“Paleez khoursheed”

Agro-Meteorology for Precision Farming

Persia (Iran) – Shiraz

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This project started in February 2005, to practice the application of agro-meteorological information in farm and orchard management. Adaptations to natural disasters, interaction with the environment, as well as improvement of agriculture knowledge bases, are the other goals of this project.

The project site is ten hectares of land located in Iran south western province of “Fars” at ELEV: 1722 m . LAT: 29° 36’ 00” N. LONG: 52° 30’ 00” E

Available meteorological data in Iran are based on the station locations of the “Iranian Meteorology Organization”. They were mainly meant and planned for aviation applications. Agricultural meteorology stations are limited in number and mainly located in government research centers.

Projects steps

1. Site preparation
2. Irrigation systems installation
3. Planting of trees
4. Weather station installation
5. Cover crop establishment & irrigation system installation
6. Agro-meteorology operational applications

Site preparation

Land preparation started with a site survey and marking the places for tree planting. Two meters wide and deep beds were made in north – south orientation with six meters space between them for the cover cropping. Several soil and water samples were also taken to know the right profile of the site. The beds were then refilled with a mixture of bio-fertilizer and compost added to the soil. Compost is an excellent bio-material with a high water absorption rate and water holding capacity.
Irrigation system installation

The site water source is a 60 meter deep well, with 17 liter per second output. A drip irrigation system was designed according to the site’s specification. The drippers are pressure regulated with 4 liter/hour output. Each tree has 4 drippers and there are 3200 trees in total. The whole system is connected via a “cyclone” and filter accessories to the water supply electrical pump, which provide 30 PSI pressure.

Planting of trees

Trees were selected for planting based on the collected temperature/humidity data in the previous years as well as experiments by the local farmers. Persian Walnut, Apple and Apricot were selected as the main trees in proper distances. Peach and Sour cherry were planted as the “filler” trees in 4 by 6 format.

Weather station installation

A weather station with acceptable sensor accuracies was selected to be installed in the newly established orchard. The station data are used to assist in management of the orchard. Irrigation scheduling, frost warning and coping with disease risks are the main applications of the meteorology station data. Irrigation management is done by measurement of ETc and direct soil moisture monitoring. The sample data of the first year of operation are shown in schedule 1.

Early spring frost warnings are based on dew point measurements at sunset of the previous day. The frost condition of 2008 spring was a good example of reliability of this method for frost warnings. The analytical explanation is shown in schedule 2.

Although the orchard is not yet bearing fruit, the first steps for coping with disease risks were taken. Codling moth is the main threat to the orchard. The related bio-fix and risk management phenological model are specially developed and will be fine tuned for the microclimate. A sample of the report is presented in schedule 3.

Archiving of the data will provide a good base for future planning of the microclimate of the whole area.

Cover crop establishment & irrigation system installation

In Iran, early spring frost is a main threat to the orchards. Related to the frost warning, which is based on the weather station digital temperature sensors, different methods of frost protection are tried. Cover cropping has environmental benefits to the orchard. Increase of bio-mass, soil erosion reduction, fertilizer efficiency improvement and water penetration are benefits of cover cropping. Moreover, the cover crop is also used to balance the temperature extremes in the orchard. Results of the first year of experiments were quite satisfactory. Schedule 4 has an overview of the orchard components.
Agro-meteorology application in operation

Several data sets and reports are created by the weather station software. These reports are daily, monthly and yearly. The formats of these reports are the NOAA format. Archiving the data will provide a knowledge base and will be used for future planning of the microclimate. The archive will support the decisions and development of solutions for better adaptation to the environment.
Irrigation Scheduling

The irrigation of the orchard was based on the monthly ETc values. In the prevailing microclimate we have approximately 30 mm of ETc. With the considering of a K factor of 0.8, based on the FAO documents, the irrigation was optimized with the ETc data (the blue line).

Two soil moisture sensors are installed, at 35 cm and 70 cm depth in the root zone of a sample tree. Irrigation start up was tuned to the soil moisture readings. The irrigation starts at 50cb and continues till the amount of the proper Etc (e.g. 30mm) of water is applied to the irrigation system. By this method the amount of irrigated water is determined with Etc and the irrigation start up is defined by the soil moisture readings. Precise water application will assist the farmers to tackle the drought conditions which are frequent in Iran.
Soil moisture readings from November 2007 to July 2008-07-15

Soil moisture sensors installation
**Frost warning and protection**

Frost warning was done with two methods. The first warning comes from the weather station based on the dew point values at sunset. This warning gives a probability of frost conditions in the morning following this sunset.

The dew point reading, in April 2 -2008, at 18:30 was -5 and the temperature reading on April 3 at 06:00 was also -5. The same phenomena happened in the next days of frost conditions. Irrigating the orchard overnight significantly reduced the frost damages. By considering the special microclimatic conditions in each site, a proper frost protection method can be proposed. For this site, some more effective frost protection methods are under investigation and development.
Another system was developed to monitor the temperature drop in the orchard. Frost warning alarm was made of a solar powered digital thermocouple and a siren. The thermocouple is monitoring the critical temperature and the trend of it in “decreasing” rate. As the alarm can be distributed via GSM modems or automatic dialers, it will be a useful help for the other farmers in the microclimate area too.
Degree days and chilling hours reports are other products of the weather station software. The degree day report will be used to track the pest and diseases in the orchard.

Sample of the degree day report.

Degree-Day Report 08/05/07

Codling moth 1st Gen

<table>
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<tr>
<th>Start Date</th>
<th>Base Temp</th>
<th>Upper Temp</th>
<th>Total for previous 7 days -</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/05/03</td>
<td></td>
<td></td>
<td>3.7</td>
</tr>
<tr>
<td>08/05/02</td>
<td></td>
<td></td>
<td>5.3</td>
</tr>
<tr>
<td>08/05/01</td>
<td></td>
<td></td>
<td>6.9</td>
</tr>
<tr>
<td>08/04/30</td>
<td></td>
<td></td>
<td>8.2</td>
</tr>
<tr>
<td>08/04/29</td>
<td></td>
<td></td>
<td>7.1</td>
</tr>
<tr>
<td>08/04/28</td>
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<td></td>
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<tr>
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<td>6.1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>175.9</td>
</tr>
</tbody>
</table>

Development Total: 260.0
Deg Days Left : 84.1
Days to Go    : 12.4

The chilling hours report will be used to monitor the required hours for proper fruit bearing of the trees. In case the required amount is not reached, a compensation can be made by application of proper supporting chemical agents.
Cover Crop

Alfalfa was selected as the Cover crop of the orchard.