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Degradation of pasture cuttings after mulching

Mulching represents a suitable husbandry measure for many grassland and fallow areas. Of decisive importance for its successful application is the rapid degradation of the mulch material as otherwise the pasture surface may be negatively affected. Degradation is especially dependent on the weather. The composition of the vegetation and the intensity of chopping are only of limited importance. Modeling of the mulch material degradation and the simulation of a representative region with weather data allow the estimation of degradation time. From this, it is possible to deduce appropriate site-specific periods in which mulching can take place.

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Where pasture or field fallow is mulched, vegetation growth is mowed, chopped and broadcast in one operation. The material remains on the surface and rots or degrades there. Mulching is a simple and cost-effective process [2, 4, 5]. Where the job is done properly, no disadvantageous effects are apparent in vegetation and soil [1, 3, 4, 7, 8]. The speed of mulch degradation is of decisive importance for the process success. Where covering and shadowing of the grass surface occurs over a long period, the sward consistency can be altered. The site-specific time required for adequate degradation of mulch should be determined. For this, the degradation period for mulch under different circumstances has to be assessed. The range of influential factors has to be determined, modelled and then simulated with the application of long term climate data.

Materials and methods

In the Potsdam area between 1993 and 1999 a wide variety of field trials was carried out investigating mulching and degrading of mulch under a variety of working dates, localities and chopping intensities. The process of mulch degradation was determined through weekly investigation of the mulch cover. Investigation of site influences took place for vegetation types dense wet meadow, poor wet meadow and 'grossseggen' meadow. To investigate the effect on mulch degradation from various chopping intensities, five 150 m^2 plots of low moorland pasture were mulched with different machines from the end of July 1993 onwards. Here, the degree of chopping ran from very intense treatment using a Muser through standard chopping with a flail mower, rough chopping with disc mower and chopper attachment through to mowing without chopping using a reciprocating-knife cutter bar [4, 6]. The percentage mulch coverage was statistically compared after a certain period of time [according to 9] with the initial coverage after cutting.

Parallel to the determination of mulch degradation, climate records were made for the trial area. A total of 1141 data entries for first growth and 824 data entries for second growth were available for the modelling of the association between weather and mulch degradation. In the subsequent simulation, calculations were based on the weather data from the Potsdam meteorological service from 1946 to 1995 for every possible mulching date and for the length of the mulching process with mulch production of from 2 to 8 t DM/ha . As standard with procedure planning, a selection of values took place with an accuracy probability of 80%. Based on the vegetation production on typical locations, the possible periods for mulching – e.g. in the Potsdam region – were calculated via the simulation results.

Mulching date, location and chopping intensity

In the trial year 1994, marked differences were apparent between the individual mulching dates. With one mulching date in mid-July only 30% of the initial mulch material remained on the surface of the field after six

Table 1: Appropriate periods for mulching of grassland sites

	Growth mass dt DM/ha	Optimal mulching periods Beginning ten days	Ending ten days	Latest date for mulching ten days
First growth				
dense wet meadows	39	beginning of July	end of July	beginning of August
fresh meadows	41	mid-June	end of July	beginning of August
canary reed-grass	46	mid-June	end of July	end of July
'grossseggen' meadows	54	beginning of September	end of October	mid-July
poor wet meadows	51	beginning of September	end of October	end of July
Second growth				
dense wet meadows	25	mid-August	end of October	end of September
fresh meadows	18	mid-August	end of October	beginning of October
canary reed-grass	16	mid-August	end of October	beginning of October

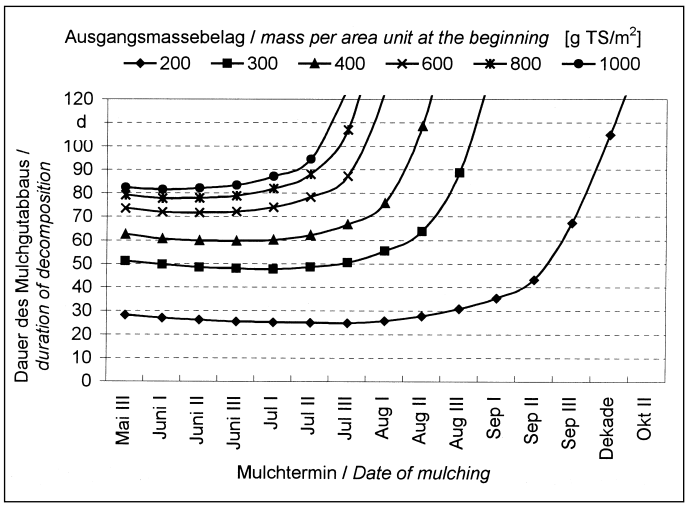

Fig. 1: Duration of decomposition of mulched material from the first grassland growth (residual cover 150 g DM/m², weather related process risk 20%)

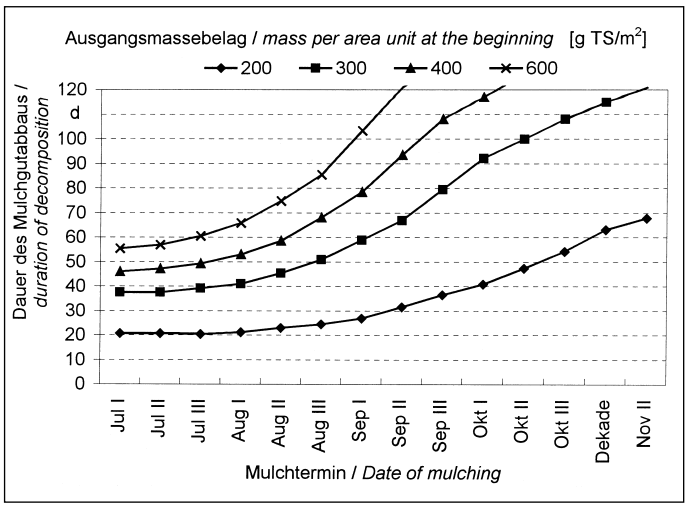

Fig. 2: Duration of decomposition of mulched material from the second grassland growth (residual cover 150 g DM/m², weather related process risk 20%)

weeks, whilst with a mulching date at beginning of September 68% remained, and 82% when mulching took place at end of October. In 1995, on the other hand, the date-specific differences of mulch degradation were hardly apparent [4].

Mulch degradation in the investigated pasture locations dense wet meadow, poor wet meadow and 'grossseggen' meadow took place with no significant differences in biotope types in the years 1994 and 1995.

Mulch rotting results were available from various chopping methods over seven years of trials. In four of these there were hardly any significant differences between the variants. In the other three trial years, the relative cover of mulch was, at least for a portion of the variants with mulch chopping, substantially lower than that of the material which was mowed with the reciprocating knife cutter bar. The very intense chopping with the Muser offered no advantage.

In total it was determined that the extend of mulch degradation was in the main determined by the weather. The influence of other factors such as location and chopping intensity were only of secondary importance.

Modelling and simulation of mulch degradation

The following regression functions proved suitable for describing the mathematical association of mulch degradation and weather.

Initial growth

$m_{rest} = m_{ausg} - 10^{-4}\ m_{ausg}\ (10{,}1\ SNDSL + 6{,}34\ STMT)$ $B = 0{,}93$

Second growth:

$m_{rest} = m_{ausg} - 10^{-4}\ m_{ausg}\ (40{,}3\ SNDSL + 5{,}21\ STMT)$ $B = 0{,}91$

m_{ausg} Initial vegetation cover g TS/m²

m_{rest} Residual vegetation cover g TS/m²

SNDSL Precipitation during the mulch degradation mm

STMT Total daily average temperatures during the mulch degradation °C

The result of the simulation using long-term weather data, the extent of mulch degradation with different amounts of vegetation mass and mulching dates can be seen for the initial and the second growth (*figs. 1 and 2*). The greater the mass of vegetation and the later the date of mulching, the longer degradation took. Because of the closer C:N ration, degradation of the second growth was fundamentally faster than that of the initial growth.

Suitable periods for mulching

Based on investigated mulch degradation, the ten day periods in which the respective degradation processes were ended by the weather conditions were identified.

Suitable lengths of time for mulching were calculated for the example-region Nuthe-Nieplitz-Niederung, south-west of Berlin. The simulation of the mulch degradation gave the latest-possible mulching date with which it was still possible to achieve degradation of mulch before frosts (*table 1*).

In the locations with a shorter degradation period for first growth such as dense wet meadows, fresh meadows and reed canarygrass meadows, satisfactorily-degraded mulching was possible without any problems. Contrary to this, where the locations meant that mulching should take place later, such as with 'grossseggen' meadows and poor wet meadows, the possible mulching periods fell before the beginning of the best times on a husbandry basis. If mulching took place within these latter periods, then sufficient degrading no longer took place.

A portion of the periods available for mulching were applicable to vegetation second growth. But other procedures had to be applied after the last ten days in September or first ten days in October.

Mulching can be categorised among the concepts for utilising vegetation growth as part of landscape care. In the context of procedural risks caused by the weather, mulching is limited by locations and times to areas which are also suitable for forage production for extensive livestock enterprises. In such cases, mulching offers a cost-effective alternative procedure when the growth cannot be used for feed through poor quality, unfavourable weather or lack of demand.

Wet and densely-growing pasture locations with very late husbandry periods which, because of the type of vegetation, basically cannot be used as forage, are also out of the question for mulching through the insufficient degradation of the cut material. Here, other methods of dealing with vegetation growth are necessary, such as clamp-composting or transporting and direct distribution on arable land [4].

Conclusions

The modelling of meadowland vegetation degradation after mulching on the basis of a wide range of field trials and simulations with long-term weather data allows estimations of degradation time and the calculation of acceptable periods for mulching. The results presented extend the bases for the evaluation of landscape care procedures.