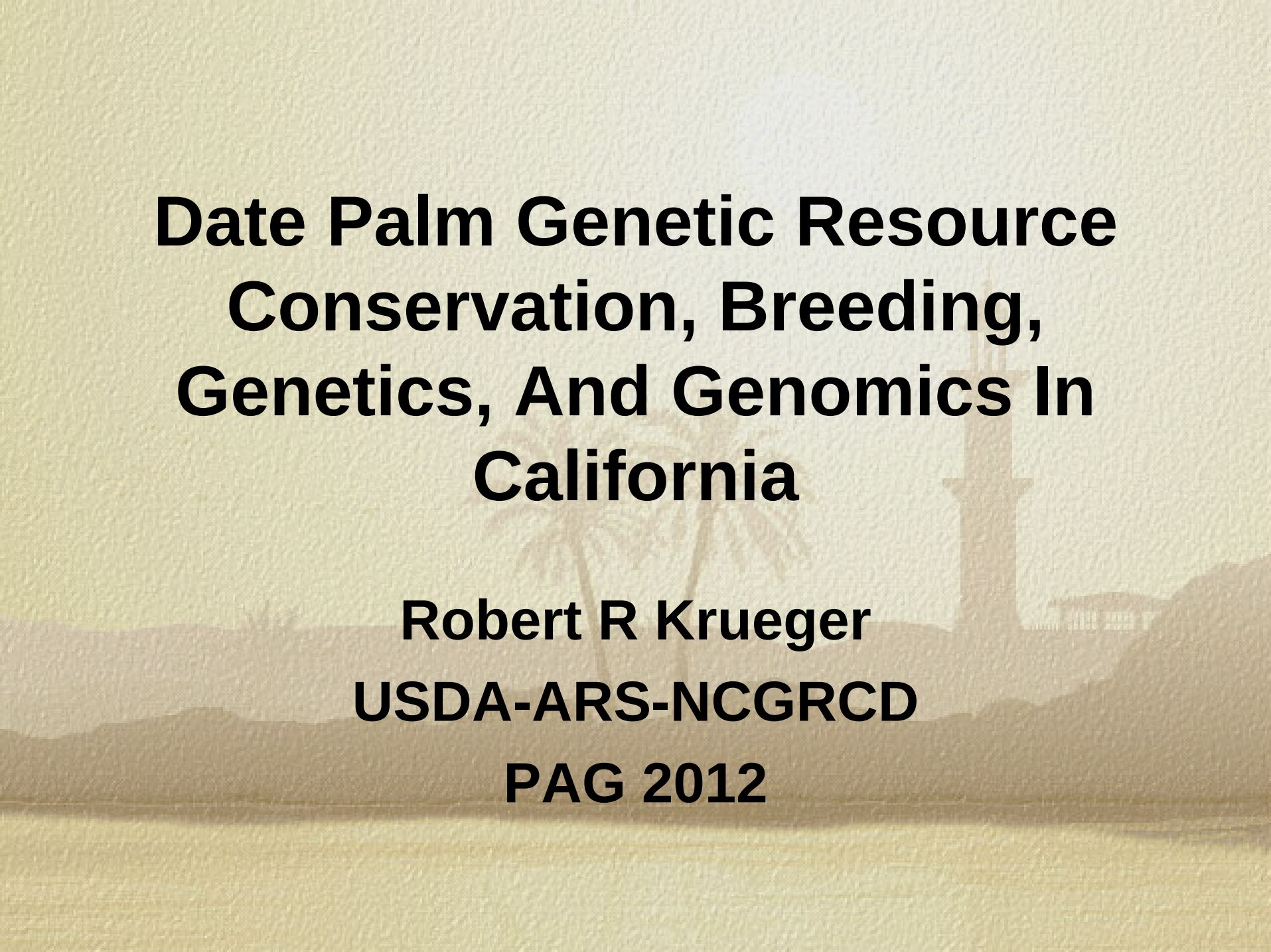




Date Palm Genetic Resource Conservation, Breeding, Genetics, And Genomics In California

**Robert R Krueger
USDA-ARS-NCGRCD
PAG 2012**

Date Palm Germplasm In California

- **Date palms come to California**
- **Date palm research**
- **Date palm breeding**
- **Date palm germplasm conservation**
- **Date palm genetic studies**
- **Date palm genomics efforts**

Date Palms Arrive In The New World

- Era of Spanish colonization
- Archivos de Academia Real Española (Rivera *et al*)
- Carribean early 1500's
- México, Perú, Chile early to mid 1500's
- Seed source
- *P canariensis* not a distinct species
- *P dactylifera* localized in SE Spain, N Africa

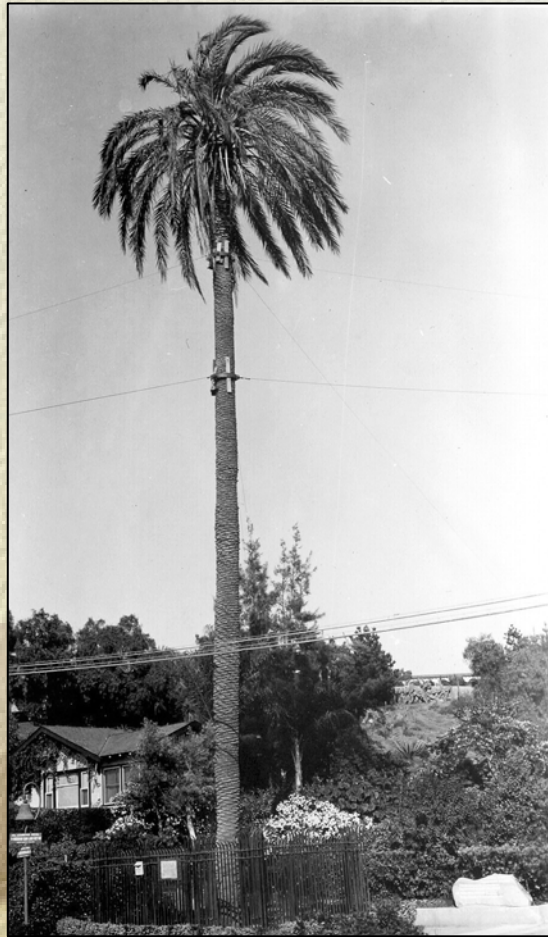
Date Palms Arrive In The Californias

- **Baja California (Sur) early – mid 1700's**
 - **Desert climate**
 - **Persistent oases**
 - **Probably little genetic diversity**
 - **Very small commercial industry**
- **Alta California late 1700's**
 - **Probably from Loreto, BCS**
 - **Coastal climate**
 - **No oases**
 - **Apparently no “historical” date palms**

San José Comandú, BCS



San Diego, California



Commercial Date Palm Cultivars Arrive In California

- **Seedling date palms planted in Central/Northern California, ca 1850 – 1870**
 - **Unsuitable climate**
 - **Abandoned in later years**
- **Offshoots imported starting ca 1876**
 - **Inferior, then superior varieties**
 - **Trialed in various States, areas**
 - **Found to be adapted to a narrow range of climatic areas in California, Arizona**

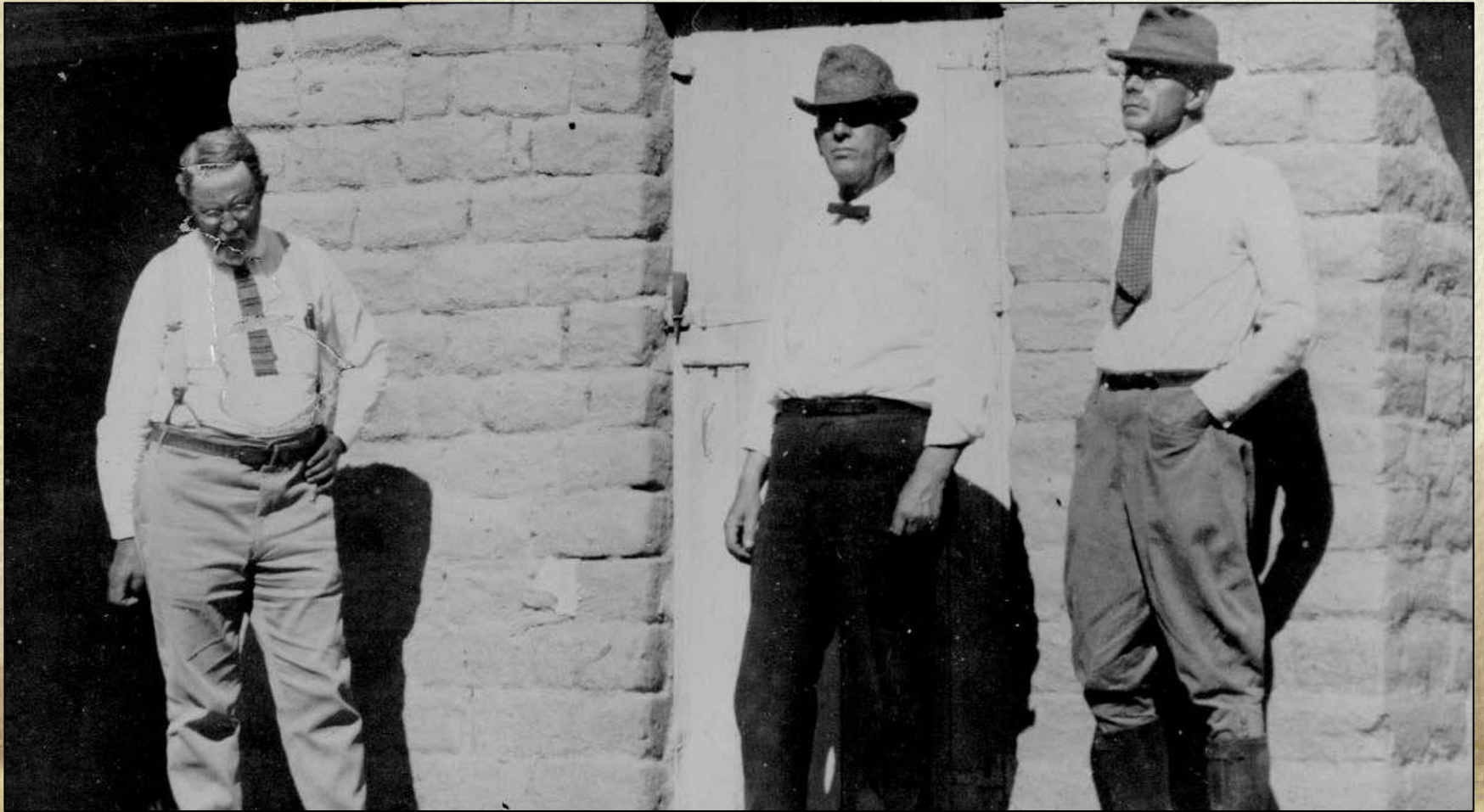
Wolfskill Orchard, Winters, California



Date Palm Offshoot Importations

- **USDA**
 - 1890 – 1929
 - Swingle, Mason, Fairchild, Kearney, Nixon, etc
 - 20,000 offshoots in 1,076 lots
 - 150 varieties (Nixon, 1950)
- **Commercial**
 - 1903 - 1922
 - Johnson, Cole, Popenoe, Mason, etc
 - 43,000 offshoots in 14 lots
 - Fewer varieties

Mason, Thackery, Swingle



US Date Garden

- **Later US Date & Citrus Station**
- **Indio, California**
- **USDA**
- **1904 - 1982**



Date Station Activities

- **Varietal Development**
 - **Breeding**
 - **Dates**
 - **Citrus**
 - **Cooperation: Orlando, FL; Weslaco, TX**
 - **Cultural Practices**
 - **Plant Pathology**
 - **Post-harvest**
- 
- A faint, sepia-toned background image of a mosque with a tall minaret, palm trees, and a body of water, likely a coastal scene in a warm climate.

USDCS Date Palm Germplasm

- **Female (Pistillate) Varieties**
- **~ 150 Old World Varieties (Nixon, 1950)**
 - **16 “Commercial”**
 - **30 “Minor” (includes ‘Medjool’)**
 - **104 “Other”**
- **~ 40 Local Selections (Nixon, 1955)**
 - **43 (Hodel & Johnson, 2007)**
- **Reduced to 20 OW, 3 NW in 1971**

USDCS Date Palm Germplasm

- **Male (staminate) Varieties**
- **Superior Local Selections**
 - **Pollen production**
 - **Timing of flowering**
 - **Metaxenic effects**
- **~ 8 Male Selections**
- **Reduced to 5 in 1971**

USDCS Date Palm Breeding

- 1948 – 1982
- Nixon, Furr, Ream, Barrett, Carpenter
- Overall objective: Obtain female varieties with fruit adapted to mechanical harvesting/processing with quality $\geq$ 'Deglet Noor'
 - 'Deglet Noor' traditionally most widely planted cv in California

Some Desirable Characteristics

- **Lower tree height (ease of work, harvest)**
- **Reduced spines on leaves (less injury, labor)**
- **Hermaphroditic flowers (no pollination)**
- **Long, flexible fruit stalks with uniformity of fruit maturation**
- **Fruit quality (esp firmness)**
- **Disease resistance, soil adaptation, etc**

USDCS Date Palm Breeding Strategy

- **Phase 1: Production of “varietal” males**
 - **Sequential backcrosses to BC5**
 - **Concept: male trees genetically similar to female parent**
 - **Pollen will impart characteristics of female ancestor when used in “intervarietal cross”**
 - **1948 – 1971 (1982)**
- **Phase 2: “Intervarietal Crosses” combining characteristics of original fruit-bearing varieties**
 - **1971 - 1982**

USDCS Varietal Males

- **1948: 35 cv, 48 “lines”**
- **1975: 14 cv, 22 “lines”**
- **BC 1 – BC 5 (mostly BC 3 – BC 4)**
- **9 used in intervarietal crosses**

USDCS Intervarietal Crosses

- **Started 1970 – 1971**
- **11 female parents**
- **1 – 10 male parents per female**
- **62 total crosses**
- **11 hybrids retained**
 - **Considered as breeding lines**
 - **Flaws reduce commercial potential**

Accession No: 71-25-36

Parentage: Medjool X (Dayri X DN BC3)

**Color: Rose over yellow (Khalal),
Medium brown (Rutab),
Dark brown (Tamar)**

Size: 68 mm X 42 mm, oblong

Flesh: Soft to semi-dry

Remarks: Large, only fair quality



National Date Palm Germplasm Repository

- **1904 - 1976: US Date & Citrus Station, Indio (unofficial)**
- **1977 - 1981: US Date & Citrus Station, Indio (officially recognized)**
- **1982 – ish: Incorporated into NCGRCD**
- **1982 - 2011 (?): Irrigated Desert Research Station, Brawley**
- **1992 - current: Coachella Valley Agricultural Research Station, Thermal**

Status Of Date Palm Germplasm Repository 2012

- **133 Total Accessions**
 - **118 *Phoenix dactylifera* Accessions**
 - **Named Old World Female Varieties = 28**
 - **Named New World Female Varieties = 9**
 - **Superior Male Selections = 5**
 - **Backcrossed Male Accessions = 30**
 - **Hybrid “Breeding Lines” = 17**
 - **Baja California Sur Seedlings = 10**
 - **Unverified = 19**
 - **15 *Phoenix spp* Accessions (7 spp)**

Accessions of *Phoenix spp*

- *P acaulis* = 1
- *P canariensis* = 1 (seedlings)
- *P hanceana* = 2 (seedlings)
- *P paludosa* = 1 (seedlings)
- *P reclinata* = 2 (1 seedling)
- *P roebelinii* = 3
- *P sylvestris* = 5

Date Palm Germplasm Repository Inventory 2012

- **Maintained as field trees at this time**
 - **Need to develop TC backup**
- **686 total trees**
 - **585 at Thermal**
 - **101 at Brawley**
- **609 *P dactylifera***
- **77 *P spp***

Thermal Collection



Brawley Collection

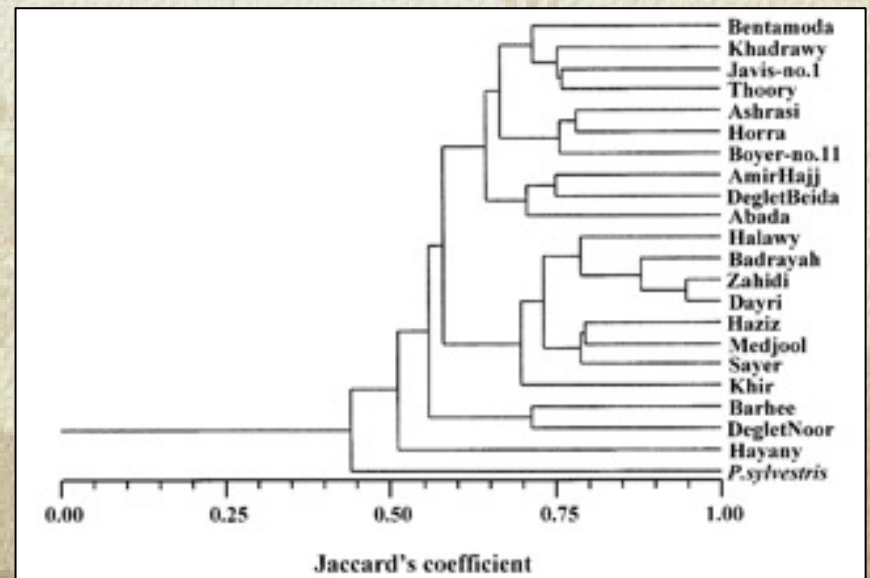


Genetic Analysis Of Date Palm Germplasm

- **Early work of Tisserat and Torres (1979)**
 - Isozymes
- **Chao and associates, UC Riverside**
 - AFLP
- **Contribute germplasm to other researchers**
 - Johnson *et al* (2009)
 - Akkak *et al* (2009)
 - Al-Dous *et al* (2011)

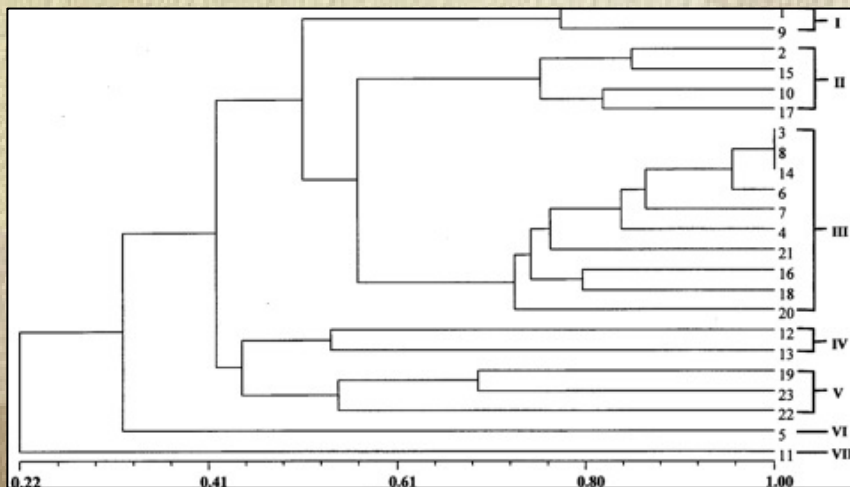
Cao & Chao, 2002

- 21 cv analyzed
- 2 major groups
- Geographically mixed
- Outliers

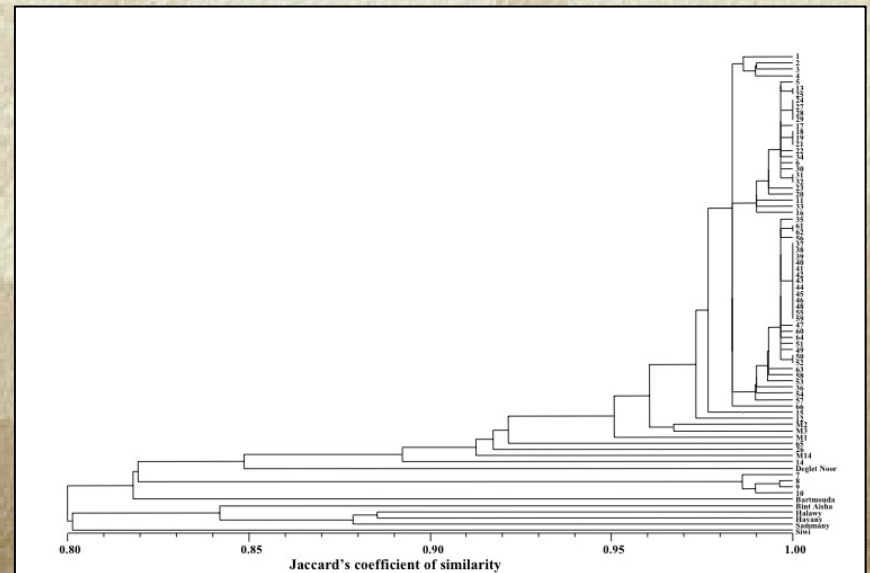


'Deglet Noor' & 'Medjool'

Minimal variation within 'Deglet Noor', large variation within 'Medjool' (Devanand and Chao, 2003)



'Medjool' a landrace in Morocco (Elhoumaizi *et al*, 2006)



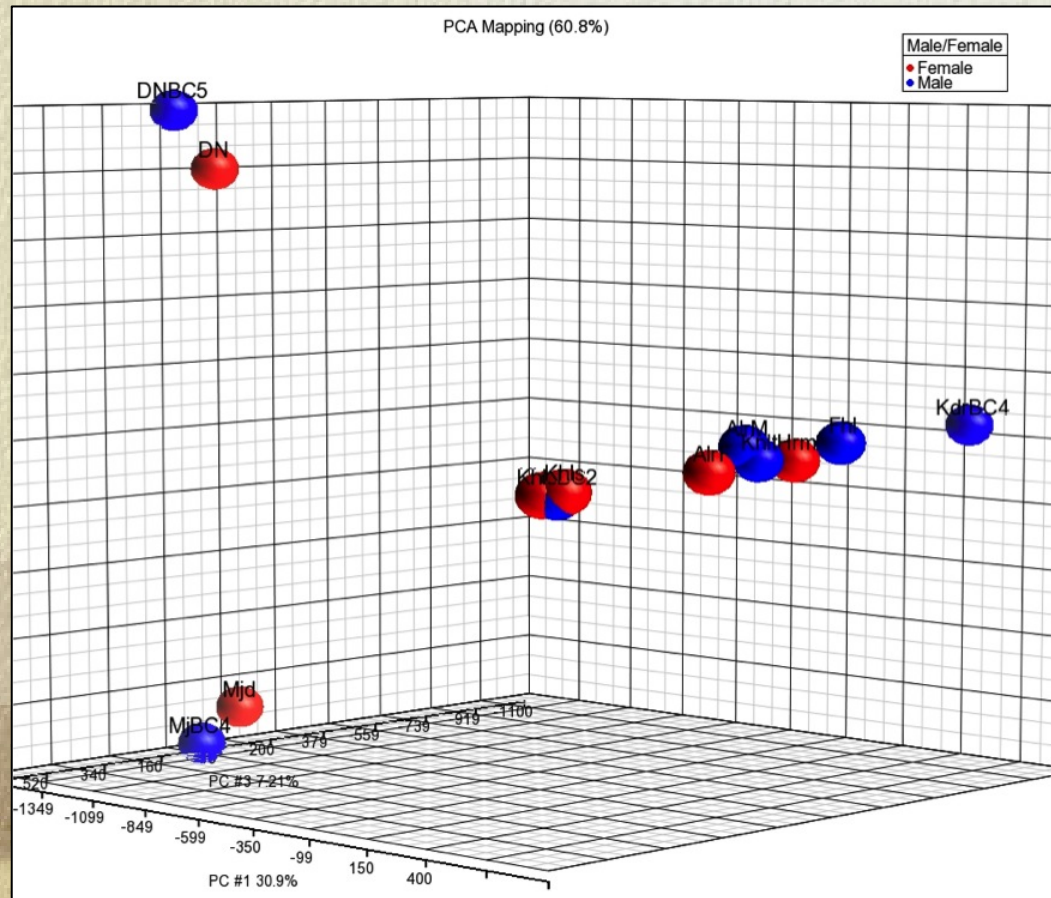
'Medjool' a landrace in California?

Analysis Of Date Palm Germplasm With SSR 2012

- **Cooperative with Jeff Bennetzen, UGA**
- **Current, ongoing project**
- **Some preliminary results**
- **41 accessions (112 trees), 8 markers**
- **Clustering of replicates**
- **Clustering of California selections**
- **Cannot separate cvs from Asia, Africa**

Al-Dous *et al* (2011)

[Qatar Project]



Current Work

- **Germplasm/variety releases?**
- **Continue backcrosses**
- **Validation of unverified accessions**
- **Analysis of diversity of BCS oases**
- **Mapping populations**
 - **Collaborative with J Bennetzen, UGA**
 - **'Barhee' X 'Medjool BC4'**
 - **'Khadrawy' X 'Medjool BC4'**
 - **'Khisab' X 'Medjool BC4'**

Contact

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Search for date (and citrus) germplasm:

[<http://www.ars-grin.gov/npgs/acc/acc_queries.html>](http://www.ars-grin.gov/npgs/acc/acc_queries.html)

Thank You!

