PEER review

Research Briefs

Improving Soil Conditions and Cover Tends to Reduce Erosion

The purpose of this column is to provide knowledge to readers of Environmental Connection *by summarizing the latest results of relevant research. The sources are mostly refereed science and engineering journals, which means the information has been reviewed by other scientists and engineers before it was published.*

This process doesn't ensure that the data reported is entirely accurate or reflects typical conditions, but it gives us some confidence that the study was performed and the analysis stated in a reasonable manner. It always is up to the reader to interpret the results relative to his or her experience. Papers from conference proceedings, which usually are not peer reviewed, may occasionally be included if the results are deemed reasonable and timely.

This review cannot cover all papers published in all journals, but hopefully the ones we include will be helpful to the reader. For more details, the reader is encouraged to look up the referenced articles.

By Rich McLaughlin, PhD

Wood Strands as Effective as Straw?

Wood strands, one of the newer erosion control products, have been the subject of several studies recently. One study was conducted under laboratory conditions using a flume and artificial rainfall, and found that the strands worked as well as straw in reducing erosion by 98 percent[3]. More recently, this was confirmed in two different soils, although the wood strands had some advantage in a finer textured-soil[10].

This has been updated with a field study comparing strands to straw and shredded wood in two Idaho forest areas similar to post-fire conditions[4]. The wood strands applied at 48 percent cover had about the same reduction in erosion as the straw applied at 67 percent cover—about 80 percent compared to bare soil. The shredded wood, applied at 50 percent cover, only reduced erosion by 41 percent, but that was still a significant reduction. The vegetation coverage, however, was best on the bare soil plots, although it had a maximum of only 7 percent. The main difference in the ground cover treatments was that the wood strands stayed intact during the year-long investigation, while the straw and shredded wood lost 29 – 36 percent of their ground coverage. This may be important in dry areas where vegetation establishment takes many years.

Using Topsoil and Compost to Repair Disturbed Areas

Establishment of vegetation in disturbed areas in semi-arid Mediterranean climates can be a challenge. One approach that was found to be successful was to spread stockpiled topsoil from a nearby area[9]. This material not only improved soil properties, but it already contained a seed bank of local plants that already were adapted to the area. The additional treatment of hydroseeding with either local or "standard" seed mixes improved vegetation cover further, but in the end the local plants dominated. The investigators suggested that the amendments in the hydroseeding mix (wood fiber, fertilizer, humic acid) enhanced the topsoil treatment. It is not clear that the "local" plants were necessarily "native," so it is important not to interpret that term. Kudzu is local in the Southeast United States, but few would consider it native. The depth of topsoil was not provided in the article, only that it had been stockpiled for less than three months and that it came from a nearby vineyard.

In another study, topsoil was added to exposed subsoil in Iowa, USA, and both topsoiled and subsoil areas were farmed for 28 years prior to testing for changes in soil properties[5]. This might be similar to the difference between trying to grow cover vegetation on unamended construction site soil, which is usually a subsoil, and adding topsoil back once grading is completed. Soil organic matter was much less and bulk density much more in the subsoil areas compared to those that were topsoiled. The researchers even found that there was a migration of organic matter downward in the profile with the topsoiling, which indicates some improvement in the subsoil over time.

Adding compost is another approach to "fixing" construction site soils, and this was the focus of another paper from Iowa[8]. Adding compost, either to the surface or incorporated, improved soil moisture retention and plant species diversity on a road embankment. The incorporation treatment had a slight advantage over surface applications. Similarly, Faucette et al.[2] found that composts improved early (three months) vegetation establishment compared to hydroseeding alone (which included just seed, fertilizer, and lime), although after one year the hydroseeding resulted in more vegetation. The difference was that the hydroseeded areas had mostly weeds instead of the Bermuda grass that was planted. One point of caution was that the loss of added nutrients in the hydroseeding application was much greater than the composted areas, primarily because the fertilizer is added to the soil surface with the mulch, seed, and lime.

Maximizing Performance of Ground Covers

Another study in the semi-arid region of Mediterranean Spain examined the relative capability of grass, herbs, and shrubs to withstand concentrated flow[1]. For 26 different species, actual plants were excavated to determine root density and diameter as a measure of resistance to erosion. The relationship between root properties and erosion resistance was established for several species under controlled conditions. Several grasses, such as spiny rush (Juncus acutus), and shrubs, such as saltcedar (Tamarix canariensis), were top performers although these can be invasive depending on the setting. Root densities of up to 20 kg m^{-3} and 120 km m^{-3} were found for grasses and shrubs, respectively.

The benefits of using polyacrylamide (PAM) as an additive to ground covers were recently published[7]. Polyacrylamide at 19 kg ha^{-1} in combination with straw, straw blankets and either wood fiber or bonded fiber matrix hydromulch were tested. One clear result was that PAM alone on bare soil can significantly reduce runoff turbidity, but any ground cover, even without PAM, is much better. In general, PAM reduced runoff turbidity, but the effect was not always statistically significant, especially for the hydromulches. There was better vegetative cover with PAM treatment overall. The take-home message was that mulches work well and PAM may improve them further. Previous work by this group had suggested that lower rates of PAM (<12 kg ha^{-1}) were not helpful on steep slopes[6].

Should PAM be applied before or after putting out the straw? This also was examined and it was determined to be a toss-up for the most part, but applying it onto the straw did have a slight advantage.

Summary

In summary, there have been a number of studies demonstrating that efforts to improve soil conditions and cover tend to reduce erosion and increase plant establishment. The most effective methods vary from one area to another, and there are many variations on soil improvements. In many cases we are still trying to grow plants in very poor soils due to the reluctance to spend the time and money to create a better environment for successful plant establishment, but the research presented in this column suggests that this may not be the most effective strategy.

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