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Can we make our agriculture more sustainable by reintroduction of horse traction and broader reliance on the on-farm produced fertilizers?

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Abstract

Soil compaction and rise of fuel and mineral fertilizers prices are probably the most important problems that modern arable farmers face. Modern soil compaction is mainly induced by the use of heavy machinery, extensive use of mineral fertilizers and lack of organic fertilizers like farmyard manure (FYM) and green manures (GM). Soil compaction is associated with poorer water soaking capacity and more pronounced drought effects. Luckily, a research conducted in Ohio (USA) has revealed that traditional Amish horse-powered farm has soil with greater water infiltration rate than neighbouring no-till cultivated soil. Considering the use of mineral fertilizers, their more than a three-fold rise of prices during the last year may push the farmers to search for a cheaper alternative, like on-farm produced fertilizers (FYM and GM). The contemporary circumstances can give rise to a question if biologically improved traditional agriculture can offer solutions to the presented problems. In the sense of this work, traditional agriculture means agrotechnical measures powered by animal traction, while the biological improvement means broader use of green manuring and cover cropping.

Key words
agriculture, sustainability, animal traction, green manure, farmyard manure

Introduction

Sustainable development of humanity and agricultural production which supports us have come into a focus of our concerns. Among the 17 sustainable development goals of UN, responsible consumption and production of food falls into SDG #12, while transitioning to affordable and clean fuels falls into SDG #7. Prospective exhaustion of distant and finite sources of fossil fuels and phosphorus fertilizers additionally stresses the importance of change of our farming into more sustainable way. In this work we try to elucidate if reintroduction of animal power in arable farming and broader reliance onto on-farm produced fertilizers can improve the sustainability of modern agriculture.

Material and methods

Research is based on the relevant literature review.

Results and discussion

Responsible and sustainable food production should be based on farming practices that conserve, or even better, improve soil quality and fertility. However, high mechanical load from modern farm machinery, especially when combined with low soil organic matter, leads to soil compaction which furtherly decreases soil porosity, aggregate stability, soil hydraulic conductivity and nutrient availability (NOOR SHAH et al., 2017). Mentioned effects in their combination negatively affect the overall soil fertility. Luckily, a research conducted in Ohio (USA), that compared soil quality under traditional horse-powered cultivation by Amish farmers and modern no-till production has revealed more favourable soil properties in Amish farm (JACKSON, 1988). Namely, the Amish farm exhibited significantly higher rates of rainfall infiltration, more organic matter content, higher levels of alkaline phosphatase activity, and lower bulk density of soil than the no-till farm that produced corn and alfalfa. Lesser soil compaction by much lighter animals and implements in Amish farm than tractors and implements in modern no-till farm is likely to be among the reasons for better soil properties in the Amish farm. What is furtherly interesting in the mentioned research, is that both, Amish and no-till farm produced corn yields well above the state average, thus showing that traditional horse-powered cultivation does not limit the achievement of modern high yields. Recent rise of fossil fuels prices is likely to give an additional moment to consideration of horse-powered agriculture as a more sustainable option since it uses locally produced fodder as a biofuel (GANTNER et al., 2017). Thus, the animal traction (figures 1 to 4), contemporarily considered as only of historical importance, may become a mean for modern agriculture improvement, at least for small farms.

Use of green manures for building the soil fertility is currently very rare in majority of conventional farms in Croatia and worldwide. But a recent dramatic rise of mineral fertilizers prices, along with previously known their detrimental effects to environment (GUTIÉRREZ, 2012), and together with modern knowledge on the benefits of cover-cropping and green manuring (COUËDEL et al., 2018; ZHANG et al., 2019) are likely to encourage the modern farmers to increasingly rely on the on-farm produced fertilizers, like green-manures and farmyard manure. However, green manuring is necessary associated with additional agricultural operations and energy consumption for the establishment of green manure crop and its either termination or incorporation into a soil (AMBRUŠEC et al., 2021), depending on the cropping system (no-till or conventional). In the contemporary circumstances of steadily rising fossil fuels prices, additional operations associated with green manuring can act discouraging. Anyway, if a farmer takes animal traction into a consideration for powering his crop production, rise of fossil fuel prices becomes less important since the on-farm produced fodder acts as a biofuel, which has already been estimated as a cost-effective alternative to diesel fuel (GANTNER et al., 2017).

Among the on-farm produced fertilizers, farmyard manure is also of great importance since it provides plant nutrients and high-quality organic matter for feeding the soil microbiome, and thereafter improving the soil quality. In a field research of BENBI et al. (1998) there was proved that application of farmyard manure increases the soil organic carbon content, water infiltration rate, water retention, soil aggregation and soil aggregate stability in water. Also, farmyard manure application enables the achievement of high maize grain yields (8 to 9.8 t/ha in Ontario,

Canada, MA et al., 1999) and high maize herbage yields (18.8 to 21 tons of dry matter per ha in Michigan, USA, BASSO and RITCHIE, 2005).

Conclusions

Presented findings indicate that reintroduction of horse traction into a field crop production and a broader reliance on green manuring and use of farmyard manure can much contribute to the sustainability of agriculture in the contemporary circumstances of steady growth of purchase prices of mineral fertilizers and fossil fuels. Rising consciousness of needs for soil and environment conservation and improvement can give additional moment to the broader acceptance of animal traction and on-farm produced fertilizers.

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