Sustainability of soil deep loosening as an amelioration measure preceding site afforestation

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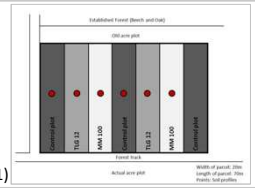
INTRODUCTION

It is well accepted that the climatic change is proceeding and many countries have increased the interest in afforestation of arable soils due to surplus agricultural production or ecological problems. However, the existing soils relevant for afforestation often possess poor properties for an effective growth of plants (marginal earning sites) and are in many cases poor in nutrients, extremely dry or very wet as well as compacted and skeletal. Deep loosening measures as amelioration methods are suited to increase the water availability and water storage capacity and to enhance soil physical properties.

STUDY AREA / EXPERIMENTAL SETUP

Area	Geographical classification	Geology & Soils	Previous usage
Waldrach (Germany)	Saar-Ruwer-Hunsrück	Devonian schist with Pleistocene covering (loess loam); Cambisols, stagnic Cambisols	Agriculture and pasture land
Müllenbach (Germany)	Hocheifel	Devonian schist with tertiary grey loam; Cambisols, stagnic Cambisols	Agriculture and pasture land
Trier (Germany)	Saar-Ruwer-Hunsrück	Devonian schist with Pleistocene covering; Cambisols, stagnic Cambisols	Testing ground for track and wheeled vehicles of the German Federal Armed Forces (WTD 41)

1)



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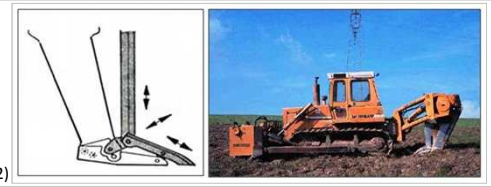

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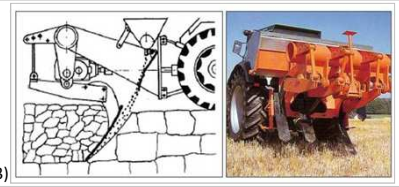

Fig.1: Experimental setup Waldrach
Fig.2: Amelioration machine TLG12 (Schulte-Karring 1999, p.8; photo: Schulte-Karring)
Fig.3: Amelioration machine MM100 (Schulte-Karring 1999, p.9; photo: Odenwald Werke Rittersbach GmbH)

METHODS

- Sampling and pedological description of the different soil profiles
- Determination of soil physical parameters (bulk density, infiltration rate, water storage capacity, percentage of soil particles >2mm)
- Investigations and measurements of plant-physiological parameters (number of accrued trees, tree heights and amount at breast height)

  ➔Calculation of current stem- and hectare volumes and profits (14 years after experimental setup)

  ➔Calculation of predicted stem- and hectare volumes and profits after one turnover (120 years)

Figure 4: a) Control plot b) ameliorated with TLG12 c) ameliorated with MM100

RESULTS

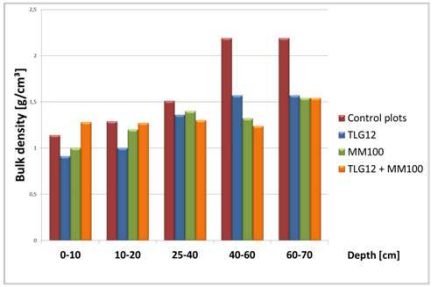

Figure 5: Averaged bulk densities for the different variants

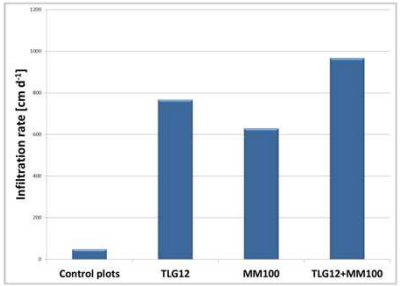

Figure 6: Averaged infiltration rates for the different variants

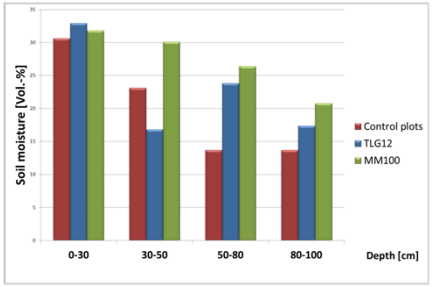

Figure 7: Means of soil moisture in different depths; Waldrach test-site 4 years after setup

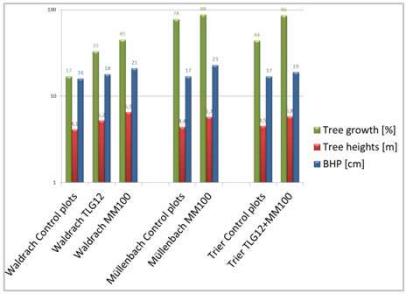

Figure 8: Plant physiological parameters

	Waldrach			Müllenbach		Trier	
	Check-Up	TLG12	MM100	Check-Up	MM100	Check-Up	TLG12+MM100
Tree accretion [%]	17	33	45	78	88	44	86
Tree height [m]	4,1	5,2	6,5	4,4	5,7	4,5	5,8
Amplitude at breast height [cm]	16	18	21	17	23	17	19
Timber volume [m³/ha]							
current (after 14a)	5	17	38	20	51	21	67
predicted (after 120a)	845	1.097	1.238	860	1.251	861	1.261
Profits from mixed timber [Euro/ha]							
current (after 14a)	350	1.190	2.660	1.400	3.570	1.470	4.690
predicted (after 120a)	**58.150**	**78.790**	**85.660**	**59.200**	**86.570**	**59.270**	**87.270**

Table 1: Plant physiological parameters and calculations

CONCLUSION

- Deep loosening is very appropriate to enhance the soil physical properties sustainably and thus the basic requirements for a fast and healthy plant growth.
- The trees on the ameliorated lots develop verifiably faster (higher), thicker and in a greater extent. Hence, an one-time deep loosening before the afforestation is advisable.
- The investment costs are already amortized after a short developing time. Higher earnings can be expected in the following years on the sustainably optimized areas.
- A large-scale appliance of deep loosening as amelioration method can lead to a successful afforestations. Avoidable costs, caused by high fault rates, can be prevented.

CONTACT

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