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# Micrometeorological measurements in orchard and above bare soil

Ágota JUHÁSZ
email: agota.juhasz@uni-corvinus.hu

Panna SEPSI László TŐKEI

Corvinus University of Budapest, Faculty of Horticultural Sciences
Department of Soil Science and Water Management

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**Abstract.** The observation and analysation of the variability and vertical profils of the meteorological parameters in orchard can be useful for choosing of suitable cultivation technologies. Investigation was carried out in Soroksár at the Experimental and Research Farm of the Corvinus University of Budapest. Monitoring was made in apple orchard and at the same time above bare soil surface. Temperature, relative humidity, global radiation and wind velocity were registrated at three different height in September 2010. We analysed the daily characters of the measured parameters at different canopy levels. The vertical gradients were compared at two different spots.

**Keywords:** temperature, microclimatology, wind speed, relative humidity, apple, bald surface

## 1 Introduction

The climate in the surface-plant-air level, the microclimate, is the issue of the interactions of the plant community with the radiant energy balance, air temperature, vapour pressure deficit and wind speed. Microclimatical measurements can usually provide some information about crop responses to weather, but even where this is not the case, they can form a vital part of

any study of plant behavior in the field. Knowledge of characteristic of the meteorological factors in intensive cultivation can help the plant protection and irrigation planning, choosing of pruning and treatment techniques. Lot of studies have been made of microclimatology of field crops [1, 2] and orchards [3, 4, 5, 6, 7] to investigate for example the water uptake of the trees [8] or to analyze the temperature of the tree's foliage [9]. The continuous monitoring of variability of meteorological parameters can help the decision about the applied technologies. By comparing of the meteorological elements measured parallel above bare soil surface and among fruit trees, can be understood the modifying effects of the plants. By inquiring of the vertical profiles it can be defined the main energy leader level.

## 2 Materials and Methods

The investigations were carried out in Soroksár (47°22'N,19°09E, 103 m above sea level) at the Experimental Farm of Corvinus University of Budapest in apple orchard in fourth leaf and parallel above bare soil surface. Detailed data of the apple orchard can be seen in the Table 1.

Table 1: Data of the investigated apple orchard

| | |
|---|---|
| Planting year | Spring 2007 |
| Species | MR-03, MR-09, MR-10,MR-11,MR-12,MR-13 |
| Controll species | Baujade, Freedom, Florina, Prima, Produkta, Remo |
| Rootstock | M9 |
| Spacing | 4×1 m |
| Row's orientation | N-S |
| Trained | to slender spindle |
| Support system | wire |
| Repeat | 2rows/species, 20trees/controll |
| Irrigation | dripping below crown level* |
| Plant protection | integrated, decreased |

*during the experiment no irrigation

Rowspaces are grass covered, grass were kept short. Foliage commences at about 0,5 m, with the maximum density at about 1,2 m. About 300 meter to the north there is a forest belt, the crest of which is approximately 10 m above the level of the orchard. On the western side there is a building within 300 meter. On the bare soil there were not any plants expect of some weeds, which were irrelevant for our measurements. The micrometeorological

measurements are made by using 4 meter height columns. Experimental period was 7-15 September 2010, on 8 sample days, on daytime. The two experimental fields are about 300 meters from each other. Temperature, relative humidity and wind speed were registrated parallel at three different heights (1m, 2m, 4m) in the two above mentioned fields. Global radiation was registrated on 4m level. Data were registrated in every minutes and averaged in every 5 minutes. None of the investigated areas got any treatment or irrigation during the experimental period.

## 3 Results and discussions

In this study we show the daily (7:00 am.-3:00 p.m.) charachteristic of the different meteorological elements at the three different floor on selected day. The daily maximum temperature reached the 25°C, but did not exceed it on 15th September. There was windy day, and sometimes cloudy, that is attested by the daily variability of the global radiation. To see the Fig.1. it can be said, that the temperature in orchard at 1 m exceeded the measured one above bare soil by 1-1,5°C in the monitored hours. In spite of the opened structure of the young plantation the densest foliage level has got heat holding role. On the other hand above bare soil the heat transport was unhampered by the wind. The temperature different decreased after midday, when the global radiation relapsed, because the clouding over. Highest global radiation value was 800 $Wm^{-2}$.

Wind velocity has got one of the most important roles in the forming of the microclimate, because it affects the exchanging processes in the air (water vapour, heat, substances transport). At flowering time it influences the pollens transport and the insect's flight. Wind speed measured at 2 m is lower in the orchard due to the blocking effect of the plantation (Fig. 2). Above the bare soil there was not any barrier against the free wind run. The highest wind speed value did not exceed 2 $ms^{-1}$ in the apple plantation, while above the bare soil 3,2 $ms^{-1}$ moderate wind was measured in the afternoon at 2 m. Too high humidity level at canopy can cause infection spreading, it flavours for the bacterias rising, at the same time it can result steady water balance in the orchard [9]. Despite of the moderate wind the relative humidity on both spots was between 60-87% measured at 4 m. In the morning according to the increasing temperature the relative humidity falls 10%. Above the foliage level the humidity values are lower than above bair soil (Fig. 3).

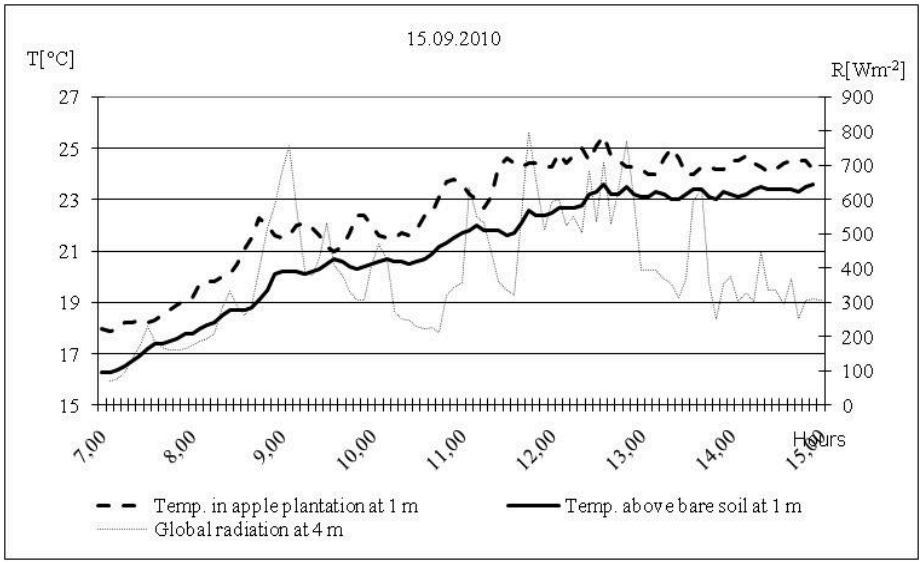


Figure 1: Daytime temperature at 1 m in orchard and above bare soil

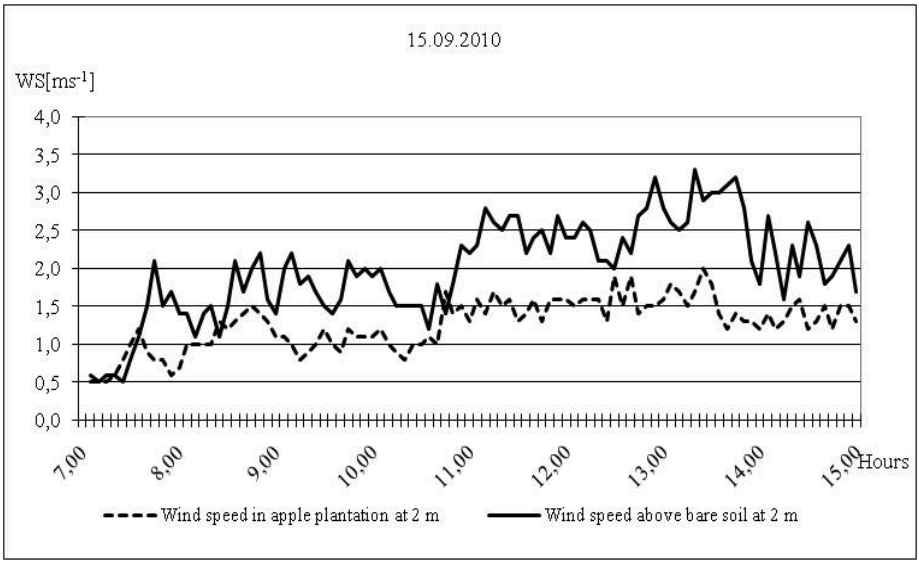


Figure 2: Daytime wind speed at 2 m in orchard and above bare soil

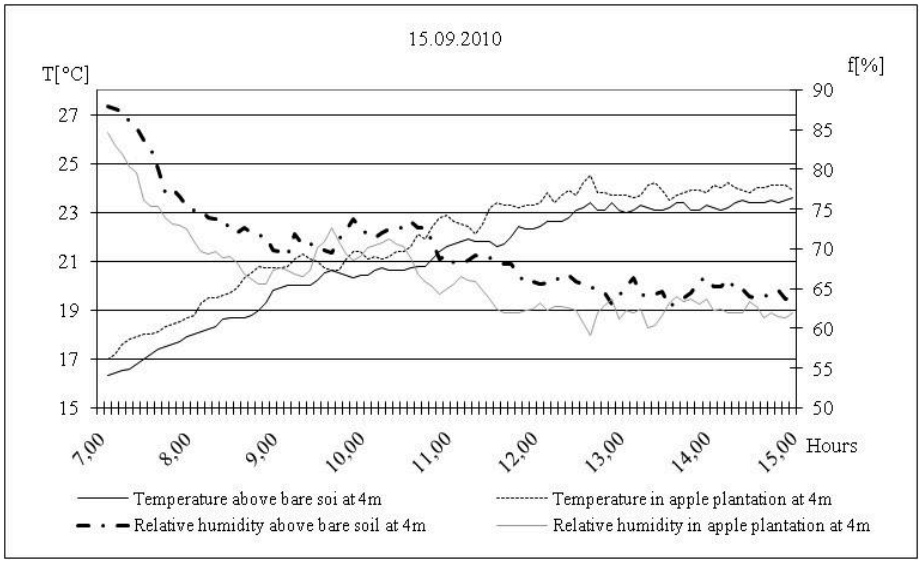


Figure 3: Daytime temperature and relative humidity at 4 m in orchard and above bare soil

Vertical profiles are shown by the Figures 4, 5, 6. By the vertical change of the temperature (Fig. 4) can be seen that the warmest level in the plantation is close to the soil, which is the active zone. Soil is heated by the radiance and than heat has being transported to the above levels. The foliages of the trees do not cover fully the rowspaces due to the opened canopy structure. Air temperature decreases exponentially by the height. The dropping is higher between 1 and 2 m than between 2 and 4 m. The relative humidity change according to the temperature explained of their relation (Fig 6.), the changing by the hight is logarithmic. To see the wind speed diagram (Fig 5.) on the selected day the wind velocity measured at 1 m above bare soil is almost the same as wind speed measured at 2 m in the orchard. The relation is logarithmic in the orchard and exponential above bare soil.

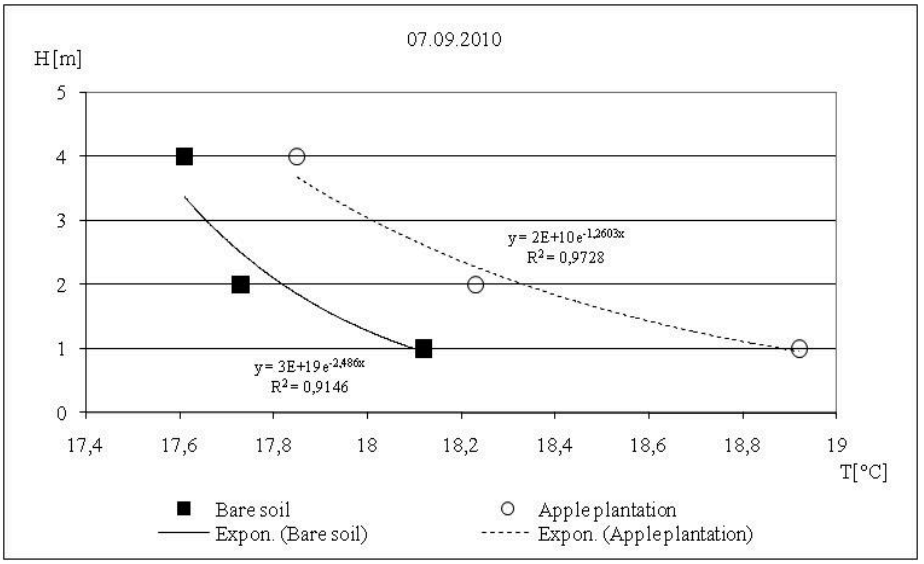


Figure 4: Vertical profil of temperature

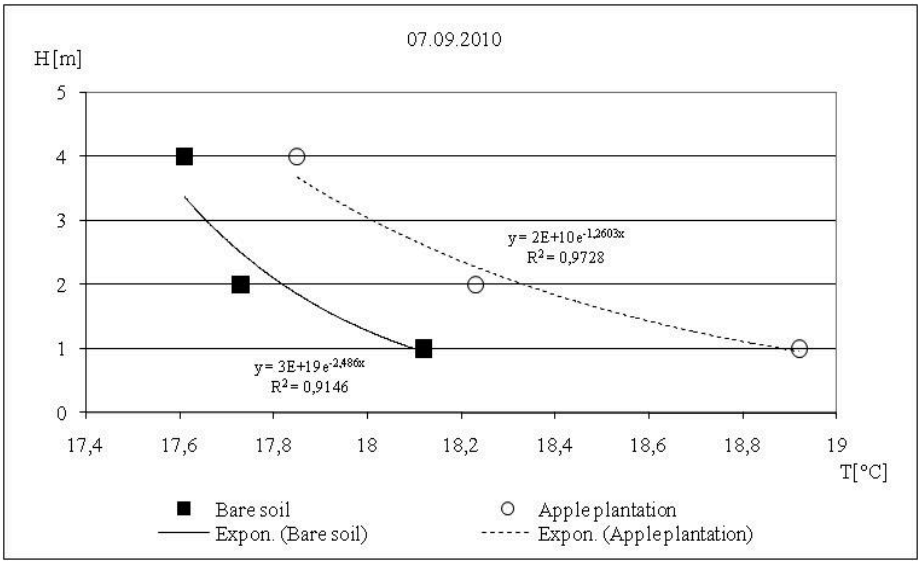


Figure 5: Vertical profil of wind speed

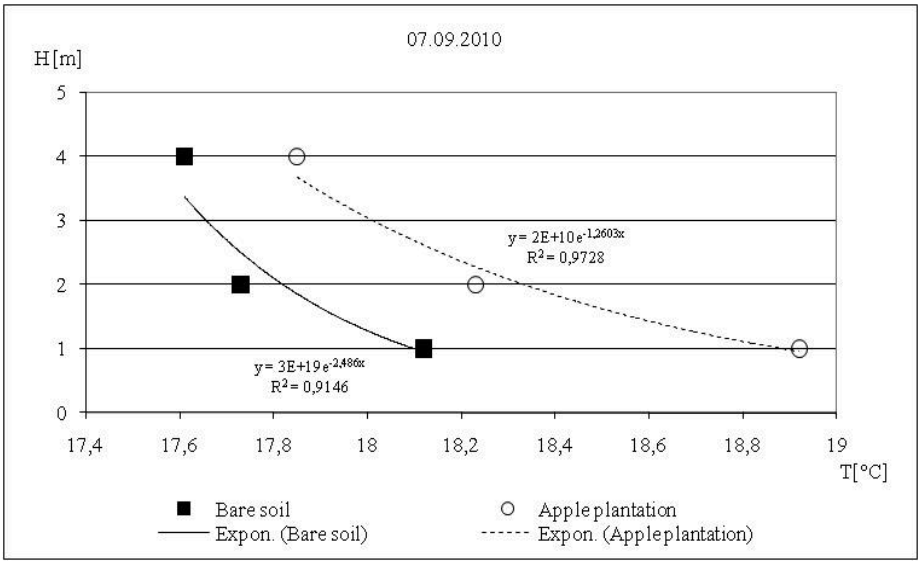


Figure 6: Vertical profil of relative humidity

# 4 Conclusion

The observation and analisation of the variability and vertical profiles of the meteorological parameters in orchard can be useful for choosing of suitable cultivation technologies. Knowledge of characteristic of the meteorological factors in intensive cultivation can help the plant protection and irrigation planning, choosing of pruning and treatment techniques. Our expedition measurements were carried out in Soroksár at the Experimental and Research Farm of the Corvinus University of Budapest. Investigation was carried out in young apple plantation with opened canopy structure and at the same time above bare soil surface. Temperature, relative humidity, global radiation and wind velocity were registrated at three different height (1m, 2m, 4m) in the above mentioned fields in September 2010. We have made daily (7:00 a.m.-03:00 p.m.) averages for illustrating the vertical profiles of the relative humidity, wind speed and air temperature on the two investigated areas. On both spots the surface was the prime energy - and stuff transport leader. The heating process started from the surface and than the upper layers pass each other the heat. On daytime the hottest zone was closed to the soil. It was also revealing for the orchard, because the canopy has been opened structured yet and the micrometeorolo-

gical transport processes were ruled by the surface. The relative humidity set also according to temperature (inversely proportional). Average wind speed was higher above the bare soil at 1m and 2m height than in the orchard. It increased also at 4m on both fields, but probably due to some local blow at 4m it could be stronger above the apple plantation.

## Acknowledgements

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