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Ability for turf techniques to establish herbs in grasland

The sowing of herbs in an area of high plant density grassland is often very problematic. Nonetheless, a commonly accepted solution to this is to cultivate and plant herbal sods which are similar to the established turf techniques. Due to morphological differences between grasses and herbs many questions still remain to be answered in particular the characteristics of the incrustation of fouling matter. Until now it remains to be seen if an incrustation of fouling matters of herbal sods is possible due to the differences o the components of its roots. Hence, an experiment with turf sods was designed in order to extrapolate the probable impact of herbal sods on the incrustation of fouling matter.

Keywords
Herbs, sods, turf

Abstract
Landtechnik 66 (2011), no. 5, pp. 366–369, 2 figures, 1 table, 12 references

Herbs perform important functions in nature and cultivated land for useful insects [1] and with their ingredients contribute to the tastiness of feeds [2, 3]. To achieve this, the share of herbs should be approx. one third of the grassland populations [4]. As the biodiversity in populations drops as a result of the increased intensity of use [5], it is necessary to establish herbs in order to upgrade the fodder. However, sowing herbs is problematic, both in new crops and subsequently, as they are inferior in growth and germination period to other vegetation [6]. One possibility of establishing this group of plants permanently could be to plant them using turf techniques that have proved successful for years. However, by contrast with turf, herbs differ in their morphology. Turf consists largely of monocotyl plants in the form of grasses, while herbs are dicotyl plants [7]. By contrast with monocotylic plants that have fine and shallow-rooting shoot root systems, dicotyl plants have stronger whole-root type or scion-shaped root systems (**Table 1**). Successful establishing of sods can be demonstrated after some time by the formation of new roots in the growth substrates. In the 1970s Turgeon developed a method for investigating the survival behaviour of 1.8 cm thick smooth-stalked meadow grass sods (*Poa pratense L.*) under different soil and nutrient conditions. The sods were placed on metal screens inserted in 30 x 30 cm large metal frames, displaying a mesh width of 1 cm². Differing growth substrates were filled in halves of a wooden frame insulated from soil beneath. After three weeks each frame was drawn out of the plant medium with a winch, the force required for this was measured on measuring apparatus, and conclusions were thus drawn on the degree of establishment [8].

By contrast with grass sods, so far no experiments on the rooting behaviour of herb sods have been undertaken. In the following therefore, establishing of herb sods is examined based on the measuring methodology described.

Material and methods

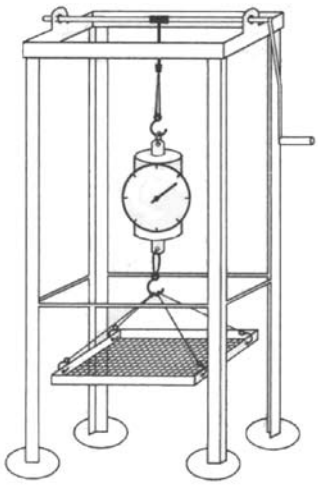
Turgeon's experimental rig was modified for measuring the survival behaviour of herb sods [8]. By contrast with Turgeon's experimental approach, the survival inspection was not conducted as a function of the soil substrates, but as a function of

Table 1

Tested herbs and their root system

Botanischer Name/*Botanical name*	Name/*Name*	Wurzelsystem [7, 10, 11]/*Root system [7, 10, 11]*
Achillea millefilium L.	Schafgarbe/*yarrow*	sprossbürtig/*scion shaped*
Arthemisia vulgaris L.	Beifuß/*mugwort*	sprossbürtig/*scion shaped*
Lotus corniculatus L.	Hornklee/*birdsfood trefoil*	polbürtig/*pin shaped*
Plantago lanceolata L.	Spitzwegerich/*narrow-leaved plantain*	heterorhizie/*hetero shaped*
Sanguisorba minor Scop.	Kleiner Wiesenknopf/*salat burnet*	polbürtig/*pin shaped*

Fig. 1



Stand and frame of metal by Turgeon [8]

varying the type of herb. The thickness of the sods in the experiment under review was approx, 3 cm, instead of 1.8 cm as with Turgeon. In the present experiment too, the surface growth of the sods was mowed in each case prior to planting and prior to harvesting. By contrast with the fast-growing grasses, the experimental period was increased from three to four weeks [9].

The relevant equipment for the experiment was constructed in accordance with Turgeon:

- Stand with measuring equipment (**Figure 1**)
- Metal frame with screen insert for placing the sods

Metal frame and stand

The metal frames were in line with the structure described above. Holes were drilled at the sides of their corners for hooking the lifting device of the stand.

The stand had a manual winch handle mounted at the head end secured to a 2 mm thick steel rope. At the outgoing end of this steel rope was an electronic hanging scale with memory function from which the four steel ropes with hooks were lowered. These were fixed in the side drill holes of the frame. The stand feet had underlay pads for stable and safe stand of the frame. The hanging scale had a measuring accuracy of ± 10 g.

Herbs used

Plants with differing morphology were used to examine the rooting of herb sods, comprising typical representatives in traditional cultivated grassland. By way of comparison, classic commercially available turf sods were also planted. The experiment was carried out in two groups with different pre-breeding locations in order to provide any information about a suitable pre-breeding method:

- Group 1: Sods, age three years, pre-breeding under natural conditions in the open
- Group 2: Sods, age six months, pre-breeding under standardised conditions in the greenhouse

Preparations for the experiment

The herb sods required for the experiment had to be pre-bred at an early stage. Group 1 was sown broadcast in July 2007 under open-air conditions with a sowing intensity of 0.4–1.5 g/m². Adherent growth was controlled regularly until the sods were cut in July 2010. Pre-breeding of Group 2 in a greenhouse was performed under standardised conditions in the form of sterilised substrate mixture and steering of optimal growth conditions. Cultivation for this took place in the period February to August 2010. The intensity and method of sowing corresponded to those of Group 1. Both groups displayed randomised positions in the rearing beds.

After cutting of the sods from the pre-bred matter they were placed in the metal frames. The fitting of the sods into the frames made it necessary to moisten the substrate to a soil moisture content of approx. 40 % in Group 2. Preliminary experiments showed that in the case of approx. 20 % soil moisture content and in view of the non-naturally grown plant substrate with little rooting, these sods did not possess reliable stability.

The sods inserted in the metal frames were placed in the area intended for growth experiments at two different times (group 1: July 2010, group 2: August 2010). The location was a level and homogenous surface. The prevailing substrate consisted of loamy sand of soil type “brown alluvial soil”. Preparatory measures consisted of repeated soil working to regulate adherent growth in order to create an optimal plant bed. The area was divided into 30 x 30 cm large plots before planting the sods, on which the sods were transplanted in randomised manner.

Up to evaluation of the experiment the weather (July 2010) required regular watering of Group 1 [12] so that 10 cm of the surface soil was moistened.

Data collection for rooting behaviour

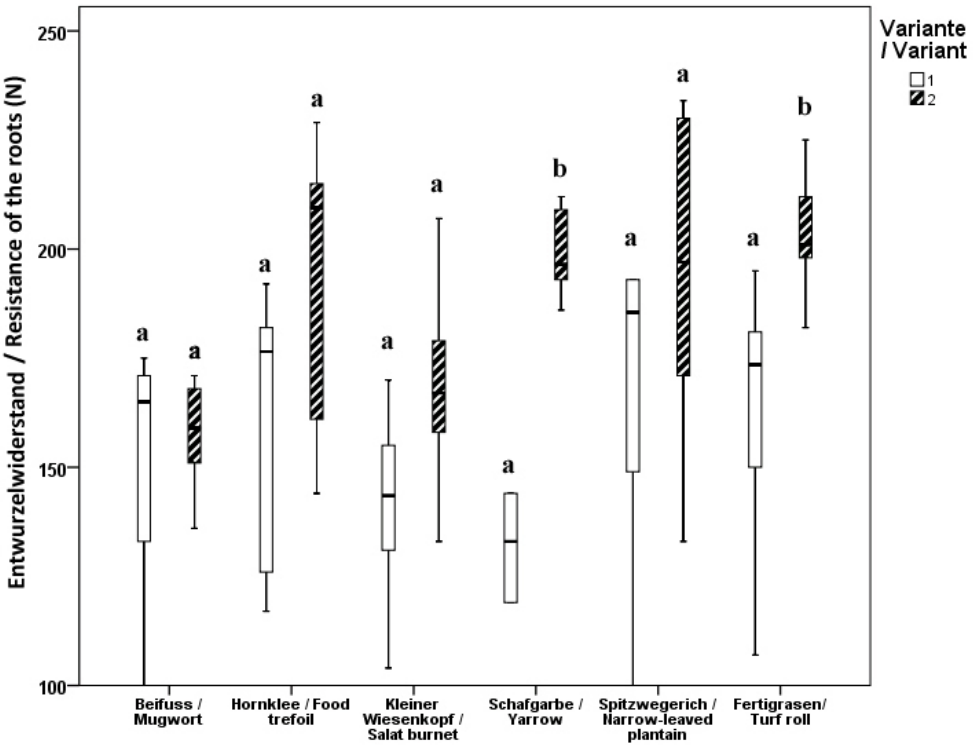
The data on the rooting behaviour of the sods were collected in group 1 at the beginning of August and in group 2 at the beginning of September 2010. The sods inserted in the metal frames were recovered individually with the lifting frame and the measurements were recorded. After the force required for extracting had been determined, the sod with frame weight was substracted from the displayed value and the data acquired were converted into Newton (N).

Results and discussion

The experiment showed that despite their different kind of root structure, herb sods definitely take root. There were no failures during the experiments – neither within the individual plant types nor among the two breeding groups. The rooting of herb sods is comparable with that of turf sods, taking the mean values of the rooting resistance into account (**Figure 2**). Thus stable and permanent herb populations can be created in grassland through this method of establishing.

If the pre-breeding groups are compared with each other, it becomes apparent that the mean values of Group 2 (pre-

Fig. 2



Resistance to uproot in Newton (N), a = dates without significant differences, b =dates with significant differences

breeding in greenhouse) tend to lie a little higher than those of Group 1 (pre-breeding in the open). The sods of turf and yarrow display significant differences between Groups 1 and 2 in the level of tensile force to be applied, while the remaining plants did not display any significant differences (**Figure 2**). Both mean values of Group 2 (pre-breeding in greenhouse) are higher for yarrow and turf. In the case of yarrow this might possibly be attributable to the fact that the root system is of a scion-shaped and wiry form [10] and could thus have ensured higher derooting resistance. The structure of the rooting system of the monocotyl grasses is also scion-shaped [11]. This could be an explanation for higher measurements in turf that moreover represented a bought-in product, of which the place of production, age and method of production were unknown. A further influence for different survival behaviour of the groups could also be the differing weather conditions during the growing period. The growing period of Group 1 (pre-breeding in greenhouse) in July was characterised by high average temperatures and low precipitation, whereby regular watering of approx. 15 to 20 l/m² was carried out in accordance with good practice. [12]. The growing period of Group 2 (August 2010) had average temperatures approx. 4 °C lower, but precipitation was approx. 100 mm/m² higher.

Conclusions

The experiment shows that establishing of herbs in the form of sods is possible. The pole roots shortened to approx. 3 cm before planting and the stronger shoot roots of the herbs formed sufficient new root mass to grow safely. Accordingly as a matter of principle herbs can be established successfully with the aid of turf techniques. Further examinations must clarify to what extent existing turf techniques can also be applied for herb sods. As the experiment did not provide any clear statement of suitability of pre-breeding places and age as regards survival behaviour, further examinations into this question must be conducted. Moreover, work should be carried out with a larger number of repetitions and plants of similar morphological character in order to consolidate the results.

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