PO445

Diminishing soil subsidence and CO2-emission of peat soil by subsurface irrigation

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Introduction

Reducing soil subsidence and CO_2-emission by peat oxidation is of main concern in The Netherlands. Due to too low water conductivity of peat soils groundwater levels can sink well below ditch water level in dry summers. High ditch water levels prove to be not effective enough to raise groundwater levels substantially to keep peat oxidation limited in dry summers and are agriculturally disadvantageous in wet periods. Submerged drains (drain tubes below ditch water level) have been introduced and investigated since 2003 to improve both infiltration and drainage to raise groundwater levels in summer to reduce peat oxidation and to improve the bearing capacity of the grass sward in wet periods to increase grass utilization. Next step is the introduction of submerged drains with pump control.

Submerged drains and pump control

Submerged drains are connected to a dich and located below ditch level and can infiltrate or drain water (fig 1 left). However, the effect is strongly dependent on the pressure difference between the ditch water level and the groundwater level. By connecting the drain tubes via a collection pipe to a separate water reservoir, the pressure difference can be increased or decreased by raising or lowering the water level in the reservoir with a pump (fig 1 right). In this way the groundwater level can be adjusted as closely as possible to a target groundwater level.

Figure 1. Left: ditch connected submerged drains. Right: water reservoir with pump and sonic reservoir water level measurement of pump-controlled submerged drains on experimental farm KTC Zegveld. The submerged drains are connected to the reservoir via a collector drain.

Field experiment

A field experiment was carried out in the western peat meadow area of The Netherlands at experimental farm KTC Zegveld in 2016-2020 to determine the effectiveness of pump-controlled submerged drains to realize a target groundwater level of 40 cm minus soil surface (fig 2). Groundwater measurements were carried out per plot in three longitudinal turns across the treatments and have been modelled and statistically tested.

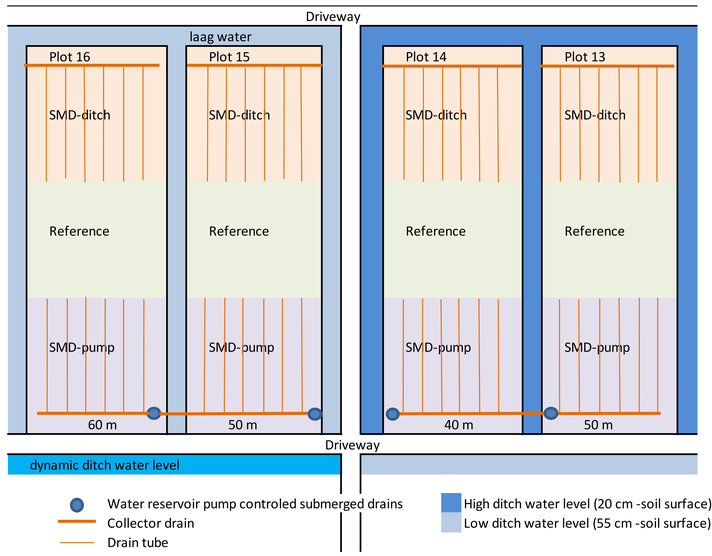

Figure 2. Setup with two ditch water level regimes (20 and 55 cm –soil surface), four plots and three treatments per plot: Submerged drains (SMD-ditch), Reference and Pump controlled submerged drains (SMD-pump, target groundwater level 40 cm -ss)

Results and Discussion

The infiltrating effect improved considerably by using a water reservoir and pump compared with ditch connected submerged drains. The deepest groundwater level during summertime was much higher than in the Reference without drains (fig. 3). Due to the extra infiltration of pump-controlled submerged drains ground water levels remain higher and penetration depth of oxygen is reduced considerably. This will result in reduced peat oxidation and therefore less soil subsidence and CO_2 emissions. This can only be achieved by a strict control of the groundwater level.
In a national project (NOBV), greenhouse gases are currently being measured in various experiments with submerged drains.
The system turned out to be sensitive to sludge accumulation and air entrapment in drain tubes and water reservoirs. In view of the high investment, this argues for a targeted use of the drains, with careful control and monitoring of the system.

Conclusions

- Submerged drains had both a draining and infiltrating effect compared to a situation without submerged drains.
- Pump-controlled submerged drains were more effective for both drainage and especially infiltration than submerged drains on the ditch.
- Submerged drains and pump-controlled submerged drains were found to be sensitive to sludge accumulation in drain tubes and water reservoirs.
- A reservoir water level above ground level easily results in wet spots in the land. A reservoir water level below the drain level, easily results in air entrapment in the drain system. Both sludge build-up and air entrapment can seriously impede infiltration and drainage and should be avoided.

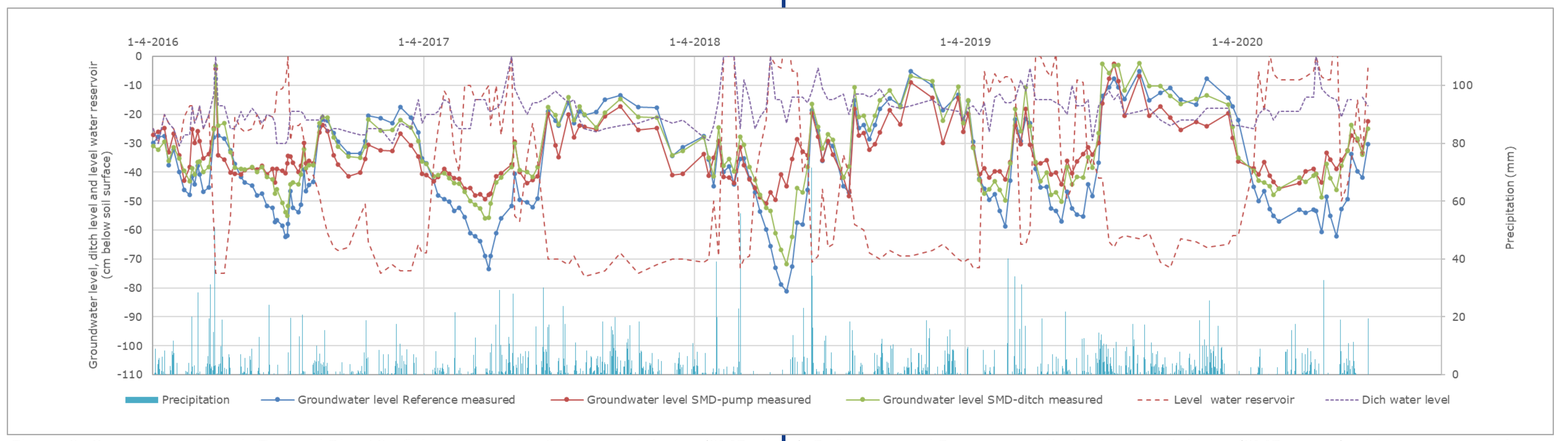

Figure 3. Groundwater levels Zegveld Plot 13 of the treatments Submerged drains (SMD-ditch), Reference and Pump controlled submerged drains (SMD-pump) with target ground water level of 40 cm -soil surface. Also, the ditch water level (high regime of 20 cm -soil surface) and the pump regulated reservoir water level are presented.