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## **Durable greening of outdoor runs as a method of fostering animal welfare in free-range chicken husbandry**

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In free-range chicken husbandry, the vegetation of the outdoor run serves several important functions: among others, for soil and water protection (with regard to the massive nutrient inputs) and for animal health. Moreover, the run vegetation can be considered as an environmental enrichment: in herds that show a good use of a green outdoor run, a reduced incidence of feather pecking and a better plumage condition have repeatedly been observed. The fact that the animals focus their pecking behaviour on the sward, whereas they may re-direct pecking on conspecifics in environments displaying few objects is being brought forth as an explanation to this observation. Hence, an intact vegetation cover of the run area may provide relevant benefits for animal welfare.

It was the goal of the present study to evaluate the suitability of a number of grassland plant species for establishing swards for outdoor chicken runs. Fourteen species (nine grasses and five forbs) which have yielded high performance within intensively managed agricultural grassland systems and within wear tests for turfgrass cultivars, and which are known for their high tolerance to grazing, cutting and trampling were selected for the experiments.

Within a field study that is presented in Chapter 1 of the thesis, the tolerance of the selected plant species towards stocking with laying hens was examined. We hypothesized that the species would differ strongly with regard to their performance, because the damage resulting from stocking with chickens is of a distinctly different nature than the disturbance caused by cutting or ruminant grazing. In a complementary greenhouse pot experiment, which is related in Chapter 2, we aimed at answering the question which traits related to the plants' growth form may confer tolerance towards mechanical damage. We hypothesized that pre-damage biomass allocation to aboveground or belowground parts, and the location of storage organs and clonal buds would determine disturbance tolerance; it would be high in species of which these organs are concentrated at the base of the shoot, close to or underneath the soil surface. We finally studied the influence of sward botanical composition and of canopy cover of green vegetation on the foraging behaviour of laying hens. We hypothesized that sward degradation would decrease the frequency of sward-directed pecking. The results of this experiment are presented in Chapter 3.

In the first field experiment, monocultures and a mixed sward of the tested grassland plant species were rotationally stocked with laying hens at three levels of stocking duration. The effects of the factors plant species, stocking duration and repeated stocking (stocking cycle) on the target parameters sward canopy cover, herbage growth rate and density of tillers or vegetation growing points were analysed. Our results confirmed the hypothesis that the tested plant species differed significantly with regard to their tolerance towards stocking with chickens, and they indicated that, under the applied conditions, grasses generally show a better performance than forbs. Tall fescue (*Festuca arundinacea*) and Supina bluegrass (*Poa supina*) altogether featured the best performance, with canopy cover values of >80 %, a constant tiller density, and constant, comparatively high values of herbage accumulation of >4.8 g dry matter m<sup>-2</sup> d<sup>-1</sup> under conditions of repeated long-duration stocking.

For the greenhouse pot experiment, a number of the species used within the field experiment were selected to represent three growth form types: caespitose, rhizomatous and

stoloniferous plants. They were subjected to a standardized mechanical damage acting simultaneously on both the shoot and the root at three levels of intensity. The results of this experiment showed that the tested plant species differed significantly with regard to damage tolerance, with the best performance recorded for tall fescue and Kentucky bluegrass (*Poa pratensis*). However, the growth form was not an important determinant of damage tolerance. Across all plant species and levels of damage intensity, the re-growth of aboveground biomass after disturbance was strongly correlated with the ratio of the root biomass of the treated plant to that of the non-treated control; yet, it was not correlated with the pre-disturbance biomass of the root. We conclude from these results that the resistance of the root to mechanical damage is an important determinant of a plant's tolerance towards the tested type of disturbance.

In the frame of the field experiment described above, we analysed the behavioural interactions of the laying hens with the sward by recording the frequency of the behavioural traits pecking plants, ground pecking and scratching. Our data showed that both botanical composition of the sward and sward degradation had a significant impact on the foraging behaviour of the chickens. Prolonged stocking duration significantly reduced the canopy cover of green vegetation; however, the tested plant species differed significantly with regard to the extent of degradation caused by a fixed stocking duration. The frequency of sward-directed pecking behaviour (plant and ground pecking together) decreased with increasing stocking duration and decreasing canopy cover of green vegetation. We deduce from these results that plant species like *Poa supina*, which show a high resistance towards the strain caused by stocking with chickens, and which at the same time provide a good incentive for pecking can enhance the value of the sward as an environmental enrichment and therefore foster the contribution of the outdoor run to animal welfare.

Our experiments have highlighted the fact that the properties of the run vegetation are essential for ensuring the multi-functionality of the sward of outdoor chicken runs. Plant species that feature a stable canopy cover at prolonged stocking and that provide an incentive for pecking are beneficial to animal welfare. Additionally, plant species that have high rates of herbage accumulation under conditions of stocking with chickens facilitate the immobilisation of the nutrient inputs to the run surface, and hence contribute to soil and water protection. Among the plant species tested within the present project, *Supina* bluegrass (*Poa supina*) altogether yielded the best score with regard to these criteria. Kentucky bluegrass (*P. pratensis*) also provided a good incentive for pecking; the growth rates of this species, however, were slightly lower. In contrast, tall fescue (*Festuca arundinacea*) featured a high resistance towards the strains caused by stocking with chickens; yet, this species provided comparably little incentive for pecking.

In conclusion, our results point out that the choice of the plant species for greening outdoor chicken runs is a relevant measure of run management. It can be recommended as a valuable complement to established measures like, e.g., rotational stocking with rest periods of sufficient duration, or the enrichment of the run area with protective structures that motivate the chickens to explore and evenly spread over the whole of the run area.