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The practical use of a model to predict the wilting time of grass

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Introduction Wilting of mown grass up to a recommended dry matter (DM) range (30-40%) improves the fermentation quality and reduces the production of effluent. However, for farmers it is difficult to estimate when the grass has reached this range and thus, when to start ensiling. Therefore, based on field trials in the 1980's, a model named 'WiltExpert' was developed for on-farm prediction of wilting time at the former Institute for Forage Production in Paulinenaue (Germany). In these trials, the wilting process was examined on more than 1.400 plots. The regressions found enabled the description of wilting as a function of weather elements, properties of the grass and technical parameters. Unfortunately, the model fell into oblivion in the wake of the political changes in East Germany in 1989. Implemented in a Microsoft excel-based calculation sheet, the model was tested again on commercial farms (Pickert et al. 2016). There, a mean absolute error of 108 minutes and a modelling efficiency of 0.99 between the observed and the predicted wilting time revealed that the predictive ability of the model is satisfactory. The aim of the present study was to evaluate the use of a further developed version of 'WiltExpert' as on-farm prognosis tool in an EIP (European Innovation Partnerships) project ('Q2GRAS').

Materials and Methods The test trials were conducted on six commercial farms in East Germany in May, June and July in 2017. A total of 13 data sets originated from the first and second cut and with or without rain were evaluated. The field name, the time of mowing, the estimated DM at mowing (in some cases, the DM was directly determined and not estimated by the farmer), the target DM (usually within the recommended DM range), the stage of maturity, the estimated yield, the soil conditions, daily evaporation, rain and technical parameters of mowing were used as model input variables and were supplied by the farmer (Figure 1). On the basis of regression equations, the model predicted the time of reaching a target DM desired by the farmer. To evaluate the predictive ability, three samples were each taken at mowing and at the predicted time from swath at the same places after the swath was thoroughly mixed (length of the sampled swath was 6 metres). Of these samples, the DM was determined by oven drying (48 hours at 60°C) in the laboratory. The estimated and the determined DM at mowing as well as the target and the realized DM at the predicted time were compared.

Input data

Date of mowing:	07.06.2017 13:30	
Estimated-DM:	19,0%	
Target-DM:	40,0%	
Yield:	120	kg/100m²
Width of mower:	9	m
Width of swath	9	m
Quantity per area:	1,200	kg/m²
Soil conditions:	5	
Swath processing:	2	
Course of evaporation:	2	

Date	Evaporation values (mm/d)		
	mm/d	Soil corrections	Swath processing
07.06.	4,9	4,500	4,570
08.06.	3,4	3,120	3,170
09.06.	3,6	3,300	3,360

Date of harvest without rain: 08.06. 10:54

Current harvest date: 08.06. 14:41

Rain periods

Rain data				Wind strength	Required rain evaporation		DM before rain	New beginning of wilting	New harvest date
Begin	End	Quantity (mm)	Cumulative (mm)		current (mm)	cumulative (mm)			
07.06. 14:00	07.06. 14:10	5	5,0	3	1,690	1,690	21,94%	07.06. 16:26	08.06. 14:41

Figure 2. Input mask of 'WiltExpert'.

Results and Discussion Table 1 shows the results of the use of the model in 2017. The highest realized DM was found at farm 1 (457 g kg^{-1}, second cut) and the lowest at farm 5 (225 g kg^{-1}, second cut). The mean deviation between the realized and the target DM was 61 g kg^{-1}. In the trials with rainfall during the wilting period, the deviation between the realized and the target DM was also high (e.g. farm 4, second cut). In most of the trials, the DM at mowing was poorly estimated by the farmers on the basis of their experiences and the realized DM deviated from the target DM entered (e.g. farm 5, second cut). When the DM at mowing was estimated (or directly determined) by Q-Dry® and was compared with the determined DM by oven drying in the laboratory (reference procedure), the deviation was small and the difference between the realized and the target DM within the first cut was sufficiently.

Table 8. Results of the use of 'WiltExpert' as on-farm prognosis tool in 2017 (values in g kg^{-1}).

Farm	Time of mowing*	Estimated DM at mowing (x_1)	Determined DM at mowing (x_2)	x_2-x_1	Target DM (x_3)	Realized DM at predicted time (x_4)	x_4-x_3	Predicted time to reach the target DM
First cut								
1	11.05.16:00	230[e]	257	27	400	359	-41	12.05.11:51
1	11.05.14:35	252[e]	255	3	400	384	-16	12.05.10:22
2	16.05.13:30	210	226	16	350	418	68	17.05.11:00
4	17.05.17:00	226[f]	[h)]	-	350	306	-44	18.05.12:05
5[a]	19.05.15:20	240	176	-64	350	279	-71	20.05.12:22
6	24.05.09:45	197[g]	249	52	350	410	60	25.05.13:57
Second cut								
1[b]	07.06.13:30	192[e]	223	31	400	457	57	08.06.14:41
1	07.06.19:30	200	276	76	400	434	34	08.06.16:07
4[c]	09.06.18:50	240	306	66	350	406	56	10.06.13:58
5	12.06.10:30	220	167	-53	350	225	-125	12.06.13:48
2	13.06.15:30	220	249	29	350	434	84	14.06.11:55
3	14.06.18:55	240	212	-28	350	306	-44	15.06.11:15
6[d]	12.07.11:10	200	254	54	350	449	99	14.07.13:41
Mean deviation							61	

a = with 0.3 mm rain; b = with 5.0 mm rain; c = with 2.0 mm rain; d = with 8.5 mm rain; * = indications in day, month and daytime; e = determined by Q-Dry®; f = determined by oven drying (105°C); g = determined by microwave; h) = the sample was discarded after determination; each *n* = 3.

Conclusion When using the model, the farmer can receive field-related information when the mown grass will have reached a target DM even under varying sward and weather situations. This information can support the optimization of the harvesting process, particularly if a greater number of various pastures must be involved in the harvest campaign. The main reason for the still occurring deviation between the target and the realized DM was seen in the over- and underestimation of the DM at mowing by the farmer's experiences and in the sampling procedure. Therefore, the future tasks will be both an improvement of the estimation of the DM at mowing and of the sampling to further increase the prediction accuracy and to minimize the deviation. In the next version of the model, time slots will be specified for certain DM ranges.

References

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