DESIRE
A global initiative to combat desertification

Mitigation of water erosion and its effects on soil indicators in the Mediterranean zone of central Chile

Soil compaction, intensive rainfall during winter and the use of conventional tillage in hilly soils has produced severe water erosion and soil degradation in Chile.

Our objectives are to develop and propose new strategies for soil conservation. We are evaluating soil and cultivation techniques, and developing land degradation indicators (biology, physic and chemistry) that can be used for the evaluation of local conservation programs for degraded zones.

The study area is located in the "secano interior" (35° 97S, 72° 24W) in the Mediterranean region of central Chile. This zone present a mean annual precipitation of 695mm with five months of drought. The soil is a Mollic Palexerals. The experiment started in autumn 2007. The size of each plot is 20*50m in a soil ≈20% slope. The tillage systems selected for an oat-wheat crop rotation are:

- No Tillage (Photo 1)
- No Tillage and subsoiling in the first season (2007)
- No Tillage and barrier hedges of phalaris
- No Tillage and contour ploughing (Photo 2)
- Conventional tillage (Photo 3)


Photo 1


Photo 2


Photo 3

Evaluations

Soil evaluation
- Biological: biomass, respiration and enzimes
- Physic: Texture, aggregate stability, soil water infiltration, bulk density, soil compaction, hydraulic conductivity.
- Chemical: pH, CTotal, Ntotal, macronutrients.

Plant evaluations
- Biomass, leaf area index, intercepted radiation, estomatal conductance.
- Water use efficiency with C^{13} in grain.

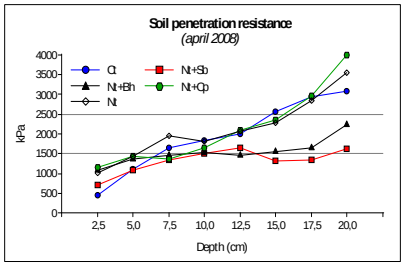
Monitoring
- Evaporation tray, rainfall, water soil infiltration (20, 40, 60, 80, 100 cm depths.)
- During each rainfall are measured runoff and sediments collected in tanks for each tillage system as shown in Photo 4.


Photo 4

Preliminary results on effects of tillage systems on yield, runoff, sediments and soil physical properties

Soil penetration resistance increased with depth; at 10-20cm a compaction layer was detected. The subsoiling treatment (Nt+Sb) was effective in reducing soil compaction in depth (Fig. 1). The benefit of the subsoiling was detected also in the average of oat-wheat yield of season 2007 and 2008, respectively (Fig. 2).

Fig. 1. Effect of tillage on soil compaction. Ct: conventional tillage, Nt:no tillage, Sb: subsoiling, Bh:barrier hedges, Cp:contour ploughing.



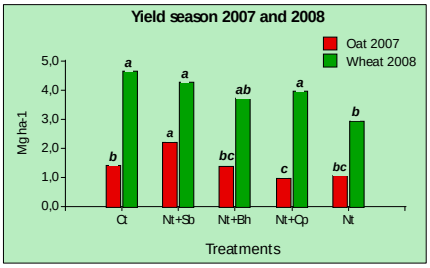
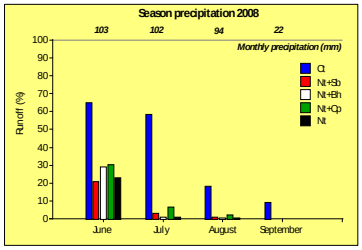


Fig. 2. Ct: conventional tillage, Nt:no tillage, Sb: subsoiling, Bh:barrier hedges, Cp:contour ploughing

Runoff and sediments collected in tanks during the second growing season (2008) were much greater in conventional tillage than in conservation systems (Fig 3). The deep variation of moisture in the root zone was greatly influenced by the increasing crop water extraction at later growth stages (Fig. 4). No tillage with contour ploughing and No tillage system significantly increased water retention than the other tillage systems.



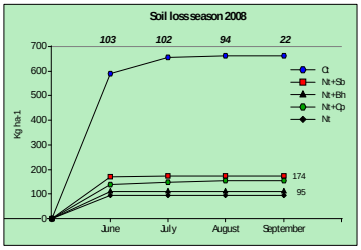


Fig. 3. Runoff (a) and soil loss (b) obtained in 2008. Ct: conventional tillage, Nt:no tillage, Sb: subsoiling, Bh:barrier hedges, Cp:contour ploughing

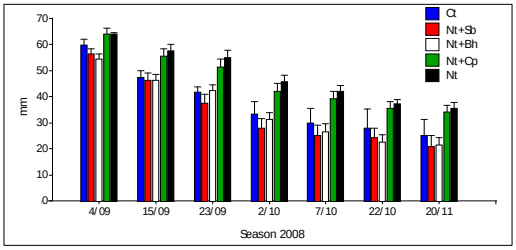


Fig. 4. Temporal variation of soil moisture content after rainfall of season 2008, soil moisture content is evaluated in the tillage system from 20-40cm depth.

The results indicate that part of the consequences of adopting conservation tillage practices are the reduction of runoff and soil losses and the increase in soil infiltrations and moisture in depth. No tillage and subsoiling (Nt+Sb) (Fig. 1 and 2) reduced significantly soil penetration resistance which is limiting crop growth and yield.

Project results and dissemination to stakeholders

- Every year (since 2007 to 2009) we received an average of 120 visitors to our experimental site among Chilean government, authorities, farmers, national and international students of several universities.

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