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

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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)
- Carribbean early 1500’s
- México, Perú, Chile early to mid 1500’s
- Seed source
- \( P \text{ canariensis} \) not a distinct species
- \( P \text{ dactylifera} \) 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
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”

• 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>
Thank You!