European Commission

Natural Water Retention Measures

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Individual NWRM

Mulching

Environment

This report was prepared by the NWRM project, led by Office International de l'Eau (OIEau), in consortium with Actéon Environment (France), AMEC Foster Wheeler (United Kingdom), BEF (Baltic States), ENVECO (Sweden), IACO (Cyprus/Greece), IMDEA Water (Spain), REC (Hungary/Central & Eastern Europe), REKK inc. (Hungary), SLU (Sweden) and SRUC (UK) under contract 07.0330/2013/659147/SER/ENV.C1 for the Directorate-General for Environment of the European Commission. The information and views set out in this report represent NWRM project's views on the subject matter and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this report. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

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I. NWRM Description

A mulch is a layer of material applied to the surface of an area of soil. Its purpose is any or all of the following:

- to conserve moisture
- to improve the fertility and health of the soil
- to reduce weed growth
- to enhance the visual appeal of the area

Mulching as NWRM is using organic material (e.g. bark, wood chips, grape pulp, shell nuts, green waste, leftover crops, compost, manure, straw, dry grass, leaves etc.) to cover the surface of the soil. It may be applied to bare soil, or around existing plants. Mulches of manure or compost will be incorporated naturally into the soil by the activity of worms and other organisms. The process is used both in commercial crop production and in gardening, and when applied correctly can dramatically improve the capacity of soil to store water

II. Illustration

No illustration

III. Geographic Applicability

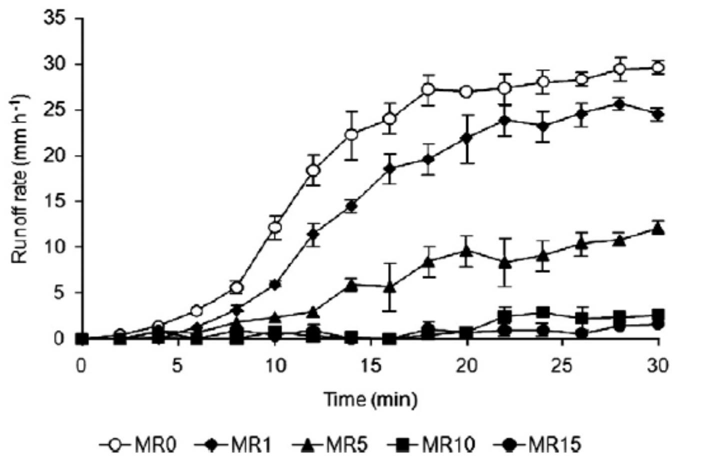
Land Use	Applicability	Evidence
Artificial Surfaces	No	
Agricultural Areas	Yes	Mulching is an agricultural practice that can be applied to agricultural areas. Particularly, it is used for market gardening in fields (potatoes, melon...), under shelter (lettuce, tomato..) and in greenhouses (cucumber, tomatoes...)
Forests and Semi-Natural Areas	No	
Wetlands	No	

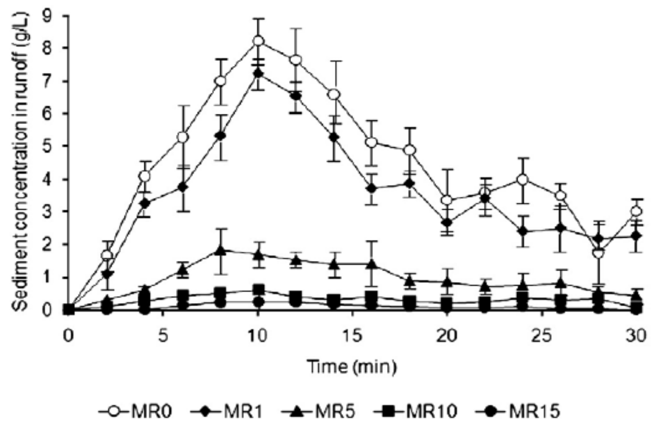
Region	Applicability	Evidence
Western Europe	Yes	
Mediterranean	Yes	
Baltic Sea	Yes	
Eastern Europe and Danube	Yes	

IV. Scale

	0-0.1km^2	0.1-1.0km^2	1-10km^2	10-100km^2	100-1000km^2	>1000km^2
Upstream Drainage Area/Catchment Area	✓	✓				
Evidence	Mulching is implemented at field scale. In terms of drainage, the concerned area is the field itself. In Europe, field size can vary a lot across states and agriculture types in each state; in France (Latruffe, 2013) and Denmark (Levin, 2006) for instance, mean field size is a bit more than 4ha.					

V. Biophysical Impacts

Biophysical Impacts		Rating	Evidence
Slowing & Storing Runoff	Store Runoff	None	
	Slow Runoff	High	Jordan et al (2010) showed that in semi-arid conditions in Spain, mulching could slow runoff: in their experiments, surface runoff and runoff at the plot outlet was delayed as mulching rate increased:  ig. 8. Variation of mean runoff rates under different mulching rates. MR0 = control; ИR1 = 1 Mg ha^{-1} year^{-1}, MR5 = 5 Mg ha^{-1} year^{-1}; MR10 = 10 Mg ha^{-1} year^{-1}; ИR15 = 15 Mg ha^{-1} year^{-1}. *N* = 5 for each mulching rate treatment. Vertical bars ıdicate ± standard deviation.
	Store River Water	None	
	Slow River Water	None	

Reducing Runoff	Increase Evapotranspiration	None	
	Increase Infiltration and/or groundwater recharge	Low	According to Jordan et al (2010), mulching contributes to a reduction in runoff generation and soil losses compared to bare soil, and negligible runoff flow or sediment yield. Organic residues in the soil surface indeed increase the hydraulic roughness and interception, which favors a higher infiltration of rain water.
	Increase soil water retention	Medium	Jordan et al (2010) showed that soil water retention can increase compared to bare soil and depending on mulching rates. In their experiment (semi-arid conditions, Spain), differences were observed for water content at 1500, 33 and 0kPa between low and high mulching rates, but not between control plots and low or moderate mulching rates.
Reducing Pollution	Reduce pollutant sources	None	
	Intercept pollution pathways	None	
Soil Conservation	Reduce erosion and/or sediment delivery	Medium	The experiment led by Jordan et al showed that the erosive response of soil under simulation quickly decreases with time after prolonged storms (30 min) due to the exhaustion of available erodible particles.  **Fig. 9.** Variation of mean soil losses under different mulching rates. MR0 = control; MR1 = 1 Mg ha^{-1} year^{-1}, MR5 = 5 Mg ha^{-1} year^{-1}; MR10 = 10 Mg ha^{-1} year^{-1}; MR15 = 15 Mg ha^{-1} year^{-1}. N = 5 for each mulching rate treatment. Vertical bars indicate ± standard deviation.
	Improve soils	None	

Creating Habitat	Create aquatic habitat	None	
	Create riparian habitat	None	
	Create terrestrial habitat	None	
Climate Alteration	Enhance precipitation	None	
	Reduce peak temperature	None	
	Absorb and/or retain CO_2	None	

VI. Ecosystem Services Benefits

Ecosystem Services		Rating	Evidence
Provisioning	Food production	None	
	Water Storage	None	
	Fish stocks and recruiting	None	
	Natural biomass production	None	
Regulatory and Maintenance	Biodiversity preservation	None	
	Climate change adaptation and mitigation	None	
	Groundwater / aquifer recharge	Medium	By increasing water infiltration (see above), mulching contributes to increase groundwater recharge.
	Flood risk reduction	Medium	By reducing and slowing down runoff (see above), mulching contributes to decrease flood risk reduction.
	Erosion / sediment control	Low	By reducing erosion (see above), mulching contributes to decrease erosion and enhance sediment control.
	Filtration of pollutants	None	

Cultural	Recreational opportunities	None	
	Aesthetic / cultural value	None	
Abiotic	Navigation	None	
	Geological resources	None	
	Energy production	None	

VII. Policy Objectives

Policy Objective		Rating	Evidence
Water Framework Directive			
Achieve Good Surface Water Status	Improving status of biological quality elements	None	
	Improving status of physico-chemical quality elements	None	
	Improving status of hydromorphological quality elements	None	
	Improving chemical status and priority substances	None	
Achieve Good GW Status	Improved quantitative status	Low	As said above, mulching contributes to increase water infiltration in the soil. Thus it helps improving groundwater quantitative status.
	Improved chemical status	None	
Prevent Deterioration	Prevent surface water status deterioration	None	
	Prevent groundwater status deterioration	Low	As said above, mulching contributes to increase water infiltration in the soil and reduce runoff. Thus it prevents groundwater quantitative status deterioration which is enhanced by high rate of runoff.

Policy Objective	Rating	Evidence
Floods Directive		
Take adequate and co-ordinated measures to reduce flood risks	Medium	Mulching can be one of the measures taken on agricultural fields and areas in order to reduce flood risks. Indeed, by slowing down runoff and enhancing infiltration, it contributes to flood risk reduction.
Habitats and Birds Directives		
Protection of Important Habitats	None	
2020 Biodiversity Strategy		
Better protection for ecosystems and more use of Green Infrastructure	None	
More sustainable agriculture and forestry	None	
Better management of fish stocks	None	
Prevention of biodiversity loss	None	

VIII. Design Guidance

Design Parameters	Evidence
Dimensions	Mulching is applied at field scale or under shelter. In Europe, field size can vary a lot across states and agriculture types in each state; in France (Latruffe, 2013) and Denmark (Levin, 2006) for instance, mean field size is a bit more than 4ha.
Space required	The required space corresponds to the dimension of the measure.
Location	Mulching can be used in fields or under shelter/greenhouses.
Site and slope stability	
Soils and groundwater	Mulch is often used on soils with low organic matter rates.
Pre-treatment requirements	
Synergies with Other Measures	Mulching is often combined with other soil conservation practices such as no till, which also contributes to reduce runoff.

Design Parameters	Evidence
Design recommendations	Mulch is put on the soil just before plantation, after preparing the soil. The soil must be clean, prepared just like for a culture. In France, between 50 and 300 m3/ha of mulch is applied on fields (Ministère de l'agriculture, de l'agroalimentaire et de la forêt, 2003).

IX. Cost

Cost Category	Cost Range	Evidence
Land Acquisition		
Investigations & Studies		
Capital Costs	0.05 to 0.15€/m2	Mulch cost can vary between 0.05 and 0.15€/m^2 depending on thickness, mulch type and percentage of soil cover (Ministère de l'agriculture, de l'agroalimentaire et de la forêt, 2003).
Maintenance Costs		
Additional Costs		
Net benefits		

X. Governance and Implementation

Requirement	Evidence
Farmers' involvement	Mulching is implemented on private areas (fields). Thus, farmers' involvement is necessary to guarantee positive biophysical impacts.
Coordination and animation	So as to be efficient on reaching some policy objectives, mulching should be part of a wider program of measure and be considered at a sufficient scale. If implemented only on individual will and at field scale, the measure will not be sufficient to impact on groundwater recharge or flood risk. Coordination of measures and animation at a relevant scale (watershed) can make the implementation of the measure more efficient and relevant. Local authorities, local water or agricultural stakeholders (consular chambers, watershed agencies...) have a role to play.

XI. Incentives supporting the financing of the NWRM

Type	Evidence
Rural Development payments for associated measures.	Mulching is not directly supported as a measure in the 2007-13 Rural Development Programme. However, associated measures such as maintaining overwinter stubbles and mulching crop residues are available. Payments for these across the EU average 128 €/ha with a range of 11 to 390 €/ha

XII. References

Reference
Jordan, A. (2010). Effects of mulching on soil physical properties and runoff under semi-arid conditions in southern Spain.
Latruffe, L. (2013). Does land fragmentation affect farm performance? A case study from Brittany. Factor Markets, Working Paper .
Levin, G. (2006). Structural development in Danish agriculture and its implications for farmland nature. Changing European farming systems for a better future – New visions for rural areas .
Ministère de l'agriculture, de l'agroalimentaire et de la forêt. (2003). Fiche technique T20 - Mise en place de paillages ou de mulchs. Guide pratique pour la conception de systèmes de culture légumiers économes en produits phytopharmaceutiques.