BPG NOTE 13

Best Practice Guidance for Land Regeneration

COMPLETE CULTIVATION

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Introduction

Compaction remains the key physical feature preventing the sustainable establishment of greenspace on restored sites. Compacted soil inhibits root development and affects the soil moisture and oxygen status, often resulting in drought conditions during dry spells and waterlogging in wetter periods. These factors have a detrimental effect on vegetation establishment, reducing the ability of the vegetation to exploit water and nutrient resources in the soil and, in the case of trees, increasing the risk of windthrow. For more information on compaction and the requirement for cultivation see BPG Note 3 and BPG Note 5.

Current guidelines for tree planting recommend an average soil depth of at least 1.5 m for restored sites, although this may be deeper depending on initial soil conditions and climatic location within the UK. Soil placement on restored sites should follow the loose tipping method, which is detailed in BPG Note 4: *Loose tipping*. However, there is a legacy of brownfield land within the UK, where traditional soil placement techniques using dozers followed by industrial ripping are still commonly practised. Incorrect application of these techniques can often result in severe levels of deep compaction. Where compaction has occurred following soil reinstatement, it is necessary to cultivate the soil prior to any greenspace establishment. In such situations the best practice method for soil loosening is complete (or total) cultivation.

Figure 1 An excavator removing soil.

Advantages of complete cultivation

Complete cultivation uses an excavator to progressively remove and replace the soil without trafficking over the cultivated soil surface (Figure 1). Although this method is relatively expensive compared with alternative methods of cultivation, it has significant advantages that are particularly relevant to greenspace establishment:

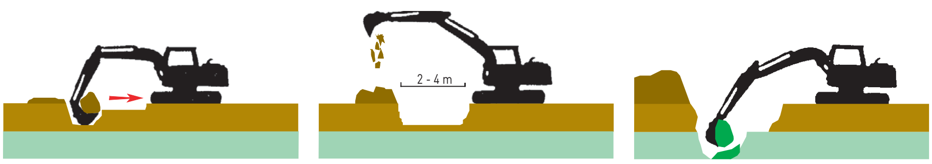
- **Achieving target loosening depth.** The depth of soil loosening achieved with complete cultivation can be adapted to the planned vegetation. The recommendation for a soil depth of at least 1.5 m can be easily achieved and it is also possible to cultivate to greater depths where the site conditions dictate this to be appropriate. Alternative methods, such as deep ripping, are often unable to achieve soil loosening to depths greater than 0.6 m (Moffat and Boswell, 1997; Sinnett *et al.*, 2006), which is insufficient for deep-rooting vegetation such as trees.
- **Loosening uniformity.** Complete cultivation involves removing soil material from the area being worked and replacing the broken-down material (Figure 2). This method therefore produces uniform soil loosening that allows root development throughout the entire profile. In contrast, cultivation using ripping machinery often results in compacted clods between tine channels that can restrict root development, particularly if vegetation is planted directly above these areas.
- **Incorporation of soil amendments.** Complete cultivation can also be used where the incorporation of soil amendments is also required to improve the soil resource available on a site, as the cultivation and incorporation can be carried out simultaneously. Further details can be found in BPG Note 6: *Application of sewage sludges and composts.*

- **Sustained loosening.** The level of soil loosening that is achieved using complete cultivation is often sustained over subsequent years. In contrast, although ripping technologies are capable of providing a loosened soil profile, this is often subject to recompaction within one year of cultivation (Moffat and Boswell, 1997). This is particularly important in the case of trees, which root relatively slowly compared with other vegetation, and therefore can not develop a sufficient root structure before recompaction takes place.

All of these factors mean that the vegetation performance is often significantly improved using complete cultivation rather than ripping technologies. Moffat and Bending (2000) reported significant increases in survival of common alder and Japanese larch of between 10% and 20% when complete cultivation was compared with industrial ripping. After only three growing seasons they also found increases of 50% and 100% in the height of Italian alder and Japanese larch grown on restored soil treated with complete cultivation, compared with industrial rip. This is important from both a forestry and community greenspace development perspective. Increased survival and growth has obvious economic benefits, but will also accelerate the aesthetic improvements that result from greenspace establishment on restored sites.

Methods of complete cultivation

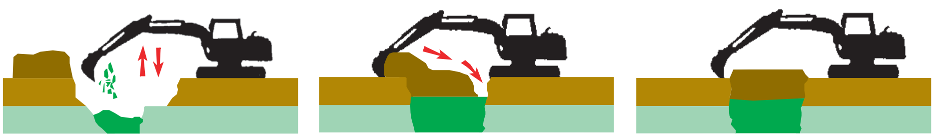
A number of methods of complete cultivation are available, but the 'Profile Strip Method' has been found to be the most cost-effective and versatile when compared with others tested by Forest Research's Technical Development Branch (Reynolds, 1999). This method is shown in detail in Figure 2. The costs of this method will vary depending on the excavator used, the width of working and the soil material present on the site. Reynolds (1999) found that when this method was employed on a restored colliery, using a Caterpillar 320B (20 tonnes) and a working width of 8 m, the cost was approximately £500 per ha. This does not include the costs of machine transport and overheads associated with site assessment, supervision, etc.



1. Strip top layer. This may be accomplished in two or more passes 15 to 25 cm in thickness depending on friability. Cultivate in an arc to a final working width of between 7 to 8 metres.

2. Place the spoil in front of the void. Drop material from height to further assist the break up. Large lumps may require further breaking up at this stage. Repeat (1) until final working width of between 2 to 4 metres is accomplished.

3. On completion of working width the next stage can be started. Cultivate second layer to required depth. If friable this may be broken up by simply lifting and raking the spoil. Long teeth on the bucket can assist in the breaking up process.



4. If material is not friable, scrape in 15 to 25 cm layers; lift and drop to assist break up. Spoil is replaced directly into the bottom of the void. Cultivate entire working length lifting spoil and dropping to increase the cultivating effect.

5. Move machine forward and pull top layer into void. Level off and move back 3 to 4 metres. Repeat (1) through (5) until strip complete.

6. The finished profile.

Figure 2 Profile strip method (from Reynolds, 1999).

References

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