CULTIVATION ALONG SOIL CONTOURS AND ACROSS SLOPES

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Description
By ploughing, cultivating and drilling perpendicular to slopes and along contours, the risk of surface flow developing is reduced.

Rationale, mechanism of action
Contour cultivation reduces soil surface erosion as well as any risk of P mobilisation on the soil surface. In addition, increased water storage can occur in the soil furrows, reducing the opportunities for surface run-off to form. Cultivation across the slope reduces the risk of surface sheet and rill flow developing. In contrast, furrows orientated down slope tend to collect water and develop concentrated surface flow paths. This risk is reduced if the soil furrow ridges are aligned across the slope. Soils cultivated across the slope also hold more water in surface depressions before surface flow is initiated. Perpendicular to the slope of the field, contour ploughing and construction of terraces are methods applied in a number of countries where sloping fields are a commonly occurring feature. The ponding that can occur allows greater time for water infiltration. However, after reaching sufficient proportions a breakthrough may occur down slope.

Applicability
Only soils prone to erosion (clay and silty soils) are relevant for contour cultivation, which is mainly applicable to cultivated soils on sloping land. It is important to take this action into account for fields where erosion causes P losses, not just where soil erosion occurs, since erosion is not necessarily associated with P losses [1]. In fact, large P losses can occur even during periods with low rainfall intensity and small erosion losses. Contour cultivation is more time-consuming than conventional field operations. It should not be carried out across very steep slopes due to the risk of the machinery overturning. For steeply sloping fields with complex slope patterns, attempts at cultivation across the slope often lead to channelling of run-off water, particularly in tramlines or tyre-lines, which can cause severe erosion. For furrow crops, such as potatoes and sugar beet, harvesters only work effectively up and down the slope. It may be more effective to stop growing such crops on steeply sloping areas. It is important for contour cultivation to be aware of erosion in depressions and take care of the surface water in these depressions [2]. Therefore, grass covered waterways are often needed in combination with contour ploughing.

Effectiveness, including certainty
Nitrogen: Contour cultivation has no effect on nitrate leaching.
Phosphorus: Contour cultivation had a four year averaged reduced erosion by 40% on an area with 13% slope [2]. On a clay soil in the UK, contour cultivation reduced total P losses by 17.7 g from ploughed land and by 7.5 g from land under minimum tillage [3]. Using the ‘all-arable scenario’, contour cultivation was estimated to reduce P losses from clay loam soils in the UK by 25% [4].

Time frame
The long-term effects should be evaluated, since the annual effects vary from year to year depending on the weather conditions.

Environmental side-effects
Contour cultivation may not be successful due to variability in slope form and channelling effects [5,6,7].

Relevance, potential for targeting
The measure may be hard to encourage but has the potential for targeting on sloping land.

Costs: Investment, labour
Contour cultivation often involves extra labour and fuel costs.

References

[1] Sharpley, A.N., Chapra, S.C., Wedepohl, R., Sims, J.T., Daniel, T.C. & Reddy, K.R. 1994. Managing agricultural phosphorus for protection of surface waters: Issues and options. J. Environ. Qual. 23, 437-451.

[2] Lundekvam, 1997. Studies on erosion, runoff, P-loss and N-loss in lysimeter and field studies. Jordforsk report no 6/97; pp 69.

[3] Quinton, J., Stevens, C., Deasy, C., Silgram, M., Jackson, B. & Bailey, A. 2007. Mitigation options for phosphorus and sediment. In Heckrath, G., Rubaek, G. & Kronvang, B. (eds). Tillage Treatments and the Use of Vegetative Barriers. International Phosphorus Workshop 3-7 September 2007, Silkeborg, Denmark, pp 295-302.

[4] Cuttle, S., Macleod, C., Chadwick, D., Scholefield, D., Haygarth, P., Newell-Price, P., Harris, D., Shepherd, M., Chambers, B. & Humphrey, R. (2007) An Inventory of Methods to Control Diffuse Water Pollution from Agriculture (DWPA) USER MANUAL. Defra report, project ES0203, 115 pp. p. 17 http://www.cost869.alterra.nl/UK_Manual.pdf

[5] Johnston, H.P., Baker, J.L., Shrader, W.D., Laflen, J.M. 1979. Tillage system effects on sediment and nutrient in runoff from small watersheds. Trans. ASAE 22, 1110-1114.

[6] Schønning, P., Sibbesen, E., Hansen, A.C., Hasholt, B., Heidman, T., Madsen, M.B., Nielsen. J.D., 1995. Surface Runoff, Erosion and Loss of Phosphorus at Two Agricultural Soils in Denmark – Plot Studies 1989-1992. SP Report No 14, Danish Institute of Plant and Soil Science, Foulum, Denmark, 196 pp.

[7] Quinton, J.N. & Catt, J.A. 2004. The effects of minimum tillage and contour cultivation on surface runoff, soil loss and crop yield in the long-term Woburn erosion reference experiment on sandy soil at Woburn, England. Soil Use Manage. 20, 343-349.