

WUEMED training course on

Integrated approaches to improve drought tolerance in crops

**Department of Agroenvironmental Sciences and Technology, University of Bologna,
Viale Fanin 44, 40127 Bologna, Italy
June 5-10, 2006**

Instructors:

- Paolo Annichiarico (CRA - Istituto Sperimentale Colture Foraggere, Lodi, Italy)
- Marc Bacon (The Lancaster Environment Centre, University of Lancaster, UK)
- John Bennett (Molecular Biology, IRRI, Los Baños, Philippines)
- Marco Bittelli (Dept. of Agroenvironmental Sciences and Technology, University of Bologna, Italy)
- Abraham Blum (www.plantstress.com, Tel Aviv, Israel)
- Jordi Bort (Dept. of Plant Physiology, University of Barcelona, Spain)
- John Boyer (Dept. of Biochemistry & Biophysics, University of Delaware, Lewes, DE, USA)
- Bill Davies (The Lancaster Environment Centre, University of Lancaster, UK)
- Steve Quarrie (Faculty of Agriculture, University of Belgrade, Serbia and Montenegro, Yugoslavia)
- Silvio Salvi (Dept. of Agroenvironmental Sciences and Technology, University of Bologna, Italy)
- Pasquale Steduto (FAO, Rome, Italy)
- Francesca Ventura (Dept. of Agroenvironmental Sciences and Technology, University of Bologna, Italy)

Coordinator and local organizer:

- Roberto Tuberosa (Dept. of Agroenvironmental Sciences and Technology, University of Bologna, Italy)

Program

Day 1. Monday, June 5

14:45-15:00. Welcome to participants and course introduction. (Tuberosa)

15:00-15:30. Participants introduce themselves.

15:30-16:15. Doing good quality research. (Quarrie)

16:15-17:00. Doing good quality research. (Quarrie)

17:00-17:30. *Break*

17:30-18:15. Doing good quality research. (Quarrie)

18:15-19:00. Doing good quality research. (Quarrie)

19:00-19:30. General discussion.

20:00-21:00. *Dinner at hotel Express by Holiday Inn*

Day 2. Tuesday, June 6

08:30-09:15. Meteorological methods to determine evapotranspiration. (Ventura)

09:15-10:00. Evaporation from bare soil. (Ventura)

10:00-10:45. Actual evapotranspiration. (Ventura)

10:45-11:15. *Break*

11:15-12:00. Innovative methods to measure soil moisture. (Bittelli)

12:00-12:45. Water balance at field and land scale. (Bittelli)

12:45-13:15. General discussion.

13:15-14:45. *Lunch at hotel Express by Holiday Inn*

14:45-15:30. Crop water productivity: basics framework. (Steduto)

15:30-16:15. Crop water productivity: benchmarking. (Steduto)

16:15-17:00. Crop water productivity: modeling. (Steduto)

17:00-17:30. *Break*

17:30-18:15. Spectroradiometric approaches to investigate drought-stressed crops.

(Bort)

18:15-19:00. Spectroradiometric approaches to investigate drought-stressed crops. (Bort)

19:00-19:30. General discussion.

20:00-21:00. *Dinner at hotel Express by Holiday Inn*

Day 3. Wednesday, June 7

08:30-09:15. Water relations principles and theory. (Boyer)

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10:00-10:45. Osmotic adjustment. (Boyer)

10:45-11:15. *Break*

11:15-12:00. Methods for measuring the water status of the plant. (Boyer)

12:00-12:45. Methods for measuring the water status of the plant. (Boyer)

12:45-13:15. General discussion.

13:15-14:45. *Lunch at hotel Express by Holiday Inn*

14:45-15:30. Photosynthesis principles (C3 vs. C4). (Bacon)

15:30-16:15. Description of photosynthesis meters and SPAD meter. (Bacon)

16:15-17:00. Chlorophyll fluorescence. (Bacon)

17:00-17:30. *Break*

17:30-18:15. Abscisic acid and its role in adaptation of crops to drought. (Davies)

18:15-19:00. Root-to-shoot signaling under conditions of water deficit. (Davies)

19:00-19:30. General discussion.

20:00-21:00. *Dinner at hotel Express by Holiday Inn*

Day 4. Thursday, June 8

08:30-09:15. Stomatal conductance (definitions and methods). (Davies)

09:15-10:00. Carbon isotope discrimination ($^{12}\text{C}/^{13}\text{C}$). (Davies)

10:00-10:45. Measuring root traits. (Salvi)

10:45-11:15. *Break*

11:15-12:00. Stay green and remobilization. (Blum)

12:00-12:45. Reproductive fertility in drought-stressed maize. (Boyer)

12:45-13:15. General discussion.

13:15-14:45. *Lunch at hotel Express by Holiday Inn*

14:45-15:30. Designing a breeding program for water-limited conditions. (Blum)

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16:15-17:00. Designing a breeding program for water-limited conditions. (Blum)

17:00-17:30. *Break*

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18:15-19:00. Designing a breeding program for water-limited conditions. (Blum)

19:00-19:30. General discussion.

20:00-21:00. *Dinner at hotel Express by Holiday Inn*

Day 5. Friday, June 9

08:30-09:15. Description of molecular marker types. (Salvi)

09:15-10:00. Forward and reverse genetics approaches to clone target genes. (Salvi)

10:00-10:45. TILLING and EcoTILLING for drought-related genes. (Salvi)

10:45-11:15. *Break*

11:15-12:00. Theory of recombination and genetic maps. (Quarrie)

12:00-12:45. QTL analysis: theory and applications. (Quarrie)

12:45-13:15. General discussion.

13:15-14:45. *Lunch at hotel Express by Holiday Inn*

14:45-15:45. QTL analysis: working through a practical example. (Quarrie)

15:45-16:15. Marker-assisted selection for enhancing drought tolerance. (Quarrie)

16:15-17:00. Cloning drought-related QTLs. (Salvi)

17:00-17:30. *Break*

17:30-18:15. Genetic engineering for drought tolerance. (Salvi)

18:15-19:00. Genetic engineering for drought tolerance. (Salvi)

19:00-19:30. General discussion.

20:00-21:00. *Dinner at hotel Express by Holiday Inn*

Day 6. Saturday, June 10

08:30-09:15. Integration of gene and allele discovery with breeding for drought tolerance. (Bennett)

09:15-10:00. Microarrays and proteomics as tools to generate new hypotheses. (Bennett)

10:00-10:45. Microarrays: experimental design, statistical analysis and gene clustering. (Bennett)

10:45-11:15. *Break*

11:15-12:00. Reversible and irreversible responses of gene networks to drought stress. (Bennett)

12:00-12:45. Potential and limitations of proteomics and metabolomics in drought research. (Bennett)

12:45-13:15. General discussion.

13:15-14:45. *Lunch at hotel Express by Holiday Inn*

14:45-15:30. Breeding for drought-prone regions: case studies from Algeria and Italy. (Annichiarico)

15:30-16:15. Writing a drought-related manuscript of good-quality. (Quarrie)

16:15-17:00. Participants bring forward and discuss their own cases/problems. (Blum)

17:00-17:30. *Break*

17:30-18:45. General discussion. (Tuberosa)

18:45-19:00. Closing remarks. (Tuberosa)

20:00-22:00. *Dinner in a local pizzeria*