SUNFUEL II – Project:
„Shelterbelt of fast growing tree species for mitigation of wind erosion and carbon sequestration in an open landscape of northeast Germany “

Aim of the project

The aim of this project (running 2010–2014) was to investigate the effects of a shelterbelt of fast-growing trees in a short rotation system on an adjacent wind-exposed field in the federal state of Brandenburg in terms of soil erosion protection, carbon sequestration in the soil as well as increasing landscape structuring and richness, biodiversity and microclimate. Moreover, it should be examined whether the energetic use of fast-growing trees is an economical alternative for farmers to the cultivation of annual crops. General recommendations for practical use shall be derived from the project results.

Scientific work objectives and associated work packages (2010 to 2014)

- **Monitoring yields of SRC and annual cultures**
- **Economic accounting of windbreaks effect**
- **Monitoring of climatological characteristics**
- **Carbon inventories after 4 years**
- **Monitoring of biodiversity (avifauna)**

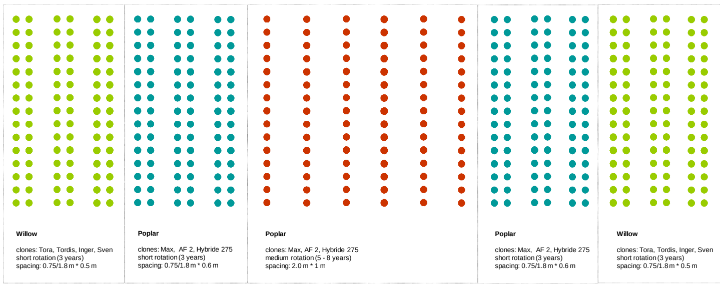
This project is financed by the Volkswagen AG. It is part of the larger framework 'Biomasse für Sunfuel' wherein the federal states of Lower Saxony, Hesse and Brandenburg and the Volkswagen AG join forces to achieve new knowledge for the development and introduction of synthetic biofuels. This poster presents selected results. Carbon inventories after 4 years and monitoring of biodiversity (avifauna) are still in progress.

Trial area and approach

At the study site in Casekow (county Uckermark, NE Brandenburg) a short rotation coppice plantation (SRC) was established by the CHOREN Industries GmbH in spring 2010, dividing a 90-hectare field in north-south direction, the main wind direction being west.
The shelterbelt of SRC has a width of 40 m and a length of 800 m. Different tree species and clones as well as different planting densities were considered (see figure 1 + 2). The aim was to manage the middle part of the shelterbelt with wider spaced poplars in a medium rotation (5–8 years), while its edges, composed of densely planted poplars and willows, should be harvested in a short rotation (3–4 years), in order to provide a continuous (but not identical) windbreak effect on the leeward adjacent arable land.
Discussions with participating farmers made clear that the acceptance of strip-cultivation of energy wood by the use of tree strips with dimensions that are adapted to the working widths of agricultural equipment (eg working width of field sprayers) can be significantly improved. This is from a socio-economic perspective, an important aspect in the implementation of shelterbelts in the agricultural practice.

Figure 1: Shelterbelt in May 2014, the areas with short rotation at it´s borders were harvested in February 2014. The poplars in it´s center with a longer rotation cycle still grow.

Figure 2: Plantig scheme

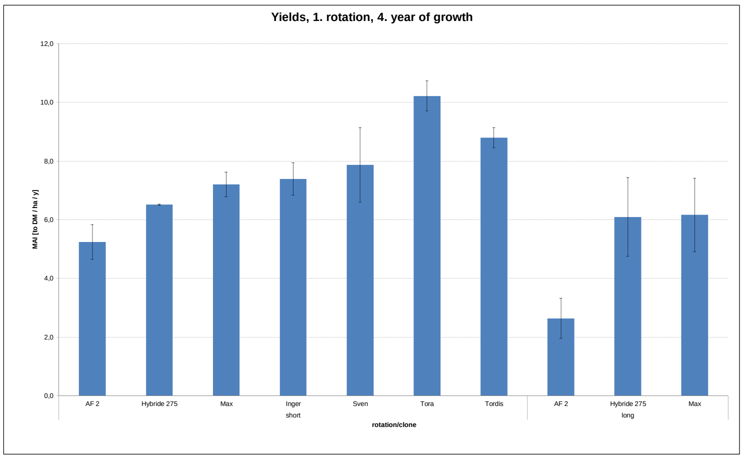


Willow clones with higher planting density, as the poplar clones were planted in the peripheral areas of the shelterbelt (see figure 2). The central part of the strip consists of three clones of poplar designated for a management in a longer rotation cycle (5-8 years). They were planted in single row layout.
In contrast to this, the dense edge areas of the shelterbelt were planted with in a double row pattern, and shall be managed in a short rotation cycle (3-4 years).
This layout should ensure a durable wind protection for the leeward adjacent area, because it´s never the entire strip to be harvested. Deviation from this original schedule, however, was harvested the entire northern part of the stripe by the Energy Crops GmbH in February 2014.

Figure 3: Results from the mapping of yields from anual cultures on the adjacent field leewards of the shelterbelt (yellow = lower, green = higher)

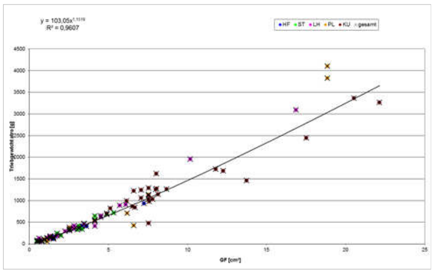
The yield determination of the leewards adjacent annual crops (2011 - winter barley, 2012 - canola, 2013 - winterwheat) was performed due to the limited project budget and for simplicity using the yield determination system of the combine used for harvesting (Claas Lexion 650). Based on the selective mapping of the combine at harvest a map with the representation of the individual values was carried out by software interpolation (see figure 3).
Based on this evaluation an effect influencing the crops that were grown to leeward from the shelterbelt cannot be demonstrated, yet. However, the detection methodology was not very accurate and should be optimized, if following research projects with better financial configuration can be established.

Figure 4: Results from the yield inventories (MAI) from fast growing tree species in the shelterbelt after four years of growth



After four years of growth biomass inventories were realized on plots on four transects. Dry matter yields (mean annual increment) with an average from 2.6 tons per ha per year to 10.2 tons per ha per year were detected for the different clones and rotation cycles (see figure 4). The willow clones in the short rotation cycle (Tordis, Tora, Sven, Inger) achieved higher increments than the poplar clones in the short- and long rotation cycle. The lowest increments were recorded from the poplar clone AF 2 at a management both in the short- and in the long rotation cycle.
The generally lower yields of poplar, which are managed in the long rotation cycle are justified by the relatively low number of trees per hectare (5,000 trees per ha in the long rotation cycle compared to 13,000 trees per ha in the short rotation cycle with poplar or 15,600 trees per hectare with willow) in relation to it´s relatively short growing time.

Figure 5: excursion biomass function, e.g. willow clone Tordis, 1. rotation



The determination of the wood increments in the shelterbelt is done by using clone-specific biomass functions that were created in the project BIODEM at the Universitiy Eberswalde (see figure 5). When creating the functions is in principle to proceed as follows:

1. Individual shoots with different diameters are taken from each clone.
2. Determination of shoot weight and diameter at 100 cm height. Calculation of the base area of each tree.
3. Preparation of the biomass function (base area to shoot weight).

Biomass functions are clone specific and only valid for the particular plant spacing and the respective rotation. While determing the increments of the trees in the shelterbelt the base areas from all shoots on plots per clone on 4 transects were measured and were used in the existing functions, considering the number of trees per unit area.

Figure 6: Monitoring of different climatic factors leewards to the shelterbelt at 15.08.2013

	Air temperature	Wind speed	Wind direction	Precipitation	Global radiation
5 m Lee	LT_LgM01 [°C]	WG_LgM01 [m/s]	WR_LgM01 [°]		
Mean	14,7	0,2	169,9		
Min	7,9	0,0	1,0		
Max	21,6	4,3	316,0		
20 m Lee	LT_LgM02 [°C]	WG_LgM02 [m/s]	WR_LgM02 [°]	N_LgM02 [mm]	GS_LgM02 [W/m2]
Mean	15,4	0,9	185,4		235,9
Min	8,9	0,0	1	0,0	0,0
Max	22,4	7,4	316	0,1	740,5
50 m Lee	LT_LgM03 [°C]	WG_LgM03 [m/s]	WR_LgM03 [°]		
Mean	15,3	2,6	177,1		
Min	9,2	0,0	0,0		
Max	21,8	24,6	339,0		
100 m Lee	LT_LgM04 [°C]	WG_LgM04 [m/s]	WR_LgM04[°]		
Mean	15,3	2,3	206,9		
Min	9,1	0,0	0,0		
Max	21,8	14,6	271,0		

To capture climatological parameters (air temperature, wind speed, wind direction, precipitation, air temperature) four monitoring stations were established in 2011 leewards to the schelterbelt (5, 20, 50 and 100 m distance from the belt). With a point-inclusion of climatological parameters on 15/08/2013 differences in wind speed and wind direction were observed (see figure 6). The wind speeds at the stations in 5 and 20 m to the strip were significantly lower than at the stations positioned further away. It is assumed that this is due to the influence of the wood strip.

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