



### Precision orchard management system and erosion control

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## **Erosion risk**

- The probability of critical soil losses could be increased in orchards
  - where soil cultivation intensive or
  - runoff value higher on compacted surface when rain intensity is high.
- In practice it has less pay attention that parameters of plantation as follows:
  - The direction of rows
  - Tree density
  - Applied phytotechnology (interception)
  - Root density in rootzone
  - is very important in course of design of plantation



# Modeling of Erosion

- To estimate erosion risk experts widely use different erosion software
- Observation based : USLE, MUSLE, RUSLE (2), GeoWEPP
- Process-based: EPIC, CREAMS, SWAT
- Critical limitation of application is the validation of models
- EUROSEM (EUROpean Soil Erosion Model; MORGAN et al., 1997) – a storm event
- Applicability of every software is depending on the quality of input data
- The weak quality of the input data could not be improved by excellent theoretical model

## **Research goals**

- To give more accurate input GIS data sources for spatial decision (DEM)
- To determine the spatial distribution of physical and water management properties of soils
  - to reduce erosion risks in orchards
- To support a precision orchard management
  - mapping the acidity and CaCO<sub>3</sub> content of soil for precision liming,
  - mapping of humus content and microelement for precision soil nutrition management
- To supply more accurancy input data for prediction modeling process



### **Examination site**

• Zamárdi

Budapest

varorszád

The research field is an 338 hectare pear, peach, apricot, sweet and sour cherry orchard at Siófok, situated in the South Western part of Hungary

## **Catchments of Balaton**

- Lake Balaton, the largest lake of Central Europe, is situated in the western part of Hungary
- The soil erosion map of the Balaton catchment area (5.775 km<sup>2</sup> uses four grades of soil erosion:
- (1) non- or insignificantly eroded areas;
- (2) weakly eroded areas (less than 30% of the original surface layer is eroded);
- (3) moderately eroded areas (30-70% of the original surface layer is eroded);
- (4) strongly eroded areas (more than 70% of the original surface layer is eroded)



(National Atlas, 1989)

## **Catchments of Balaton**

- In the flatter southern sub-catchments of Balaton the approximate distribution among the stronglymoderately-weakly non-eroded categories is 10, 40, 40 and 10% respectively.
- In the valleys, local basins and low-lying areas, large portions are affected by sedimentation.







Suspended sediment, 11 september 2008

The main cause of erosion is the extreme storm event in Hungary (total prec. 650mm/y). The increasing frequency of the extreme event caused by climate change.













#### Impact of hailstorm 08/2011



## Field data aquisition of relief

- Relief is critical model input to modeling run-off and sedimentation process
- Digitizing of contour lines (time consuming)
- Photogrammetry (local error of microrelief)
- LIDAR or Ground laser (fix or mobile)
  - LiDAR (Light Detection and Ranging) capturing geometric data. The technology is used to generate terrain or canopy models

## Lidar (Light Detection and Ranging)







### **Ground Laser Surveying**

Accurancy 5mm within 10m; 532 nm; 50 000 pulse/s



#### Virtual recontruction of orchards



## **DEM of Orchards**



 At the examined site, the lowest point was 101 m above sea level, while the highest point was 162 m.

## Aspect

- North Eastern oriented 30 % This aspect is not advantageous from environmental protection point of view: increase in fungous diseases and pesticide amount
- South Western oriented 24,8% of the orchard
- On Southern slopes faster snowmelt and intensive rainfalls can cause greater amounts of erosion.



## Slope

- Homogeneous slope characteristics
- Considerable risk of rill erosion appears at the steepest slopes (12 % or more), which is only 1.18 % of the orchard



### Soil plasticity and humus content

 Soil plasticity value measured the highest at the sampling points with the highest altitude, it was possibly caused by high clay content caused - erosion process





- Humus content and soil plasticity has the same spatial distribution r=0.7, p<0.05</li>
- besides the possible increase of clayminerals, the increasing rate of colloidal humus content.

## Acidity and CaCO<sub>3</sub> content of soil

- pH and calcium carbonate show positive moderate correlation (r=0.689)
- Small part of the orchard has to be limed, -> most of the orchard has neutral pH, CaCO<sub>3</sub> supply is also appropriate which is advantageous for stone fruits.



## Conclusions

Row directions of the orchard also strengthen the effect of erosion

"WHAT IF" modeling results could be find the hot spots of erosion risk, where could be reduced the erosion risk:

- grassed row
- micro terraces
- soil cover (e.g.mulch, crop rotation)
- farm roads and tracks network with convex profile ,
- open side, mowable drains stormwater-drains are required
- The information layers developed by GIS increase the data quality of applied software (SWAT parameters) (crop growth model, leaf area, canopy structure, plant evaporation, harvesting index, Ca leaching, DEM, runoff)
- Basic maps of Precision DGPS drived Horticultural Technology

#### Thank you for your kind attention!



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