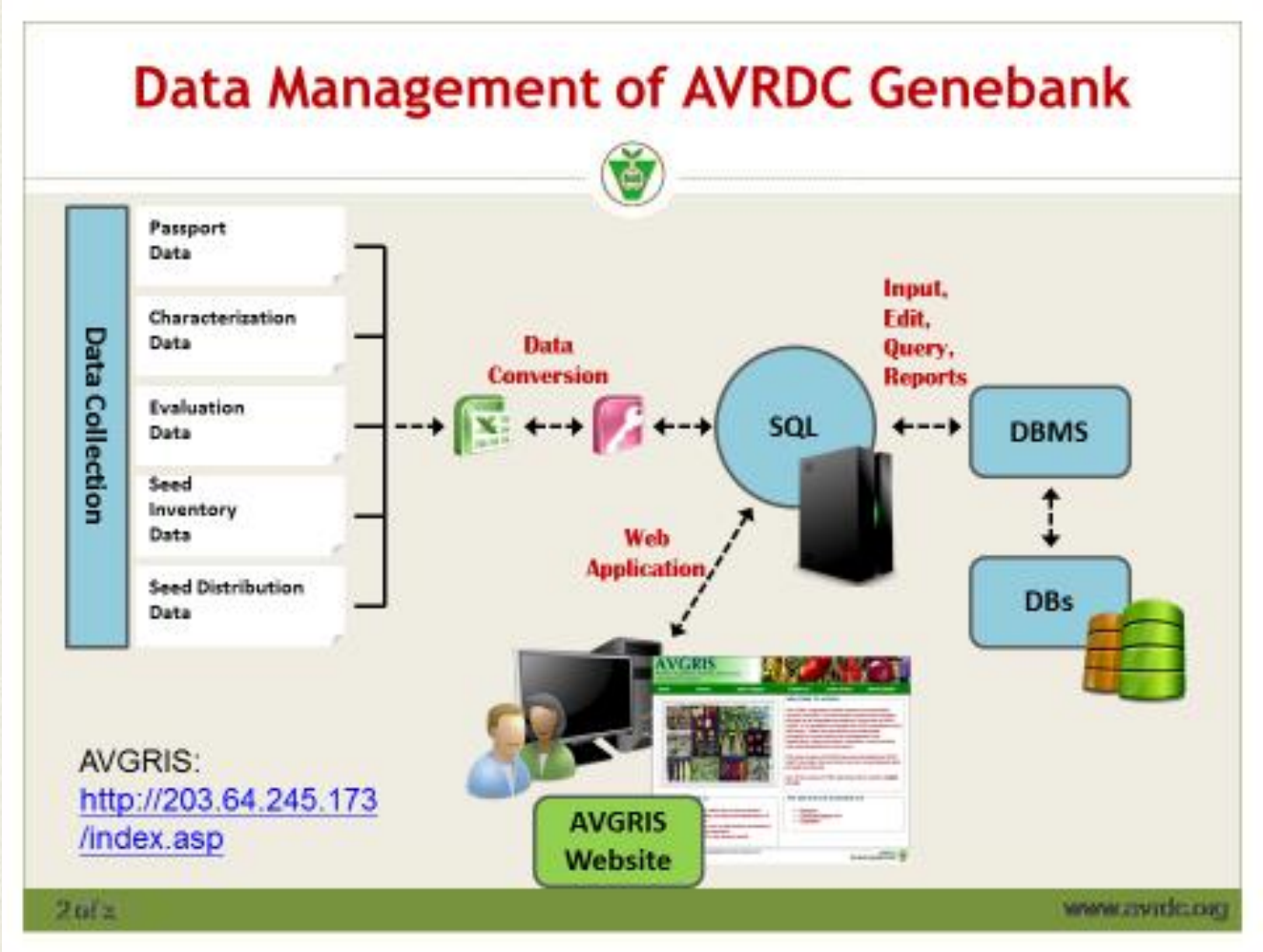
- To get a large quantity seed of collected germplasm
- To have chance for morphologic characterization on Collected materials
- To renew the seed stock when the seed vigor is decreased

Operating a Genebank (H-7)

Documentation facility

GRSU/World Vegetable Center

- Recording all information concerning collected germplasm



Operating a Genebank (H&T)

Hardware (Building, Facility, Field)

Technology (Human resources, Knowledge, Skill, Strategy)

Operating a Genebank (T-1)

Germplasm acquisition

- To get germplasm materials from different resources.
- Passport date or collecting data should obtained

GRSU/World Vegetable Center

- Registration and given a VI (Vegetable Introduction) number.
- Insert all passport data came with the material into computer – Database of passport.
- Put received seed into mid-term storage after re-dried

Operating a Genebank (T-2)

Germplasm Documentation

- All information of collected germplasm be recorded
- Passport data
- Characterization data
- Evaluation data
- Seed inventory
- Distribution data

GRSU/World Vegetable Center

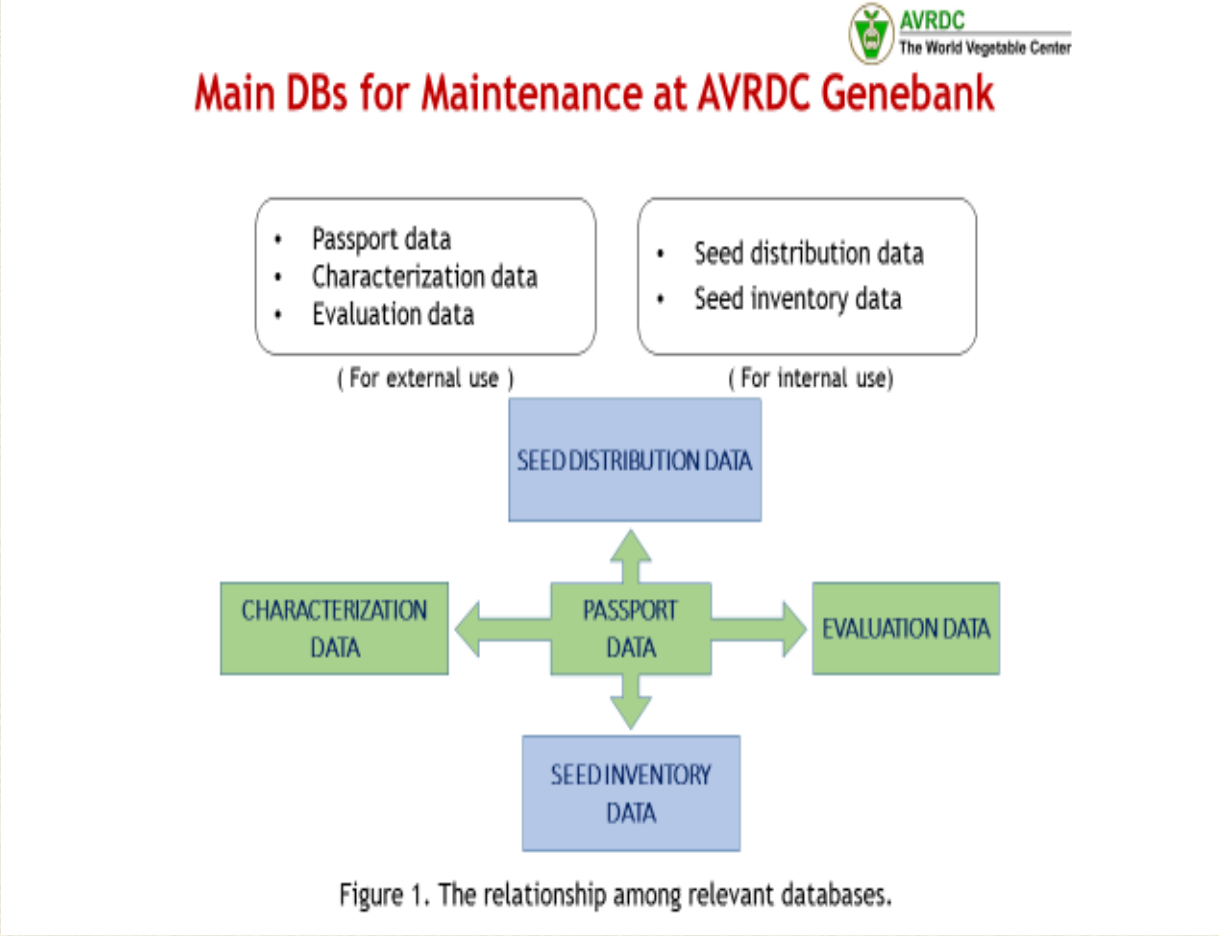


Figure 1. The relationship among relevant databases.

Operating a Genebank (T-3)

Regeneration of germplasm

- Multiply for increasing quantity of germplasm materials
- Get good quality seed for long-term preservation

GRSU/World Vegetable Center

- Standard protocol of regeneration was carried
- Sowing – transplanting – Field management – Pollinating – Harvesting – Seed processing (extraction, cleaning, drying, packing…)

Operating a Genebank (T-4)

Morphologic Characterization

GRSU/World Vegetable Center

- To have more knowledge about the collected materials
- Seed & Seedling data
- Vegetative data
- Inflorescence data
- Fruit data

Operating a Genebank (T-5)

Seed procession

GRSU/World Vegetable Center

- Post harvesting of regenerated seed
- Seed extraction
- Seed cleaning
- Seed drying
- (Seed coating?)
- Seed treatment

Operating a Genebank (T-6)

Seed moisture content Determination

GRSU/World Vegetable Center

- Measure seed moisture content before packing to have a good storage situation
- Standard method

  (Oven, infrared)
- Electronic Conductivity
- Humidity equilibrium

Operating a Genebank (T-7)

Seed packing

GRSU/World Vegetable Center

- Isolating and identifying different germplasm from each other
- Keep seed stable in storage room
- Prevent outside impact to affect the collected materials

Operating a Genebank (T-8)

Seed vigor determination

- Mainly through germination test
- Initiate one of get the seeds
- Monitor in time set
- Mainly following the regulation of ISTA

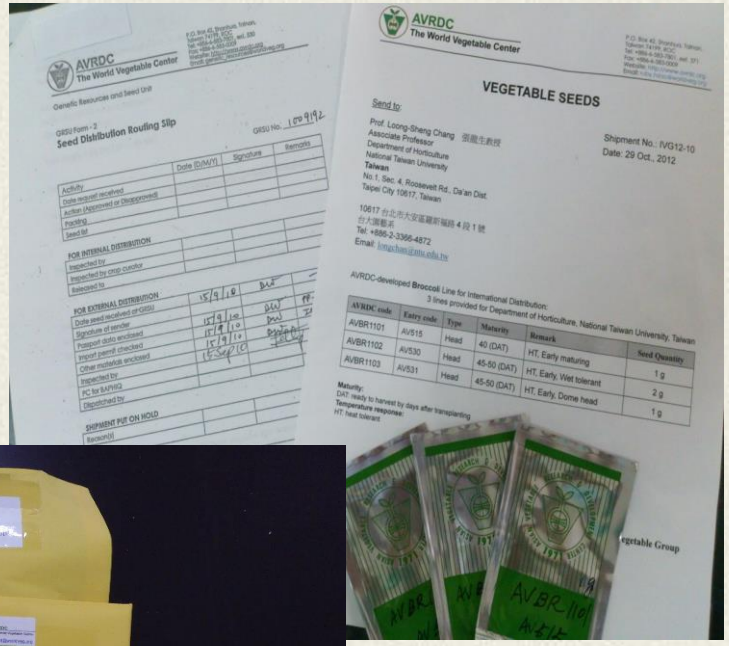
GRSU/World Vegetable Center

Operating a Genebank (T-9)

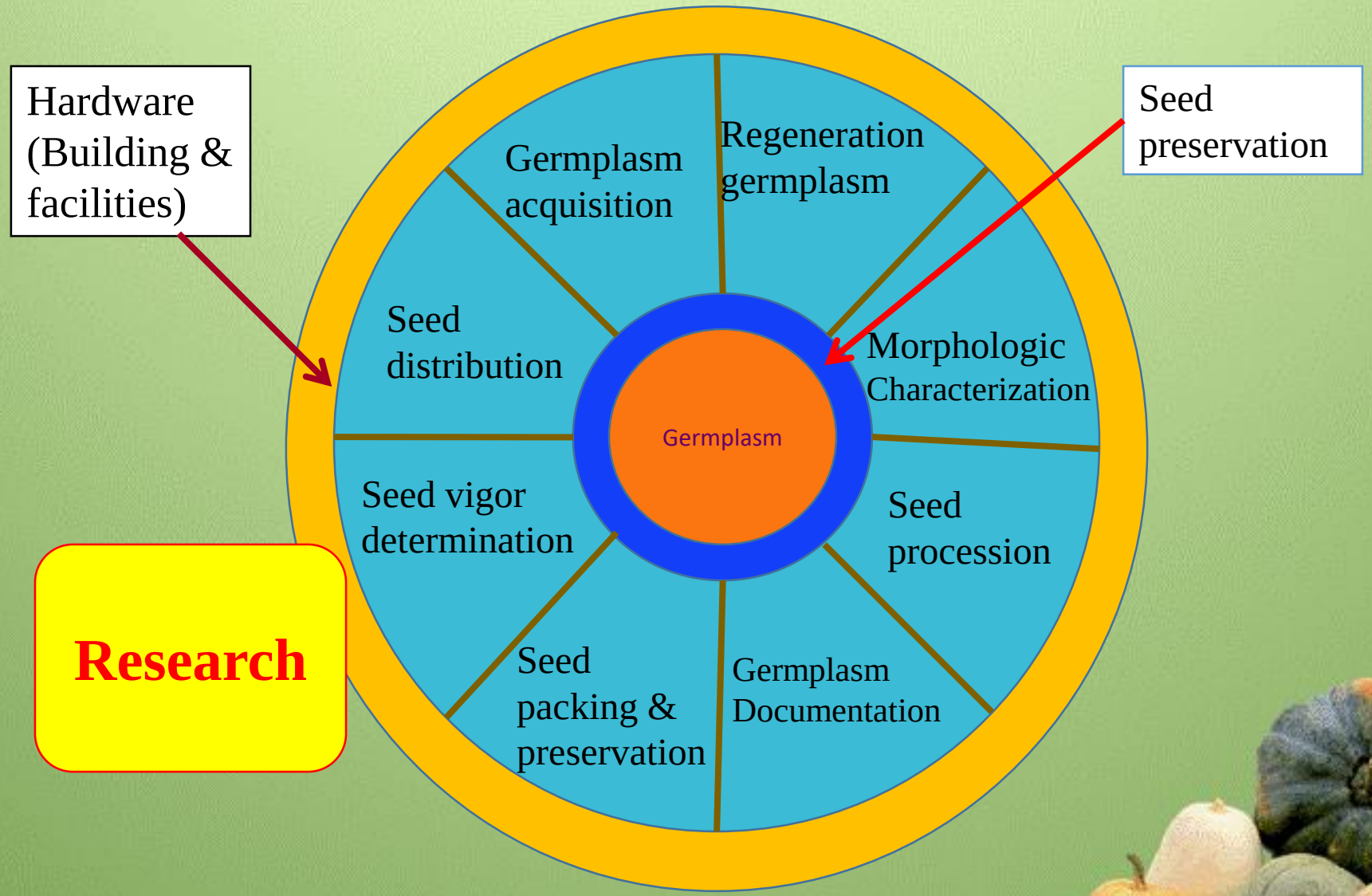
Seed distribution

- For utilization of plant genetic resource
- Import permit may need if sent to aboard
- MTA or SMAT need be signed
- Quarantine for phytosanitary certificate is necessary for go aboard

GRSU/World Vegetable Center



GENE BANK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Germplasm Documentation
Research

Conclusion

- Conservation of plant genetic resources in a very important work in regard to agriculture research and sustainable exist of human been.
- Nature resources may not exist forever especially when development of man's civilization.
- The distinguish of nature resources is going to limit or even terminating development of man's civilization.
- Protect and conserve genetic resources in nature is an **UNAVOIDABLE** responsibility of our generation.
- The more we do the less regret will happen.

Thank You for Your Attention

IVTC