THE EFFECT OF GRASS STRIPS ON SOIL RETENTION AND EROSION REDUCTION IN AGRICULTURAL LANDSCAPE

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Abstract
Grass strips are one of the landscape features that separate large blocks of arable land into smaller plots. Together with other elements, they form a landscape mosaic that contributes to improving the ecological, aesthetic and cultural values of the agricultural landscape. A varied landscape mosaic is the main prerequisite for increasing the ecological stability of the landscape, opening up the landscape to people, or further use for recreational purposes. The research activities of RISWC include long-term measurements of the retention capacity of grass strips and continuous monitoring of erosion events in catchments with implemented grass strips. The results show the positive effect of these grass strips. After their implementation, the infiltration rate of rainwater is significantly increased. There is also a significant reduction of erosion on the slope with the implemented grass strips. In this paper we present an example of the function of grass strips in the model catchments Hustopeče-Starovice.

Key words: Grass strips; water erosion; water retention; landscape; recreation

Introduction
In the Czech Republic (CR), more than 50% of farmland is threatened by soil erosion (Podhrázská et al., 2022). The main reasons of the high erosion threat in CR were insensitive human interventions into the landscape in the second half of the 20th century. Until this period, agricultural production exploited land blocks of a mean size of 0.5 ha. Appropriate anti-erosion measures must be implemented to reduce the risk of water erosion (Karásek et al. 2022). One of these multifunctional measures is anti-erosion grass strip. Protective grass strip must be placed on the slope along the contour. Retention grass strips have an anti-erosion and retention function (Hejduk, 2011; Kučera et al. 2021; Sochorec, 2016; Podhrázská et al. 2022). They can be implemented as technical anti-erosion measures, which serve to interrupt the surface runoff and to infiltrate it (Karásek et al. 2022). Research on infiltration processes in permanent grasslands has long been carried out by the Research Institute for Soil and Water Conservation in the Hustopeče-Starovice experimental catchment. In this paper, the results of infiltration experiments on erosion-resistant grasslands are interpreted in comparison with the surrounding arable land.

Methods and Results
The experimental catchment area Hustopeče u Brna – Starovice (Fig. 1–3) is part of a small agricultural catchment area with a distinct valley, terminated by a dry reservoir with an outlet to the Starovický Brook on the border of the intravilan. The grassed valley is followed by a total of 5 anti-erosion grass strips implemented in 2017. The grass strips are about 300-500 m long and 20 m wide. According to the overall climate, Hustopeče and its surroundings belong to the natural area of the Hustopeče Upland with favourable climatic conditions. The geomorphological unit belongs to the warm, warm and dry region with mild winters and relatively shorter sunshine. The annual average temperature is 9,2 °C. The annual rainfall is 563 mm with a maximum in July and a minimum in February.
To simulate natural rainfall and measure the rate and amount of infiltrated water, including surface runoff, a portable rain simulator, the U.S. Geological Survey Infiltrometer, modified by Janecek (1989) and subsequently by Karasek (2017), was used. This type of simulator meets the requirements for applicability in field conditions. The components of the said device are: a rain head (drip head), a water reservoir with a regulator, a stand with wind protection, and an overflow device for catching surface runoff. Distilled water is used for throttling. The volume of water in the storage tank (approx. 20 l) is sufficient to produce 120 mm of rain. The droplets fall on the surface to be rained from a height of 1.6 m inside an organic glass tube. A metal ring in the shape of an inverted cone with an inner diameter of 200 mm is used to define the rainfall area. In this ring there is a hole (overflow) at the level of the soil surface through which the eroded soil slurry drains into a graduated cylinder. Field investigations were always carried out in the spring and autumn seasons (before full growth of field crops and after harvest) (Fig. 4, 5).

Fig. 1: Anti-erosion grass strip in the cadastral area Starovice – Hustopeče u Brna

Fig. 2: Anti-erosion grass strips in the cadastral area Starovice – Hustopeče u Brna

Fig. 3: Anti-erosion grass strip in the cadastral area Starovice – Hustopeče u Brna

Fig. 4: Measurement of infiltration characteristics on arable land in the vicinity of an anti-erosion grass strip

Fig. 5: Measurement of infiltration properties on the anti-erosion grass strip

In the course of the research, 58 simulated rainfall processes were carried out by the field rainfall simulator in the period 2019-2021 and the results of experiments on permanent grassland and arable land were compared. The following data were processed: rainfall duration, total simulated rainfall, total rainfall intensity, total infiltration, total infiltration intensity, average infiltration intensity, infiltration coefficient, total surface runoff, total surface runoff intensity, average surface runoff intensity, runoff coefficient. From the results of the simulated rainfall-runoff ratio measurements, the parameters infiltration coefficient and runoff coefficient were determined. The infiltration coefficient (ratio of infiltrated rainfall to rainfall volume) for all measured sites and land types, as an indicator of soil infiltration capacity, is presented in Fig. 6.

All measurements showed a higher infiltration rate on permanent grassland (erosion control grassland) compared to conventionally managed arable land in its surroundings. The differences in infiltration rates are in the order of tens of percent. Differences are also evident between years and measurement periods. The infiltration characteristics are also influenced by the way the arable land is cultivated, the condition of the soil on the surface (soil crust vs. loose surface), etc.

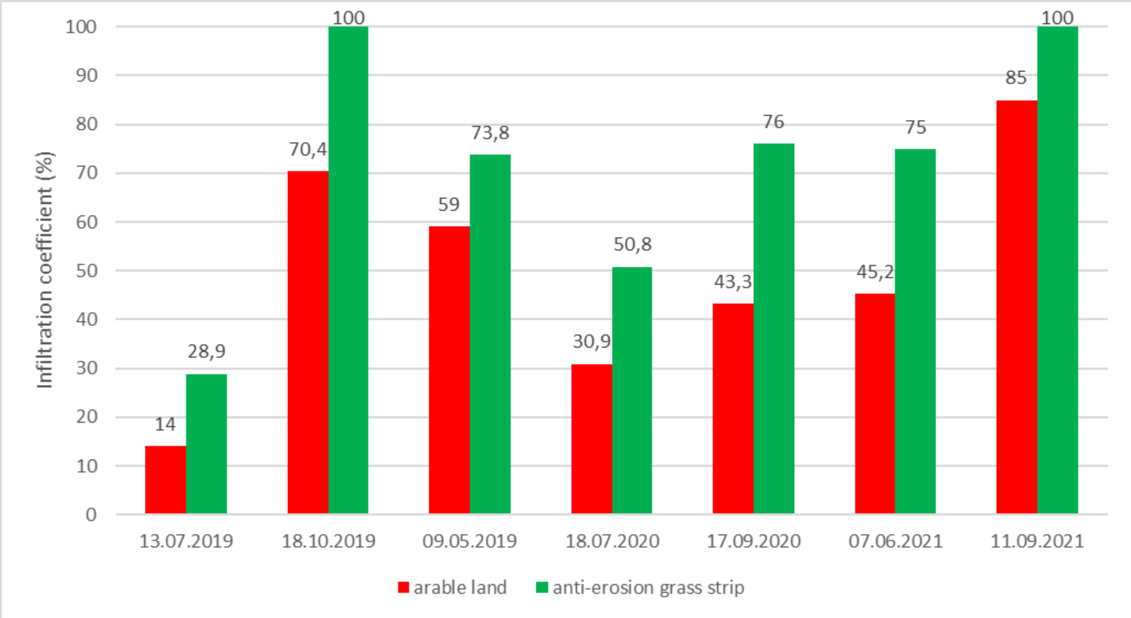

Fig. 6: Comparison of infiltration characteristics of arable land and anti-erosion grass strips on the model locality Starovice – Hustopeče u Brna

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Souhrn

Trvalé travní porosty mají výrazně vyšší míru infiltrace srážkové vody oproti konvenčně obhospodařované orné půdě. To platí i protierozní travní pásy. Ty se realizují v orné půdě jako ochranné opatření. Rovněž však mají funkci krajinotvornou. Utváří pestrou krajinu, jsou přirozeným stanovištěm živočichů, zvyšují estetickou funkci krajinu a rekreační potenciál venkovské krajiny. Jednou z jejich funkcí je zasáknout vodu, která při srážce naprší na travní pás i nad plochu (svah) nad ním. V modelovém území Starovice-Hustopeče u Brna byly v letech 2019–2021 prováděny polní měření přenosným simulátorem deště za účelem testování míry infiltrace protierozních travních pásů a okolní orné půdy. Při všech měřeních byl prokázána výrazně vyšší schopnost travních pásů infiltrovat srážkovou vodu (oproti orné půdě). To potvrzuje teorii o jejich pozitivní funkci při ovlivňování povrchového odtoku a vzniku eroze na svažitých erozně ohrožených pozemcích.

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