Palm tree being 'showered' i.e., liquid pollination by drone

Liquid Pollination for Date Palm Production (Oman)

DESCRIPTION

Pollination of date palms is essential to ensure good quality yield. Currently, pollination is done manually: this is a costly process and dangerous. Mechanised Liquid Pollination (MLP) reduces variable costs by 80% and prevents causalities while maintaining yield.

In the Middle East, the date palm is a common crop with significant cultural and economic value. Date palms are typically found in dry, arid and hot areas. Due to climate change in the form of high temperatures, heatwaves, increased water scarcity, harsh winds, poor pollination and the increase of pests, production problems are increasing. The International Center of Agricultural Research in Dry Areas (ICARDA) acknowledged these challenges and led an initiative to address the key issues. One major challenge identified was the labour-intensive and dangerous practice of manual date palm pollination: a farmer climbs up the tree and spreads the pollen. This is expensive and dangerous. An alternative tested was mechanised liquid pollination. Pollen is mixed with water and then sprayed onto the inflorescence of the palm tree. The costs are reduced substantially, and there is a three times higher benefit-cost return. In addition, pollination is now less depending on the climate, thus more resilient to climate change.

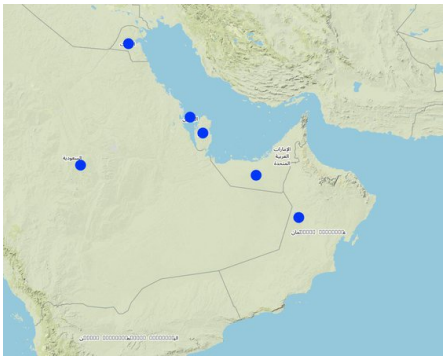
Prior to pollinating, the male spathes are cut off to avoid the losses of pollen. This is done when the spathes begin to ripen. The spathe is brought to a temperature-controlled room to dry for few days. Then the inflorescence is opened and strands are left to dry further. As the moisture content of the inflorescence decreases, its flowers begin to open and the pollen is released. It is captured, and mixed with water. Pollination is then carried out mechanically with a pump system or drones.

Regarding the costs, based on 140 date palms per hectare this corresponds to 28 inflorescences required. These are processed into 560 grams of pollen following the methodology as described above. The cost per inflorescence is around 6 Omani Riyal (1 Omani Riyal = 2.6 USD). The actual pollination through a drone, also known as showering, costs around 150 Omani Riyal. Showering is done four times, with each consisting of an operation time of 3 hours, so 12 hours in total. In other words, the total cost per hectare for applying this liquid pollination through showering is estimated at around 518 Omani Riyal, or 1,350 USD. The purchase costs of a drone and the related devices is estimated at 8000 Omani Riyal.

To conclude, this innovation is very useful because it substantially lowers variable costs of date palm production and prevents the risks of accidents under the conventional method of pollination. However, the required investments are very large for individual farmers.

Information and data presented are partly made available through the project "Support to Date Palm Production in the Gulf Council Countries," funded through the GCC General Secretariat by the member countries, managed by the International Center for Agricultural Research in the Dry Areas (ICARDA) and implemented in the Sultanate of Oman by the Directorate General of Agriculture & Animal Research.

LOCATION



Location: Kingdom of Saudi-Arabia; Qatar; Kuwait; Bahrain; United Arabic Emirates, Oman

No. of Technology sites analysed: > 1000 sites

Geo-reference of selected sites

- 55.97567, 21.48105
- 45.08126, 23.89236
- 51.18453, 25.36181
- 47.4823, 29.31863
- 50.55788, 26.07234
- 53.84355, 23.42963

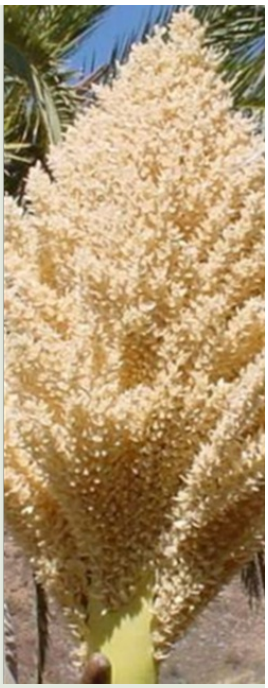
Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?: No

Date of implementation: 2011

Type of introduction

- ☐ through land users' innovation as part of a traditional system (> 50 years)
- ☑ during experiments/ research
- ☑ through projects/ external interventions



On the left the male date palm with its spathes; On the right, the inflorescence of the male date palm

Liquid pollination through a drone also known as showering

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- improve production
- reduce, prevent, restore land degradation
- conserve ecosystem
- protect a watershed/ downstream areas – in combination with other Technologies
- preserve/ improve biodiversity
- ✓ reduce risk of disasters
- ✓ adapt to climate change/ extremes and its impacts
- mitigate climate change and its impacts
- ✓ create beneficial economic impact
- create beneficial social impact

Land use

Land use mixed within the same land unit: No

Cropland

- Tree and shrub cropping: dates

Is intercropping practiced? No

Is crop rotation practiced? No

Water supply

- rainfed
- ✓ mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation

- prevent land degradation
- reduce land degradation
- restore/ rehabilitate severely degraded land
- ✓ adapt to land degradation
- not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion

biological degradation - Bq: quantity/ biomass decline

SLM group

- forest plantation management
- Improved Pollination

SLM measures

agronomic measures - A7: Others

management measures - M2: Change of management/ intensity level

other measures - Liquid Pollination

TECHNICAL DRAWING

Technical specifications

Drone equipment used for showering. Drone may vary; this drone has a length of around 1 meter and a width of around 0.74 meter.

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **1 hectare**)
- Currency used for cost calculation: **Omani Riyal**
- Exchange rate (to USD): 1 USD = 0.39 Omani Riyal
- Average wage cost of hired labour per day: 10

Most important factors affecting the costs
n.a.

Establishment activities
n.a.

Establishment inputs and costs (per 1 hectare)

Specify input	Unit	Quantity	Costs per Unit (Omani Riyal)	Total costs per input (Omani Riyal)	% of costs borne by land users
Equipment					
Drone package (including sprayer, tank, controls, etc)		1.0	8000.0	8000.0	
Total costs for establishment of the Technology				**8'000.0**	
Total costs for establishment of the Technology in USD				*20'512.82*	

Maintenance activities
1. Cut off male spathes (Timing/ frequency: February-March)
2. Drying of spathes (two times, three days) (Timing/ frequency: Until inflorescence open up)
3. Cut off inflorescence (three times) (Timing/ frequency: February-March)
4. Extract pollen from inflorescence (Timing/ frequency: None)
5. Liquid Pollination (Timing/ frequency: February-March)

Total maintenance costs (estimation)
518.0

NATURAL ENVIRONMENT

Average annual rainfall
- ✓ < 250 mm
- 251-500 mm
- 501-750 mm
- 751-1,000 mm
- 1,001-1,500 mm
- 1,501-2,000 mm
- 2,001-3,000 mm
- 3,001-4,000 mm
- > 4,000 mm

Agro-climatic zone
- humid
- sub-humid
- semi-arid
- ✓ arid

Specifications on climate
n.a.

Slope
- ✓ flat (0-2%)
- ✓ gentle (3-5%)
- moderate (6-10%)
- rolling (11-15%)
- hilly (16-30%)
- steep (31-60%)
- very steep (>60%)

Landforms
- ✓ plateau/plains
- ridges
- mountain slopes
- hill slopes
- footslopes
- ✓ valley floors

Altitude
- 0-100 m a.s.l.
- ✓ 101-500 m a.s.l.
- ✓ 501-1,000 m a.s.l.
- 1,001-1,500 m a.s.l.
- 1,501-2,000 m a.s.l.
- 2,001-2,500 m a.s.l.
- 2,501-3,000 m a.s.l.
- 3,001-4,000 m a.s.l.
- > 4,000 m a.s.l.

Technology is applied in
- convex situations
- concave situations
- ✓ not relevant

Soil depth
- very shallow (0-20 cm)

Soil texture (topsoil)
- ✓ coarse/ light (sandy)

Soil texture (> 20 cm below surface)

Topsoil organic matter content
- high (>3%)

- [x] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

- [x] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

- [ ] medium (1-3%)
- [x] low (<1%)

Groundwater table
- [ ] on surface
- [ ] < 5 m
- [x] 5-50 m
- [ ] > 50 m

Availability of surface water
- [ ] excess
- [ ] good
- [x] medium
- [ ] poor/ none

Water quality (untreated)
- [ ] good drinking water
- [ ] poor drinking water (treatment required)
- [x] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to: both ground and surface water

Is salinity a problem?
- [x] Yes
- [ ] No

Occurrence of flooding
- [ ] Yes
- [x] No

Species diversity
- [ ] high
- [ ] medium
- [x] low

Habitat diversity
- [ ] high
- [ ] medium
- [x] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [x] mixed (subsistence/ commercial)
- [ ] commercial/ market

Off-farm income
- [ ] less than 10% of all income
- [x] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [x] manual work
- [ ] animal traction
- [x] mechanized/ motorized

Sedentary or nomadic
- [x] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [x] individual/ household
- [ ] groups/ community
- [ ] cooperative
- [ ] employee (company, government)

Gender
- [ ] women
- [x] men

Age
- [ ] children
- [ ] youth
- [x] middle-aged
- [ ] elderly

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [x] 5-15 ha
- [x] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

Scale
- [ ] small-scale
- [x] medium-scale
- [ ] large-scale

Land ownership
- [x] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [ ] individual, not titled
- [x] individual, titled

Land use rights
- [ ] open access (unorganized)
- [x] communal (organized)
- [ ] leased
- [x] individual

Water use rights
- [ ] open access (unorganized)
- [x] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

health	poor ✓	good
education	poor ✓	good
technical assistance	poor ✓	good
employment (e.g. off-farm)	poor ✓	good
markets	poor ✓	good
energy	poor ✓	good
roads and transport	poor ✓	good
drinking water and sanitation	poor ✓	good
financial services	poor ✓	good

IMPACTS

Socio-economic impacts

Crop production	decreased ✓	increased
crop quality	decreased ✓	increased
risk of production failure	increased ✓	decreased
land management	hindered ✓	simplified
farm income	decreased ✓	increased
workload	increased ✓	decreased

Liquid Pollination does not result necessarily in increased production.

Pollination is enhanced, improving the quality.

Liquid pollination decreased dependency on natural pollination which can fail due to changing climate.

Less failure of falling down the tree and less labour consuming with respect to conventional pollination.

Less costs for labour, resulting in more net-income.

Less labour required with respect to conventional pollination.

Socio-cultural impacts
situation of socially and economically disadvantaged groups (gender, age, status, ehtnicity etc.)

worsened ✓ improved

Ecological impacts

Off-site impacts

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns: very negative ✓ very positive
Long-term returns: very negative ✓ very positive

Benefits compared with maintenance costs

Short-term returns: very negative ✓ very positive
Long-term returns: very negative ✓ very positive

Return of investment in the short term is slightly negative due to high investment costs.

CLIMATE CHANGE

Gradual climate change
Worsened pollination increase

not well at all ✓ very well

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- single cases/ experimental
- ✓ 1-10%
- 11-50%
- > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- ✓ 0-10%
- 11-50%
- 51-90%
- 91-100%

Has the Technology been modified recently to adapt to changing conditions?

- Yes
- ✓ No

To which changing conditions?

- climatic change/ extremes
- changing markets
- labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Saves time and effort (reducing labor cost and improving the effectiveness and productivity of the labor used)
- Reduces the quantity of pollen needed
- Reduces labor and pollen costs
- Reduces the risk of climbing accidents to laborers

Strengths: compiler's or other key resource person's view

- Reduces the risk low fruit set by pollinating during the peak period of flowering.
- Improves the quality of the fruits and consequently the profitability of the varieties intended for export.
- Improves the fruit setting percentage.
- Contributes to reducing harvesting losses.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- High initial costs → Improve the production of these devices (drones and extraction device).
- Limited number of date palm trees per farmer (the investment in the pollination extraction device is not profitable). → Creation of cooperatives so that the investment can be shared.
- No interest from the younger generation in date palm production. → Increase economic potential

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Resistance of farmers to adopting the new technology and to changing their practices (farmers are accustomed to the old technology of hand pollination). → Good dissemination practices to show the succes e.g. by farmers field days.
- Lack of specialized extension staff for the date palm.

REFERENCES

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Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_5917/

Linked SLM data
n.a.

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