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Evaluation of different techniques for erosion control on different roadcuts in its first year of implantation

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Linear infrastructures, such as highways and railways, present a large environmental impact. Among this impact is the effect on landscape and the modification of the hydrological conditions of the area and an increase in erosive processes (Martin et al., 2011). The increase of erosive processes is specially significant in roadbanks, resulting in high maintenance costs as well as security risks for the use of the infrastructure if it is not properly controlled. Among roadbanks, roadcuts are specially challenging areas for erosion control and ecological restoration, due to their usually steep slope gradient and poor conditions for establishment of vegetation. There are several studies in Mediterranean conditions indicating how the combination of semiarid conditions with, sporadic, intense rainfall events makes a successful vegetation development and erosion control in motorway roadbanks extremely difficult (e.g. Andrés and Jorbat, 2000; Bochet and García-Fayos, 2004).

This communication presents the results of the first year evaluation (hydrological year 2012-2013) of five different erosion control strategies on six different locations under different materials on roadcuts of motorways or railways in Andalusia during 2012-2013 using natural rainfall and simulated rainfall. The six sites were located on roadcuts between 10 and 20 m long on slope steepness ranging from 40 to 90%, in motorways and railways spread over different materials in Andalusia. Site 1, Huelva was located on consolidated sand material, sites 2, Osuna I, site 3, Osuna II and site 4, Mancha Real, on marls. Sites 5, Guadix, and 6, Fiñana, were located on phyllites, in comparison a harder material.

At each site 12 plots (10 m long and 2 m wide) were installed using metal sheets buried 10 cm within the soil with their longest side in the direction of the roadcut maximum slope. Six different treatments were evaluated at each site, two replications each. These treatments were: 1- A control with bare soil, 2-Hydroseeding with a mix of grasses and legumes adapted for Mediterranean conditions, 3- Plantation of Mediterranean shrub species at a 1 plant m-2 density, 4- organic erosion control mat (made of coconut or esparto grass, Stipa tenacissima, fiber) plus hydroseeding. 5- synthetic net mat for erosion control plus hydroseeding. 6- synthetic 3D-net mat for erosion control plus hydroseeding. All the plots had an outlet with routed runoff and sediment to a sediment trap located at the base of the roadcut. The treatments were installed during early fall 2012. Since that date sediments were regularly collected and the evolution of vegetation was monitored. In four of the sites (the other two were vandalized) rainfall simulation experiments using a mesoplot rainfall simulator based on Sumner et al. (1996) were performed in summer 2013.

The evaluation of vegetation cover and number of plants made in May, at the end of the rainy season, indicated how the hydroseeding treatments (the three mats plus the hydroseeding without mat) presented a relatively high ground cover (between 25 to 35 %) but with a relatively large standard deviation (around 25%). This variability was clearly related to site features (slope, parent material, and climate conditions for the year) with no clear differences among treatments. The plantation and control treatments presented a much lower ground cover, as expected, ranging, in average, from 5 to 10%. There was a large variability in the pattern of plant distribution within the plots, with site to site differences. So in sites 1, 2 and 5 there was a trend towards increased plant density in the lower area of the plot while in site 3 this trend was reversed and in sites 4 and 6 there was not a clear pattern.

Sediment lost during the rainfall period, which ranged from 294 to 778 mm from October 1st to May 31st,

presented a large variability among sites with maximum values ranging from 2.5 g m-2 (Fiñana) to 1800 (Mancha real). In all the sites there was a clear difference between the mat treatments which presented very low erosion rates, with an average for all sites and the three mat treatments around 4 g m-2, compared to the non-matted treatments which presented much higher erosion rates, average of all sites and three non-matted treatments around 432 g m-2.. There were no significant differences among the different treatments within these two large groups, albeit in some sites a slight reduction in the average erosion rates was observed in the hydroseeding treatment compared to the control and plantation treatments.

Simulation experiments performed during summer indicated no runoff generation in the Fiñana site (the one with the lowest sediment generated during the rainy season with an average of 0.7 g m-2), while in the Mancha Real, Huelva and Guadix sites, the results were qualitatively comparable with those observed during the rainfall period with natural rain. The matted treatments presented average sediment losses of 16 g m-2 (for rainfall simulations lasting 35 minutes and an rainfall intensity of 34 mm h-1), while the non-matted treatments averaged sediment losses of 2297 g m-2. The range of maximum sediment losses among sites varied this time in relation to the natural rainfall results with maximum values measured in the Huelva and Guadix sites.
The results indicates that effective erosion control in these roadcuts under mostly sedimentary material and Mediterranean conditions was achieved only using erosion mats plus hydroseeding. The protection was achieved mostly by the protective effect of the erosion mats, as indicated by The rainfall simulation experiments highlighted the protective effect of the erosion mats when most of the vegetation was already dead., In addition, there were no apparent with not clear differences during this first year among the different matting materials. Hydroseeding and plantation were apparently successful during the first season, with a significant ground cover and plant density.; However the success of vegetation establishment can only be evaluated in the coming years, since previous experiences (e.g. Bochet and García-Fayos, 2004) indicates the difficulty of successful vegetation recovery on these conditions. Rainfall simulations have proven to be a useful tool to evaluate erosion risk and performance of the different treatments in a shorter time.

References

Andrés. P., Jorba, M. 2000. Mitigation strategies in some motorways embankments (Catalonia, Spain). Restoration Ecology, 8: 268-275.
Bochet, E., García-Fayos, P. 2004. Factors Controlling Vegetation Establishment and Water Erosion on Motorway Slopes in Valencia, Spain. Restoration Ecology, 12: 166-174.
Martín, J.F., De Alba, S., Barbero, F. 2011. Consideraciones geomorfológicas e hidrológicas. En: Restauración Ecológica de áreas afectadas por infraestructuras de transporte. Fundación Biodiversidad. p. 43-75.
Sumner, H.R; Wauchope, R.D.; Truman, C.C.; Dowler, C.C.; Hook, J.E. 1996. Rainfall simulator and plot design for mesoplot runoff studies. Trans. ASAE 39:125-130.